



EQUITY • DIVERSITY • INCLUSION • JUSTICE • RELEVANCE

84TH ANNUAL MEETING

PROCEEDINGS OF THE 84TH ANNUAL MEETING

2021

OCTOBER 30 - NOVEMBER 2, 2021
SALT LAKE CITY, UTAH

IN PERSON | VIRTUAL

Salt Lake Marriott Downtown
at City Creek

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Managing Editor
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About the Meeting

INFORMATION: EQUITY, DIVERSITY, INCLUSION, JUSTICE, AND RELEVANCE

For 84 years, ASIS&T researchers and practitioners, along with those from related fields, have been pushing advancements in information understanding, technology, and use, making substantial progress and contributions. However, the nirvana hinted at by Vannevar Bush with the sum total of human knowledge at our fingertips is not so blissful. With the advantages, we also see hate speech, rumors, conspiracy theories, cyberbullying, AI systems turned racist, fake news, click fraud, adversarial IR, privacy concerns – the list goes on. What happened? As the premier international conference dedicated to the study of information, people, and technology in contemporary society, the ASIS&T Annual Meeting is a forum to assist in addressing these issues as we continue to push forward the positive contributions of information and technology.

THIS YEAR, WE WILL BE EXPLORING:

Archives, Data Curation, and Preservation
Data Science, Analytics, and Visualization
Domain-Specific Informatics
Fourth Industrial Revolution
Human Computer Interaction (HCI)
Information Theory
Library and Information Science
Privacy and Ethics
Research Methods
Social Media and Social Computing
Technology, Culture, and Society

VOLUME 58

PROCEEDINGS EDITOR

Jim Jansen, Qatar Computing
Research Institute (QCRI), Qatar

PUBLISHED FOR THE ASSOCIATION FOR
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JOHN WILEY & SONS, INC.
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CHAIR'S MESSAGE

It is an honor to serve as General Chair of the 2021 Annual Meeting of the Association of Information Science & Technology (AM21), an academic and industry gathering that has served as a pillar of and excellent networking for the information science community for now 84 years. We meet this year in a hybrid manner, both in Salt Lake City, Utah, USA – a fascinating and beautiful city with a unique history – and virtually to accommodate our members facing the challenges of safe travel due to COVID-19. A hybrid conference is a test of organization and endurance, which the ASIS&T staff has more than successfully passed! We all owe them many thanks for their efforts to make AM21 happen.

The theme of AM21 poses a conundrum for the information science community: **Information: Equity, Diversity, Inclusion, Justice, and Relevance**. The annual meeting will provide an excellent platform for the joint exploration of this challenge with a broad and an inclusive program selected through a rigorous peer review process. We accepted 43 of 87 full papers (49%) and 24 of 53 short papers (58%), in addition to 11 workshops, 26 panels, and 76 posters. We also have two industry panels. Many submissions connect to the conference theme, and others reflect longtime areas of focus and emerging issues in our field's cutting across research and practice. Areas of emphasis in AM21 are: social media, human information behavior, informatics and altmetrics, data science, digital curation, knowledge organization, libraries, cultural institutions, and information ethics.

Our opening keynote speaker is Professor Luciano Floridi, Professor of Philosophy and Ethics of Information and Director of the OII Digital Ethics Lab at the University of Oxford, is a world-renowned expert on digital ethics, the ethics of AI, the philosophy of information, and the philosophy of technology. He has published more than 300 works, translated them into many languages. He is deeply engaged with policy initiatives on the socio-ethical value and implications of digital technologies and their applications and collaborates closely on these topics with many governments and companies worldwide.

Our closing keynote speaker is Dr. Maia Hightower. As Chief Medical Information Officer at The University of Utah Health (UUH), Dr. Hightower and her teams transform data into value and drive the exceptional digital experience for patients, faculty, staff, and students. Her teams include the enterprise data warehouse, provider informatics, data science services, FHIR clinical applications, and virtual care that support University of Utah Hospitals and Clinics, University of Utah School of Medicine, and University of Utah Health Sciences. She also developed the Healthcare IT Equity Maturity Model (HITEM) to dismantle structural bias hardwired in healthcare IT and develop an inclusive and equity-minded healthcare IT culture. Dr. Hightower was recently recognized by Health Data Management as one of the "Most Powerful Women in Healthcare IT" and "25 leading CMIOs at healthcare organizations."



Jim Jansen
AM21 Conference Chair

For AM21, we took the unique course of seeking volunteers for the conference committee, and the response was overwhelming! Seriously, multiple volunteers for every position. As a result, the Program Committee for this year's conference was engaged and is a diverse representation of academic interests! A heartfelt thanks to the members of the AM21 Organizing Committee: Paper Co-Chairs (Annie Chen, University of Washington School of Medicine, USA and Lu Xiao, Syracuse University, USA), Panel & Alternative Event Co-Chairs (Jianguan He, University of Tennessee, USA and Wen Lou, East China Normal University, China), Poster Co-Chairs (Md. Anwarul Islam, University of Dhaka, Bangladesh and Tingting Jiang, Wuhan University, China), Doctoral Colloquium Co-Chairs (Pnina Fichman, Indiana University, USA and Howard Rosenbaum, Indiana University, USA), Industry Series Co-Chairs (Sandra Hirsh, San José State University, USA and Don Turnbull, Aqua M&A, USA), Conference Chair Assistants (Aaron Bowen-Ziecheck, McGill University, Canada and Han Zheng, Nanyang Technological University, Singapore), and last but certainly not least Communications Co-Chairs (Lisa Hussey, Simmons University, USA and Brenton Stewart, Louisiana State University, USA).

This international group of the AM21 conference committee coordinated the review of submissions and prepared the technical program for the AM, drawing upon the contributions and commitment of hundreds of reviewers who, collectively, completed even more individual reviews. We are grateful to all the reviewers who volunteered their time and expertise to this enormous task.

I would also like to thank the ASIS&T President Brian Detlor, who somehow talked me into chairing this conference, and the members of the ASIS&T Board for trusting me with the opportunity to chair this fantastic event. It has been an exciting and insightful experience. I would especially like to thank the capable ASIS&T staff who do so much of the work that makes the annual meeting possible, especially Lydia Middleton, ASIS&T Executive Director, and Cathy Nash, Director of Meetings and Events. Finally, a meeting of this scale cannot occur without support, and we are incredibly grateful to all of the sponsors who have made AM21 possible.

For 84 years, ASIS&T researchers and practitioners, along with those from related fields, have been pushing advancements in information understanding, technology, and use, making substantial progress and contributions. However, the nirvana hinted at by Vannevar Bush with the sum total of human knowledge at our fingertips is not so blissful. With the advantages, we also see hate speech, rumors, conspiracy theories, cyberbullying, AI systems turned racist, fake news, click fraud, adversarial IR, privacy concerns – the list goes on. What happened? As the premier international conference dedicated to the study of information, people, and technology in contemporary society, the ASIS&T Annual Meeting is a forum to assist in addressing these issues as we continue to push forward the positive contributions of information and technology.

Please connect to the conference website for information and join us for the enticing and rich program of keynotes, meetings, panels, and presentations.

Jim Jansen
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Many thanks to the 351 reviewers who completed 923 reviews of papers, panels, and posters.

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Hey There! What Do You Look Like? User Voice Switching and Interface Mirroring in Voice-Enabled Digital Assistants (VDAs)

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ABSTRACT

We investigated user voice switching behavior (VSB) in voice-enabled digital assistants (VDAs), focusing on the importance of and preference for the voice accents, genders, and age to match with those of the users. We incorporated images of ten people with diverse races, ethnicities, age, genders, and religions to embody the voice interfaces (EVIs). In an online survey, we collected demographic, background, and VDA usage data. The sample consisted of 214 participants recruited through Amazon Mechanical Turk (<http://mturk.com>). The participants were selected based on owning a VDA (e.g., Alexa Home) or owning a device (e.g., smartphone, tablet, or computer), and setting the device on English as the default language. The age of the participants ranged from 18-35 years. Findings revealed that, regardless of age, the majority of the participants switched the voice interface and for various reasons. Further, participants placed importance on voice matching with their gender, accent, and age. Participants ranked the young White female, Asian female, and Black female EVIs as the most preferred for voice switching and interactions. We coin the concept, *Interface mirroring*, which should help designers to create more diverse and inclusive EVIs, ensuring fairness and equality in the design of VDAs.

KEYWORDS

Digital Assistants; Voice Switching Behavior; Interface Mirroring; Diversity and Inclusion; Embodied Voice Interfaces (EVIs).

INTRODUCTION

The past decade has witnessed a remarkable increase in the adoption of voice digital assistants (VDAs) in the US. In 2017, for example, 46% of US adults used a VDA on their smartphones (Pew Research Center, 2017), compared to 51.5% in 2018 and 56.4% in 2020 (Kinsella, 2019, 2020). Juniper Research (2020) predicts that the number of VDAs in use will reach 8.4 billion and that voice interactive devices led by smartphones will double worldwide by 2024. In addition, by the end of 2020, voices in digital assistants will start to sound more human-like than robot-like (Kinsella, 2020) and voices implemented in a device such as a VDA influences a user's behavior for a range of tasks (see for example, Large et al., 2017; Lee and Nass, 2003; Nass and Brave, 2005; Nass and Lee, 2001). In HCI, a dearth of literature has investigated gender stereotypes in digital assistants and user perception of the gendered voice in VDAs (Tolmeijer, Zeirau, Janson, and Wahdatehagh, 2021). In a recent UNESCO report focusing on gender bias in voice-based conversational agents, West, Kraut, and Chew (2019) commented that the most popular voice-based conversational agents are those designed to be female, but that use of a female gendered interface may have a harmful effect on society; for example, by perpetuating female stereotypes. Feine, Gnewuch, Morana, and Maedche (2020) investigated the design of 1,375 chatbots in chatbots.org. They found that gender-specific cues were often used in the design of chatbots and that most chatbots were designed to represent a female over a male, arguing that there is a bias in the design of chatbots. Sweeney (2021) addressed the issues associated with the race of the VDA, noting that the racialization of VDAs is not only a complex issue, but may be encoded aesthetically through embodied representations (e.g., skin tone, phenotype), dialect, and speech patterns of VDAs.

Early studies by Lee, Nass, and Brave (2000), for example, found that a male-voiced synthesized speech in a computer had greater influence on the user's decision to conform to the computer's recommendation on a series of social dilemma situations than the female-voiced speech. Specifically, male participants perceived the male voice to be more trustworthy and socially attractive, while female participants exhibited preference for the female voice with respect to social attraction and trust, conformed more to the female voice recommendation, but had the same perception in term of attractiveness and trustworthiness as the males.

Pitardi and Marriott (2021) note that individuals that interact with VDAs treat them as social entities by employing human social rules. Early studies by Nass, Moon, and Green (1997) and Nass and Moon (2000) provide evidence that people anthropomorphize technology, ascribing human-like features to computers and interacting with them in a similar manner as they do with people (Lee and Nass, 2003). Similarly, recent studies revealed that people tend to

personify their VDA (e.g., Lopatovska and Williams, 2018; Schweitzer et al., 2019), attributing personality traits to them (e.g., Garcia, Lopez, and Donis, 2018), and prefer that those traits match their own (e.g., Bilal and Barfield, 2021). Given that the voice interface is also gendered in VDAs, users may interact with the voice as they do in human-to-human interactions (Chattaraman et al., 2019) and may stereotype the VDA based on the gendered voice. However, despite their ubiquitous use (Ammari, Kaye, Tsai, and Bentley, 2019; Pitardi and Marriott, 2021), today's VDAs only provide options for different languages, accents, and genders; ignoring race, ethnicity, age, and religion, among other characteristics.

VDAs with a default voice vary in terms of language, accent, and gender. In the US, for example, the default voice for Apple's Siri has been gendered female with an American accent (Lee, Kavya, and Lasser, 2021). Recently, Siri added two new voices from which users may choose (Panzarino, 2021). Siri also speaks with British, American, Australian, Indian, Irish, and South American accents (Sorrel, 2021). In languages other than English, Siri can speak in Arabic, French, and Dutch, but its default voice is gendered male, unlike in the US (Lee, Kavya, and Lasser, 2021). In addition, not all VDAs provide a default voice; instead, users may select a voice from available options as part of the initial VDA setup. While supporting various voice interactions in terms of language, accent, and gender, VDAs fall short of meeting the needs of diverse users with respect to race, ethnicity, age, and religion. Additionally, we are yet to understand user voice switching behavior (VSB) in VDAs and whether the availability of voices embodied in certain identities and characteristics may provide reasons for users to switch the voice interface. Liao and He (2020) found that in using conversational agents, users prefer that the agents match their own race and ethnicity. They characterized this user preference as "racial mirroring," "a match between the user and agent's race/ethnicity" (p. 431). In the present study, we extend "racial mirroring" to VDAs, and investigate additional factors, such as age and religion, in which we used images of people representative of varied race/ethnicity, age, gender, and religion to embody voice interfaces (EVIs). As the design of today's technology should be more inclusive, the design of voice interfaces in VDAs should be optimized to empower a diverse population to use this technology, ensuring social inclusion and equality. Currently, religion, age, race, and ethnicity are underrepresented in the design of VDAs.

Accordingly, the purposes of this study are to: 1) investigate user voice interface switching behavior in VDAs; and 2) examine user preferences for EVIs and whether the EVIs of varied race/ethnicity, age, gender, and religion influence the user's preference and decision to switch the voice interface of their VDAs.

The findings from this study have implications for humanizing VDAs through inclusive design that supports voice options extending beyond gender, language, and accent, contributing to fairness and equality in designing this AI technology. As Liao and He (2020) note, technology should be designed to appeal to different genders, races, and ethnicities in order to successfully meet the needs of diverse members of society. Other implications are that the voice interface in VDAs should support images representative of a wide range of diverse people as embodied voice interfaces that provide more concrete than abstract voice interactions. Embodied voice interfaces (EVIs) that match user characteristics (e.g., age, gender, race, ethnicity, language, accent, and religion) could contribute to optimizing the user's interaction, while supporting positive user experiences that could trigger engagement and loyalty (Moriuchi, 2019).

RELATED LITERATURE

Prior studies showed that VDA users desire more customizations in their VDAs beyond gender, language, and accent (e.g., Bilal and Barfield, 2021; Lopatovska, et al., 2020). In two studies, Greysen (2007, 2013) investigated the design of pedagogical interface agents to provide design guidelines encompassing issues of race and gender. Greysen included 27 females and 16 males of diverse age, with the majority being under the age of 24 years. Greysen found that when given the opportunity to design their own pedagogical agent, individuals designed agents that reflected positive self-perceptions and/or mirrored images of themselves. Brahnham and De Angeli (2012) used a chatterbot's interaction log data in a website designed to vary in gender, age, and ethnicity. The authors reported that for young people aged 18-24, gender stereotypes affected interactions more at the relational (style) level than at the referential (content) level and that there was evidence of racial and ageist stereotypes among participants.

Lopatovska and Williams (2018) explored the usage of Amazon Alexa using 19 participants who kept diaries of their interactions. They found that less than half of the participants reported personification behaviors, but those that did engaged in "mindless politeness, such as "thank you" and "please," suggesting a need for human-like interactions. In a related study, Lopatovska et al. (2020) gathered design recommendations from 18 participants, of whom 13 were female and 5 were male, aged between 18-55. The authors found that user recommendations included features, such as customizability, increased control over the intelligent personal assistant (IPA) features, and transparency in terms of functionality. In another study, Lopatovska (2020) examined 162 interactions from 13 users who kept a week-long diary. They reported that Alexa and Siri were more frequently perceived as possessing

much lower warmth compared to Google Assistant and Cortana. This finding provides additional evidence of users' expectations to interact with a VDA the way that they do with people.

Inclusivity in terms of race/ethnicity in conversational agents is another factor users desire in digital assistants. Focusing on chatbots, Liao and He (2020) involved 212 participants who interacted with a chatbot that was designed to appear as White/Caucasian, Black/African, American, Latinx, and Asian (male and female). They found that a user's engagement and perception of conversational agents was highly influenced by the perceived race and ethnicity of the agent. Liao and He explained this preference as an example of "racial mirroring," in which subjects preferred to interact with a conversational agent which "mirrored" their own race and ethnicity. Currently, the voice interface in most VDAs is set to reflect a young female, reinforcing gender stereotypes (Curry, Robertson, and Rieser, 2020). In a study that explored alternative designs of the persona in VDAs, the authors elicited preferences for the characteristics of the persona from 72 participants using drawings and a questionnaire. Of these, 32 completed the questionnaire. They found that the majority prefer a robotic voice (32.4%), followed by female (20.6%) and male (11.8%), and a gender-neutral voice (26.5%), in contrast to the predominant gendered female voices in most VDAs. In a pilot study of 31 participants, Bilal and Barfield (2021) found that the participants desired that the age and perceived personality of their VDA match their own age (Mean=28.5) and their own self-reported personality traits. As Kinsella (2020) note, the majority of users of digital assistants are aged between 18 and 35. In contrast, Curry, Robertson, and Rieser (2020) reported that 44% of the participants in their study expressed that their conversational voice assistant be aged between 25-40; while 38% had no preference, 15% desired the age to be 40 and above, and hardly a participant indicated an age range of 24 or younger.

In sum, the reviewed studies show that users expect to interact with VDAs in the same way that they communicate with people, ascribing human characteristics to this technology; and that users prefer to customize their VDA voice interface based on their own characteristics. Perceived age, gender, race, ethnicity, and personality of the voice affects users' engagement, interactions, and perception of their VDA. However, despite the prevalence of VDA use in daily life, scarce research has investigated user voice switching behavior in general or preferences for voice interfaces that are embodied in images representative of people of diverse backgrounds beyond race/ethnicity. This study begins to address this gap by extending Liao and He's (2020) "racial mirroring" to "interface mirroring," which in addition to race/ethnicity, explores a gamut of user preferences for voice interfaces embodied in diverse images within the context of voice interface switching behavior. Such embodiment could contribute to creating blueprints for designing and developing future voice interfaces that are diverse and more tangible, capable of meeting the needs of a wide range of users.

RESEARCH QUESTIONS

In this study, we addressed the following research questions:

RQ1: For what reasons do users switch the default voice interface in their voice-enabled digital assistant (VDA)?

RQ2: How important is it to users to have the voice interface in their VDA match their personal characteristics in terms of accent, gender, and age?

RQ3: What embodied voice interfaces (EVIs) do users prefer in their VDA in the context of voice switching?

METHOD

Theoretical Framework

This study is informed by Paul Dourish's "embodied interaction" approach (1999), which is defined as "the property of being manifest in and of the everyday world. Embodiment constitutes the transition from the realm of ideas to the realm of everyday experience" (p. 5). Embodied interaction offers a new dimension for understanding and interpreting interaction that extends to 'tangible' and 'social' computing as understanding the interaction is informed by the user's location, social environment, and physical world of embodied factors. This interaction goes beyond the physical world to include aspects of everyday life (Dourish, 2014). Thus, understanding voice interactions in a VDA are a form of embodiment as the voice alone may trigger a user's deep connection to the technology (Pitardi and Marriott, 2021). However, currently voice interactions are abstract, lacking tangible images to provide visual representation of the appearance of the assistants. In this study, we embodied the voice in VDAs in ten images of people representative of diverse backgrounds and characteristics. Such embodiment provided understanding of the relationships between the embodied voice interfaces and user decisions to switch or not switch the voice interface in their VDA.

Another theoretical underpinning lies in "racial mirroring" (Liao and He, 2020). The concept of "racial mirroring" is closely related to similarity-attraction theory, which posits that people like and are attracted to others who are similar, rather than dissimilar, to themselves (Berscheid and Walster, 1971; Byrne, 1971). In the present study, we extended the concept of "racial mirroring" to "interface mirroring" in VDAs to encompass additional variables with

which users may identify in interacting with their voice interface, including embodied images of younger and older Male, younger and older Female, and Male and Female of a specific religion.

Population and Sample

This study employed both quantitative and qualitative research methods using a survey questionnaire with closed and open-ended questions. The sample consists of 214 participants recruited through Amazon Mechanical Turk (21<http://mturk.com>). The participants were selected based on specific criteria, including owning a voice-enabled stand-alone digital assistant device (e.g., Alexa Home) or owning a device (e.g., smartphone, tablet, or computer) with an integrated digital assistant; and, in either case, setting the device on English as the default language. Additional criteria included being proficient in the English language and between the ages of 18 to 35. We chose this age range based on current statistics of VDA usage. As Kinsella (2019) note, young users within 18-35 are very active users of the technology. In total, the participants included 158 males and 56 females. (See Procedure).

Instrument

We developed a survey instrument in Qualtrics consisting of 53 questions of which 26 were closed and 27 were open-ended. We tested the instrument with thirty-one participants (average age, 28.5 years) and revised the questions based on their feedback (Bilal and Barfield, 2021). The closed questions collected demographic data (e.g., gender; age) and background information about VDA usage (e.g., frequency of use; type of VDA owned). The open-ended questions asked participants to describe their digital assistant and voice switching behavior preference (e.g., gender, language; accents). The instrument included ten images of people representing diverse races, ethnicities, ages, genders, and religions. The images were downloaded from Unsplash.com, a Creative Commons website.

Procedure

The data was collected in March 2021. An invitation to participate in the study was posted on Amazon Mechanical Turk (<http://mturk.com>). The invitation described the purposes of the study and contained the survey URL. Our target was to recruit 300 participants aged 18-35. Based on the selection criteria we employed (see Sample), 214 responded to the survey (71%) and were compensated \$1.45 each. The invitation included the survey URL and a code for use by the participants.

We identified ten images of people with diverse races/ethnicities, genders, ages, and religions (Figure 1), which were downloaded from Unsplash.com, and were cropped, resized, and enhanced in terms of appearance (i.e., color, sharpness, background). The images were displayed randomly in the instrument and labeled alphabetically, from A-J.

RESULTS

Background

We grouped the participants into three age groups, of whom 28 are aged 18-23, 98 are aged 24-29, and 88 are aged 30-35. Such grouping allowed us to identify whether VDA voice switching behavior and VDA preferences, among others, varied by age group. Of the 214 participants, 46 (21.5%) used Apple Siri, 88 (41%) Amazon Alexa, 79 (37%) Google Assistant, and one user had Microsoft Cortana. Participants had been using a VDA for 4-5 years. The average frequency of use per week is (hours=20.32). Sixty-nine (32%) of the participants reported the gender of their VDA as set on male and 145 (68%) on female. Slightly over half of the participants (52.3%) had the accent in their VDA set on American English. Other participants indicated the accent as Australian, British, Indian, Brazilian, and a combination of English accents. Additionally, 126 (59%) had knowledge of how to change the voice interface in their VDA; 49 (23%) were unsure, and 39 (18%) did not know how to perform this function.



Figure 1. Embodied images, left to right: Black male, Black female, Asian female, Asian male, Muslim Female, Muslim male, mid-age White female, mid-age White male, young White male, and young White female

RQ1: For what reasons do users switch the voice interface on their VDA?

More than fifty percent of the participants ($n=108$, 51%) switched the default voice in their VDA to another voice interface. As Figure 2 shows, 61% of the participants aged 18-23 switched the voice interface, as compared to 53% aged 24-29, and 44% aged 30-35. We performed a two-way ANOVA to examine the participants' voice switching behavior (switch or not switch), to detect whether they preferred a male or female EVI, and whether there was an interaction between these two variables. The results showed a significant main effect as a function of the participants' switching to a male or female EVI ($F_{1,16} = 14.81$, $p < .001$); and switching the voice to female EVIs was more frequent than to male EVIs. However, overall, there was no significant main effect on whether participants switched or not ($F_{1,16} = 2.17$, $p > .05$). A significant two-way interaction ($F_{1,16} = 4.57$, $p < .05$) indicated that those who did not switch preferred female EVIs, as did those who switched.

To learn about reasons for switching the voice interface, we asked the question, "for what reason(s) did you change the voice of your Digital Assistant? Please be specific." One-hundred and nine participants ($n=109$) answered this question. Of these, 52 responses were useful. One participant said, "I want voice to make me feel pleasant;" four mentioned voice clarity and noted, "some words not clear and rushing of words," "to get a more understandable clear voice," and "because that voice [is] not clear." Another participant indicated, "I changed the voice because it was like [a] robot talking." Other participants switched the voice to match their the accent of their native language," commenting, "I live in India, so I like to have Indian accent in Alexa," "I wanted an accent that I can relate to, an accent of my mother tongue rather than that of another country, so that it makes me feel at home," "I used to have an Italian accent while speaking in English and it does not feel right sometimes so I changed it." Responses that were not useful either were blank, had "no," "good," defined what a digital assistant is, or described the software of a digital assistant, among others. For example, one participant noted, "Intelligent Personal Assistant: This is software that can use a wake word to become active and perform certain tasks." Another participant provided a detailed response indicating that "a voice assistant is a digital assistant that uses voice recognition, ... It wasn't long ago that an internet search had to be very specific and ... This is why you cannot change your wake word to anything you want it to be. ... What Siri did for phones, Alexa did for homes, initiating the rise of the smart speaker said." It is possible that the participants avoided to answer the question or misunderstood it.

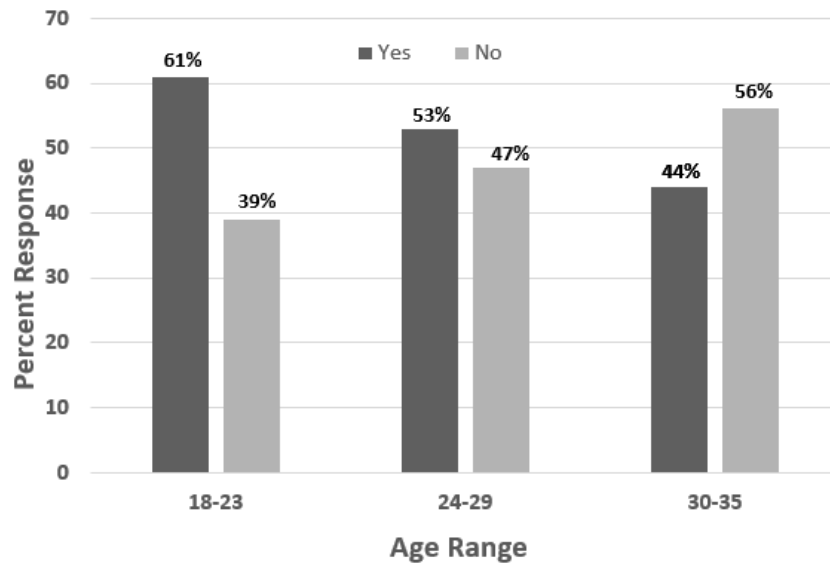


Figure 2. Participants' Voice Interface Switching by Age Group

RQ2: How important is it to users to have the voice interface in their VDA match their personal characteristics in terms of accent, gender, and age?

We asked the participants to rate the importance of voice interface matching with their gender, accent, and age using a scale ranging from 1-5 (1=not at all important; 5=extremely important). In relation to the *gendered voice match*, in total, 81 of the participants (38%) indicated extremely or very important, 36 (17%) indicated moderately important, and 97 (45%) said slightly or not at all important. As to the gendered voice of the participants' VDA, 146 (68%) mentioned a female and 68 (32%) indicated a male voice.

Concerning *voice accent match*, 75 (35%) of the participants mentioned that it was extremely or very important for the VDA voice interface accent to match their own accent, 51 (24%) indicated moderately important, and 88 (41%) responded slightly or not at all important. As to a *voice and age match* with participants, 64 (30%) reported that it was extremely to very important; 42 (20%) said moderately important; and 108 (50%) noted slightly or not at all important. Based on the reported perceived age of the participants' VDA, the mean age is ($M=25$ years old), which we note is close to the mean age of the participants in the study ($M=28$ years old).

RQ3: What embodied voice interfaces (EVIs) do users prefer in their VDA in the context of voice switching?

Of the 214 participants, the 28 aged 18-23 chose the EVIs of the White female (J), Asian female (C), and Black female (B) more than they did other ones. The Chi-Square statistical test shows a strong association between the selected EVIs and the youngest participants' decision to switch the interface (χ^2 , 9df = 22.41, $p < .01$). The older participants ($n=98$), aged 24-29, selected the same EVIs and also tended to prefer the mid-age White female (G). There is also a moderate association between the EVIs and the older participants' decision to switch the voice interface (χ^2 , 9df = 50.23, $p < .001$). The oldest participants ($n=88$), aged 30-35, chose EVIs of the young White female (J) and young Asian female (C). Here too, we found an association between the selected EVIs and the participants' decision to switch the voice interface (χ^2 , 9df = 46.06, $p < .001$).

First-ranked EVIs

We asked participants to rank the top three most preferred EVIs to have in their VDA to identify the extent to which those EVIs mirror the participants' own identity and characteristics. In terms of gender, the majority (73%) selected a female EVI and (27%) chose a male EVI. As to the first-ranked EVI (Table 1), seventeen (2%) chose a Muslim male (F) EVI and seven (6%) selected a Muslim female EVI (F) wearing a head covering. Considering race/ethnicity, participants selected the young White female EVI (J) most often ($n=51$, 47%) as the first-ranked choice, followed by the young Asian female EVI (C) ($n=26$, 24%) and young Black female EVI (B) ($n=25$, 23%). The Chi-Square test for independence shows that the participants' first-ranked EVIs varied, supporting the view that the EVIs, which varied by race, ethnicity, and gender, were not selected with equal likelihood across the 10 images (χ^2 , 9df = 92.67, $p < .001$).

Ranked EVIs by Participants	Number One Ranked EVIs (n=109)	Top 3 Ranked EVIs Combined (n=642)*
Black Male (A)	7% (n=8)	10% (n=66)
Black Female (B)	16% (n=17)	13% (n=82)
Asian Female (C)	22% (n=24)	21% (n=13)
Asian Male (D)	2% (n=2)	4% (n=24)
Muslim Female (E)	6% (n=7)	9% (n=60)
Muslim Male (F)	0% (n=0)	2% (n=17)
Mid-Age White Female (G)	12% (n=13)	12% (n=75)
Mid-Age White Male (H)	3% (n=3)	3% (n=22)
Young White Male (I)	1% (n=1)	7% (n=45)
Young White Female (J)	31% (n=34)	19% (n=119)

*The number is based on 214 participants by three top selections.

Table 1. Participants' Ranking of Embodied Voice Interfaces (EVIs) by Race/Ethnicity, Gender, Perceived Age, and Religion

Matching EVIs and Gender

Table 2 displays the frequency in the participants' response to the top 3 EVIs by gender of the participants' VDA and their own gender. In the survey, we asked the question, "in visualizing the appearance of your digital assistant, which of the following [i.e., images or EVIs] would you most prefer. Select up to 3." Because the participants (n=214) were asked to select three EVIs, the number of responses varied for each EVI. For example, three female participants selected the young Asian male EVI (D) and 2 females chose a Muslim male EVI (F). These two EVIs were the least favored among all male EVIs. In cases when the participants' VDA was set on a female voice, the preferred EVI gender was a female. In this case, the young White female EVI (J) and the young Asian female EVI (C) were the most preferred. Overall, regardless of age, ethnicity, and other factors, and as seen in Table 2, there are 131 occurrences of female participants who selected the three-ranked female EVIs, compared to 337 occurrences of male participants who did so, totaling 468 occurrences. In contrast, there are much fewer occurrences for female participants selecting male EVIs (37), totaling 174, compared to 468 occurrences preferring female EVIs. We found a strong inverse correlation between the participants' gender and the gender their VDA is set on ($r=-0.863$, $p<0.0001$). Overall, the findings show that regardless of race/ethnicity, age, and religion, female EVIs are much more preferred to male EVIs. The findings also provide evidence of the importance of providing visual representations of voice assistants as embodied EVIs so that users select the EVIs with whom they identify the most or with whom they feel the most connected, allowing a number of options from which to choose, especially when such virtual assistants are diverse.

Top Three Ranked EVIs Combined	Gender VDA Set On		Participant Gender	
	No. of Male	No. of Female	No. of Male	No. of Female
Black Male (n=66)	43 (65%)	23 (34%)	52 (79%)	14 (21%)
Black Female (n=82)	28 (34%)	54 (66%)	57 (70%)	25 (30%)
Asian Female (n=132)	36 (24%)	96 (73%)	102 (77%)	30 (23%)
Asian Male (n=24)	18 (75%)	6 (25%)	21 (88%)	3 (12%)
Muslim Female (n=60)	8 (13%)	52 (87%)	46 (77%)	14 (23%)
Muslim Male (n=17)	13 (76%)	4 (24%)	15 (88%)	2 (12%)
Mid-Age White Female (n=75)	13 (17%)	62 (83%)	46 (61%)	29 (39%)
Mid-Age White Male (n=22)	12 (56%)	10 (44%)	17 (77%)	5 (23%)
Young White Male (n=45)	20 (44%)	25 (56%)	32 (71%)	13 (29%)
Young White Female (n=119)	13 (11%)	106 (89%)	86 (72%)	33 (28%)

Table 2. Embodied Voice Interfaces (EVIs) and Gender Based on (n=214)

Matching EVIs' voice accent

Table 3 shows that the Asian female EVI (C) received the highest rating of importance (from extremely important to moderately important) by 84 participants in terms of voice accent matching, followed by the White female EVI (J) (n=73), and the Black female EVI (B)(n=42). The lowest rating of importance is for the Mid-age White male EVI (H) (n=13), Asian male (D) (n=12), and Muslim male (F) (n=10).

EVIs Accent Match	Extremely Important	Very Important	Moderately Important	Slightly Important	Not at All Important
Black Male	12	8	18	18	10
Black Female	11	13	18	17	23
Asian Female	25	29	29	29	20
Asian Male	2	2	8	10	2
Muslim Female	10	14	13	13	10
Muslim Male	4	2	4	4	3
Mid-Age White Female	11	13	17	19	15
Mid-Age White Male	4	3	6	2	7
White Male	8	7	14	11	5
White Female	21	26	26	24	22

Table 3. Importance of Voice Accent Matching Between Participants' VDA Own Voice Accent, and EVIs

Matching EVIs' perceived age

Table 4 shows how important it was for the perceived age of the embodied EVIs in a VDA to match that of the participant's age. Given an embodied EVI in a VDA, the Asian female EVI (C) was rated as extremely important, important, and moderately important, combined, the highest across all EVIs in terms of age match (by n=74), followed by the White female EVI (J) (by n=58), and the Black female EVI (by n=37). Similar to accent matching, and as seen in Table 4, participants rated the Asian male (D) (by n=13), Mid-age White female (G) (by n=11), and Muslim male (F) (n=7) as the least important EVIs in terms of age matching.

EVIs	Extremely Important	Very Important	Moderately Important	Slightly Important	Not at All Important
Black Male	9	11	12	25	9
Black Female	9	12	16	26	18
Asian Female	25	24	25	37	20
Asian Male	4	4	5	9	2
Muslim Female	8	9	15	20	8
Muslim Male	3	2	2	6	4
Mid-Age White Female	9	11	10	27	18
Mid-Age White Male	4	1	6	4	7
White Male	6	9	9	13	8
White Female	16	16	26	37	23

Table 4. Importance of Participants' Age to Match the EVIs Perceived Age

DISCUSSION

The findings showed that slightly more than half of the participants (59%) switched voices in their VDA, higher than what was revealed in the pilot study (38.7%) by Bilal and Barfield (2021), suggesting a trend in voice switching behavior in VDAs. Switching the voice was predominant among the participants aged 18-23 (61%), as compared to those aged 24-29 (53%), and participants aged 30-35 (44%). The embodied EVIs influenced the participants' decision to switch the voice interface and this decision varied by age of the participants. There was a strong association between the EVIs the youngest participants (aged 18-23) selected and their decision to switch the voice (χ^2 , 9df = 22.41, $p < .01$); and a moderate association between the EVIs participants aged 24-29 (χ^2 , 9df = 50.23, $p < .001$) and those aged 30-35 (χ^2 , 9df = 46.06, $p < .001$) and their decision to switch the voice. This finding indicates that age has an effect on users' decision to switch or not switch the voice interface. Of note and regardless of age, the majority of the participants (59%) had knowledge of how to change the voice in their VDA, while nearly (23%) were unsure, and (18%) did not know how to perform this function. This finding suggests a design issue in the participants' VDA, if such a function is not easily discovered, not intuitive or self-explanatory, or not found by asking the VDA. Observing user behavior in switching the voice interface in their VDA could unveil the nature of this issue.

Of the different reasons for voice switching, the findings showed that interacting with a voice that relates to or matches a participant's ethnicity or relates to their home country is of interest. For example, one participant noted, "I live in India, so I like to have Indian accent in Alexa," and another participant noted, "I wanted an accent that I can relate to, an accent of my mother tongue rather than that of another country, so that it makes me feel at home," Regardless of race, ethnicity, and age, however, the findings showed a strong preference for female EVIs by both male and female participants, as compared to male EVIs (occurrences=468 vs. occurrences=174, respectively), and a strong inverse relationship ($r=0.864$, $p<0.0001$) between the selected EVIs and the gender of the participants. This finding confirms the study by Curry, Robertson, and Rieser (2020), which showed that (11.8%) of the participants favored a male voice in their digital assistant, as opposed to (20.6%) who indicated a female. Our study also revealed preference for younger male and female EVIs, which is incongruent with the study by Curry, Robertson, and Rieser (2020), where hardly any participant favored a voice assistant aged 24 or younger. Nonetheless, age preference for the three young female EVIs could be due to their appearance (i.e., perceived attractiveness, class, style) rather than their perceived age. Additionally, Among the EVIs, the Muslim male EVI was the least preferred and those who selected this EVI were mostly male participants (occurrences=46), as opposed to female participants (occurrences=2). While there were a few occurrences (occurrences=46) for preference of the female Muslim EVI by a few male participants, there were much fewer of such occurrences (14) by female participants. Note that we are analyzing the participants' responses on reasons for ranking these two EVIs as least preferred.

The majority of the participants perceived that a match between their own accent, gender, and age (55% vs. 59% vs. 50%, respectively) is extremely important to important. However, with respect to gender and in asking the participants in the survey to choose and rank the three EVIs they most preferred, the majority of male and female participants indicated a female gendered voice, possibly due being accustomed to the current default female-gendered voice in most VDAs. In relation to race/ethnicity, we found that of the first-ranked and most preferred

EVI, (31%) of the participants preferred the young White female, (22%) the Asian female, and (16%) favored the Black female (Table 1). These participants also indicated that they would switch the voice in their VDA to communicate with these EVIs. While race/ethnicity seems to have influenced the participants' decision to switch the voice interface, we are uncertain whether this is attributed to the perceived appearance (e.g., attractiveness) of the EVIs or to their race/ethnicity, especially since we did not collect data on the participants' race/ethnicity. However, we speculate that both race/ethnicity and the perceived attractiveness of the EVIs influenced the participants' selection decisions. We are analyzing additional data generated to identify reasons for this preference.

Based on the findings of this study, we extend "racial mirroring" (Liao and He, 2020) to a more inclusive "interface mirroring" in the design of VDAs. That is, an interface that mirrors the characteristics of the users on a spectrum of characteristics and not only race/ethnicity, to include accents, languages, genders, age, race/ethnicity, and religion. Embodiment of the voice interface in images representative of people of diverse backgrounds and characteristics would provide tangible voice interactions, currently absent in VDAs. In relation to religion, the perceived Muslim male EVI was the least preferred, but the Muslim female received a somewhat moderate importance rating by a number of participants for accent and age matching. Thus, including a wide range of images of people representative of different religions will ensure a more universally inclusive design of the voice interface in VDAs.

LIMITATIONS

One of the limitations of this study is that we did not collect data of the participants' race or ethnicity or religion. Thus, we were unable to test for a relationship between the EVIs the participants selected and their own race, ethnicity, and religion. Another limitation lies in the gender and age imbalance of the participants. An additional limitation resides in the images (EVIs) that while they depict age, race/ethnicity, and some religion, they could have been perceived as attractive or stylish and, subsequently influenced the participants' importance ratings and ranking of the EVIs. Use of Amazon mTurk, did not yield a sample representative of the general population, affecting the external validity of the study. In addition, employing the survey approach resulted in some responses that required further explanation and interpretation.

CONCLUSIONS AND IMPLICATIONS

The findings showed a trend in user voice switching behavior (VSB) in VDAs. We believe that this trend is expected to continue, as user adoption of smartphones continues to increase in the future. We conclude that regardless of the participants' gender, a female gendered voice in VDA is the most preferred. The majority of the participants switched the voice in their VDA for various reasons, including but not limited to, feeling connected to one's own native country and language; communicating with a voice accent that is more fun, and hearing a clearer and easier to understand voice. Of note, 41% of the participants who did not switch the voice interface were either unsure of how to do so or lacked knowledge of how to perform this function, suggesting a possible issue in the design of the voice interface in their VDA. Based on our findings, designers of VDA should consider improving the design of the voice interface.

The age of the participants had an effect on their voice switching behavior in that the youngest group tended to switch the interface more than the mid-age or oldest groups. While no participant selected the Muslim male EVI, seven participants ranked the Muslim female EVI as the first choice. This finding calls for additional research that is inclusive of religion in use of VDAs. The finding that a match between the participants' accent, gender, age, and race/ethnicity is a fruitful area for future research.

User voice switching behavior in VDAs is a nascent area of research. Replication of this study with a sample representative of diverse populations should provide richer data, allowing for a better understanding of user switching behavior. Based on the findings from this study and informed by Liao and He's (2022) "racial mirroring," we coin the term *interface mirroring* in VDAs. Interface mirroring has implications for designing human-centered VDAs that is more inclusive and universal to ensure design fairness and equality in this AI technology.

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The Meaning of “Participation” in Co-Design with Children and Youth: Relationships, Roles, and Interactions

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ABSTRACT

The paper examines the concept of participation in co-design practices with children and youth. Rooted in *Participatory Design* and *Participatory Action Research* frameworks, the paper draws from multi-disciplinary literature to survey existing definitions of the relationships, roles, and types of human interactions in participatory co-design. The paper advocates for the active role of children and youth in the co-design process and presents models of youth participation. The paper highlights the importance of understanding and clearly communicating various degrees of participation, with the ultimate goal of empowering youth and involving them in brainstorming, planning, decision-making, and interpretation stages of the design process. We introduce the concept of *conscious co-design* and the need to reflect on the design process at a meta level in *Participatory Design* and *Participatory Action Research*.

KEYWORDS

Participatory Design, participatory Action Research, Co-design, Children and Youth, Literature Review.

INTRODUCTION

What do we mean when we speak of youth participation in co-design? What does that space, where adults and young people work together to create something new, look like? This paper tries to address these questions by investigating conceptual models of interaction in co-design with children and youth. Rather than focus on methods and techniques, this paper looks at the relationships, roles, and nature of human interactions.

The paper was inspired by the authors’ own self-reflective journeys into co-design with youth, on a research project investigating how to design youth data literacy activities *for* youth, *with* youth. Similar to other researchers and practitioners who work with children and youth, the authors tried to tackle the issue of the asymmetrical distribution of power in participatory research with children, particularly in relation to adult-initiated research. (Morrow, & Richards, 1996; Kellett, 2005; Bernikis et al., 2019). We acknowledge that it can be difficult to disentangle methods and interaction because some methods do invite greater interaction. However, the nature of interaction can shape the results of the co-design process and thus, deserve a closer look. Furthermore, co-design with children and youth is often intergenerational, suggesting an inherent inequity in power distribution. While we cannot always plan for specific forms of interaction, given the somewhat messy and organic nature of this research, we can at least be conscious of what those interactions look like.

To be transparent about “youth participation”, we need a structural understanding of the partnership itself and a deeper understanding of what happens when designers (usually adults) work alongside less experienced members of the community (often youth) to create a product, a process, a pedagogy, or a program. To increase such understanding, this paper reviews the literature on participatory research with children and youth—arising from the fields of *Participatory Design* and *Participatory Action Research*—focusing on the literature that investigates and categorizes the nature of interaction within these participatory spaces. The entire body of literature on participatory research with children and youth is not analyzed in this paper. We focus on a selection of works that have attempted to create models of interaction, where the outcome is a product created *with* children and youth, *for* children and youth. The lens of our investigation is, nevertheless, wide, to include multiple spheres of co-design with youth—from technology to library services.

Our goals are twofold: First, to identify themes, constructs, and frameworks that characterize the interactions, roles, and relationships of design partners within the context of co-design, and second, to reflect upon their applicability to our own research project exploring how teens co-design after-school programs as sites of critical data practice. The structure of this paper is as follows: We begin with a description of our methods for conducting the literature review. We then situate our study within the broader context of the sociology of childhood and two dominant participatory approaches to co-design—*Participatory Design (PD)* and *Participatory Action Research (PAR)*. We examine

specific models of interaction in participatory work with young people to arise within each approach and then conclude with a discussion about *conscious co-design* and the need to reflect on the design process at a meta level in PD and PAR.

METHODS

In developing this paper, we conducted a literature review and content analysis. The literature review on PD and PAR began in support of the authors' research study, *Data Literacy with, for, and by Youth*, with the initial goal of building a collection of resources related to the co-design of informal STEM learning alongside teens. Sources were acquired through searching (including citation mining) using key terms such as participatory design, participatory action research, participatory practices in libraries, and co-design, and by reviewing publications by leading scholars and practitioners in our areas of interest, narrowing the scope to focus on children and youth. The literature review unfolded over the course of six months, each step narrowing the scope and focus. In the first phase, we sought articles describing specific techniques of PD and PAR with youth, drawing from the scholarly and professional literature in the fields of Human Computer Interaction, Library and Information Science, and community-based work with youth. We identified an initial list of 48 articles. This list, however, was not meant to be exhaustive, its purpose being to inform our own research in terms of potential techniques. We also sought articles offering a comparative analysis of techniques and this search yielded 28 articles. As we reviewed the literature, one of our discoveries was that there is a rich body of research about *how* to run participatory research with youth, but there is less said about the meaning and nature of participation with youth. In the final stage of the literature review and content analysis—the phase reflected in this paper—we narrowed the field to works that defined participation (alongside youth) through the use of broader conceptual frameworks and models, focusing our inquiry on interaction.

The search was conducted in the following databases: ACM Digital Library, the archives of *American Libraries Magazine*, Library and Information Source, H.W. Wilson's Library and Information Science Full Text, Scopus, and Google Scholar. In addition, we found the search strategy of citation mining to be particularly valuable. For example, we utilized Scopus to find newer resources that cite commonly referenced, but older, literature reviews and analyses related to PD. We also scanned conference proceedings such as those of the ASIST annual meetings, the Participatory Design Conference (PDC), and the Interaction Design and Children (IDC). As well, we reviewed the gray literature from institutions known for informal STEM learning, such as libraries and non-profits reaching young people in after-school/out-of-school environments. For this paper, we do not include analyses of specific techniques and "how to do it" guidelines, although that literature is certainly of value. This is because we are specifically interested in using the literature to paint a picture of the relationships, roles, and interactions in co-design.

CHILDREN AND YOUTH IN THE DESIGN PROCESS

Children and Youth as Agents of Change

Multiple discourse threads weave their way throughout the research and practice in co-design with children and youth, including conversations about critical pedagogy, the movement toward democratic and inclusive design, and the empowerment of young people as agents of change. We discuss these throughout the paper in specific relation to PD and PAR. However, the actual starting point for this exploration into participation are considerations about children's rights and the ways that childhood is framed in society.

The Youth Participatory Action Research community draws from the child rights movement and the sociology of childhood, recognizing young people's fundamental right to participate in making decisions about the matters that affect their lives (Shamrova & Cummings, 2017). Nevertheless, in the literature about children as design partners in technology development, little acknowledgement has been given to underlying ideologies of childhood and how they influence researchers' understanding about what young people are capable of doing and their right to do it. Childhood is not just a time of life: it is also an idea. The child rights movement, exemplified by the United Nations Convention on the Rights of the Child (UN, 1989), positions children as social actors with the inherent right to be informed, to be creative, to participate and have opinions on matters concerning their own well-being. The United Nations General Comment 25, released in March 2021, applies these rights to young people's engagements with the digital environment, including its design (UN, 2021).

In the realm of research, the "new sociology of childhood" reflects a similar stance on childhood, suggesting that young people should be seen as the subject of research and active participants, rather than the objects of study, as if they were laboratory rats "at the mercy of external stimuli" (James & Prout, 1997, p. 13). Adopting this stance on childhood means that research should be conducted *with* children, rather than *on* children. Young people should be viewed as agents of change, and not just assets for research.

Participatory Approaches with Children and Youth in the Co-design Process

In this section, we set out some definitions for two approaches to participatory research that have been used with children and youth in the co-design process: *Participatory Design (PD)* and *Participatory Action Research (PAR)*. PD is often applied to the design of technology while PAR is more often associated with social processes. (With technology increasingly embedded into everyday life, one wonders if a more unified approach is needed). Co-design is often characterized as a subset of PD and is closely associated with Cooperative Inquiry (CI), where children and youth work alongside adults as equal partners in the design of new technology (Druin, 1999, 2002; Guha et al., 2013). However, co-design has been applied to contexts beyond technology design, as, for example, a method associated with emancipatory approaches to teaching and learning.

Understanding that there are important distinctions, ideological and otherwise, between the various methodological practices of participatory research, we look instead for the common threads that bind them together. In this way, we can explore the patterns of interaction in co-design across different contexts. One such thread is the concept of “participation” as a tool for the empowerment of people. Another is the desire to create something and make it *actionable* (whether it be a new technology, space, curriculum, or a community project).

Bustamante Duarte et al. (2018), explored the benefits of combining various participatory approaches in their work to develop tools and strategies to empower young migrants during resettlement. When used in tandem in the same project, each approach filled in the gaps left by the other, creating a richer environment for discovery. On the other hand, the authors realized that the meaning of participation can be interpreted in different ways, depending on the research tradition from which it arises, leading them to argue that “it is crucial to discuss and reflect on the degree of participation in a study” (3.8)

Participatory Design

Participatory design is a methodology that gives the end user an active role in the design process. PD’s primary guiding principle is the promotion of collaborative relationships between users and designers, with the user invited to contribute to the final product as a member of the design team (Yip et al., 2017, p. 5742). PD is associated with a movement originally rooted in the Scandinavian approach to systems design in the workplace, which emphasized workers’ involvement in designing improvements to their quality of working life. This approach was based on the premise that workers should have a voice in determining their work experience (Halskov & Hansen, 2015; Nettet & Large, 2004).

In the 1990s, PD emerged as a larger field of research, expanding from the original workplace context to a broader application in the area of technology based on the following premise: Just as workers should have a role in shaping their working life, technology users deserve to be active participants in technology development and advancement (Halskov & Hansen, 2015, p. 88; Yip et al., 2017, p. 5742). This principle includes not only adults but also children as technology users, with PD playing a role in the field of Child-Computer Interaction (Tsvyatkova & Storni, 2019).

Beyond technology, PD has also been adopted in other domains—such as healthcare, civic engagement, and cultural heritage—coinciding with a shift in focus from the quality of a specific end product to an improved quality of life more generally. Perhaps because PD occurs across these multiple contexts and has an increasingly broader aim, no single methodological approach to “participation” has emerged as a best practice in the field (Halskov & Hansen, 2015; Sanders et al., 2010).

Including children in the design process does not inevitably lead to equality. Druin points to four roles that young people can take on in PD of technology—*users*, *testers*, *informants*, and *design partners* (Druin, 1999, 2002). It is only when children and youth are recognized as partners that true co-design can occur. Yip et al. (2019) argue that PD is broader than co-design and “includes any activity with end users (for example, user-testing, informing opinions)” (p. 1243). In contrast, Tsvyatkova and Storni (2019) view “co-design with children” as the umbrella category that includes PD as well as user-centered design and learner-centered design. This lack of consensus around the term “co-design” is perhaps not surprising, given Halskov and Hansen’s (2015) finding that the very idea of “participation” seems to vary within the PD community. This amorphous conception of participation seems aligned with the divergence in perspectives on co-design and its relationship to PD and PAR.

Participatory Action Research

Participatory Action Research (PAR) is an epistemological approach to inquiry in which the beneficiaries of research are directly involved in planning and conducting the research. PAR challenges traditional precepts about expertise and validity by treating research as a collective process in which historically marginalized community members are considered an essential part of the research team (Anderson, 2020; Caraballo et al., 2017; Cammarota & Fine, 2008; Khanlou & Peter, 2005).

The roots of PAR lie in *Action Research (AR)*, an approach to inquiry first articulated by Lewin in 1946 as a response to Taylor’s “scientific management” of industrial processes, to show that human productivity and

development could be achieved through democratic practices, rather than autocratic coercion. Lewin's great concern was helping minorities overcome exploitation and colonialism through their inclusion in self-study and research to affect solutions (Lewin, 1946). AR rejects positivism and instead operates on the premise that individuals' social perceptions guide their behavior; therefore, the focus is on understanding the meaning behind people's practices in order to successfully influence their actions (Frauenberger et al., 2015; Khanlou & Peter, 2005; Fabian & Huber, 2019). Although forged in the context of industrial management, Lewin's *Action Research* has expanded, to include broad applications in the areas of community-development, social planning, and, in the world of education, to the improvement of teaching practices and curriculum design. Contemporary action research is not so much a research technique but rather, "a family of practices of living inquiry that aims, in a great variety of ways to link practice and ideas in the service of human flourishing" (Reason & Bradbury, 2008, p. 1).

Participatory Action Research positions the people or community under study as experts of their own lifeworld and agents of change in their own lives, not the objects of research. The mark of critical pedagogy on PAR cannot be ignored. Emphasizing the participant's development of a "critical consciousness" through participatory action research, critical pedagogy serves as a springboard for gaining the self-awareness and agency needed to advocate for one's own liberation. (Freire, 2000; Caraballo et al., 2017; Zeller-Berkman, 2007). Building on Freire's critical pedagogy, PAR features a design-like process of collective inquiry and application, its goal being real-world structural transformation for oppressed populations (Freire, 2000). To this end, directly impacted members of the community or workplace control the entirety of the research process, including determining the research's topic of focus (Khanlou & Peter, 2005).

In practice, there is no one unified approach to the methodologies that constitute PAR. Indeed, some practices of PAR have a distinct "design" flavor to them, as with the cyclical design process followed in QuAKTIV, a community-based project to create natural spaces for children, with children (Fabian & Huber, 2019, p. 159), while others do not. Nevertheless, Shamrova and Cummings (2017) identified a set of what they call "mutually agreed upon components" of PAR across the literature, based on a review of 45 papers: "participation, engagement, empowerment, mutual learning, capacity building and fulfillment of both research and action agendas" (p. 401).

Relationship between participatory design, participatory action research, and co-design

As described above, a review of the literature about PD and PAR brings to light an overall lack of agreement and clarity around the concepts of participation and collaboration. As well, across both approaches there is an absence of a strict set of methodologies and practices that are commonly regarded as the most effective and most ethical within each approach. At the same time, many methods are shared.

Despite this overall murkiness and fragmentation, commonalities do emerge across PD and PAR—most notably in the realm of foundational principles and aims that transcend domains of knowledge and medium of expression. Both approaches are committed to the youth point of view and have as a goal the enactment of an outcome or product. They each upend the traditional paradigm in which an outside "expert" takes the lead. Instead, these approaches honor the validity of the lived experiences of those who are most affected but usually least represented within the dominant power structures that govern standard design, development, and research processes. Thus PD and PAR endeavor to give the end user or directly impacted community a voice in determining their own experiences and futures. Most of the components of PAR identified by Shamrova and Cummings (2017) encapsulate not just shared elements within the PAR community but also shared ideals across PAR and PD - namely participation, engagement, and empowerment (p. 401). The sections below examine models of interaction and participation to arise from the PD and PAR contexts.

MODELS OF INTERACTION IN CO-DESIGN WITH YOUNG PEOPLE

The Ladder of Participation

Including users in the design of technology is, if not ubiquitous, certainly a common and acceptable practice. A growing body of research includes children and youth in the process, generally alongside adults. However, what is meant by "participation" can be opaque.

A good starting point for any discussion around co-design with children and youth is Hart's *Ladder of Participation* (1992), a typology for thinking about young people's participation in projects, and critically, avoiding exploitation (See Figure 1 below). Developed to support the U.N Convention on the Rights of the Child (1989), the *Ladder* is meant to be used as a tool to operationalize children's rights as citizens. It is not meant to be a simple measuring stick nor is there an expectation that every participatory project with young people lives at the highest rungs on the ladder. Inclusion of young people in any initiative can fall within two zones – participatory and non-participatory. In other words, just having young people associated with a project does not mean that they are partners. Worse, using young people in tokenistic, decorative, or manipulative ways may even be harmful, should inclusion lead to their cynicism and disengagement. Involving young people in PD, therefore, has added responsibilities for the adults who initiate the project. As Hart notes, young people's "understanding of democratic participation and the confidence to

participate can only be acquired gradually through practice; it cannot be taught as an abstraction” (p. 5). A young person’s inclusion in a participatory project should, therefore, be a first step toward greater engagement with the world, and not a lesson in stepping away.

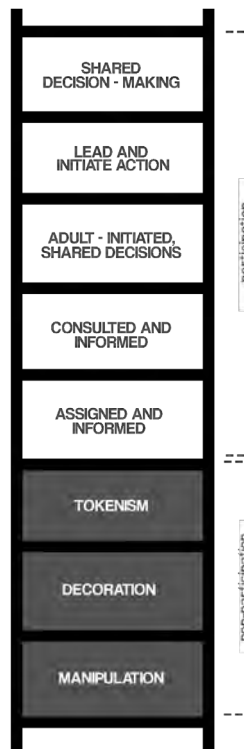


Figure 1. Ladder of Participation. Adapted from Hart, 1992, UNICEF

Participatory Design of Technology with Children

Wright et al’s *Stage Model of Participation* (2010, as cited in Bustamante Duarte et al., 2018) is similar to the *Ladder of Participation* in its aim to define participatory research and comes from the PD community in the field of Human Computer Interaction. (See Figure 2). Of the nine levels, the first two levels are labelled “Not Participation”, indicating that the presence of people on a design project does not indicate participation. At level eight, decision-making shifts from researchers to co-researchers and the researchers shift into the role of consultant. Level nine is perhaps beyond the realm of participation, as non-researchers assume full responsibility. While helpful, this model does not seem to allow for the equal distribution of power and decision-making amongst all members of a design team. It simply shifts from one group (researchers/designers) to the other (users/people in the community). Furthermore, it isn’t specific to work with children and youth.

In another exploration into the meaning of “participation” in PD, Halskov and Hansen (2015) conducted a “critical survey of the role of users, emphasizing the way in which users are involved in various phases of the design process” in the HCI participatory design context (p. 81). One hundred and two papers presented at the Participatory Design Conferences (PDC) from 2002 to 2012 were reviewed. Although few papers were specific to design with children (which the authors attribute to the success of the Interaction Design and Children (IDC) conference), their paper nevertheless offers a good foundation for understanding what is meant by “participation” in PD and how the field conceives of the roles and relationships within. In general, researchers had fluid definitions of “participation”, which differed from paper to paper (p. 87).

Halskov and Hansen (2015) found that the literature on PD approaches “participation” from three stances: First, as *implicit*. In other words, it’s *not* defined, and the role of participants is taken for granted. Second, as an *expression of the user’s point of view*, implying that PD is a platform where stakeholder’s perspectives can be expressed and reconciled. And third, as a *space for mutual learning*, where participation represents a transfer of knowledge between members of the design team (p. 86). Notable by its absence from the PD literature is a category representing the complete control of the design process by the users for whom the product is being designed.

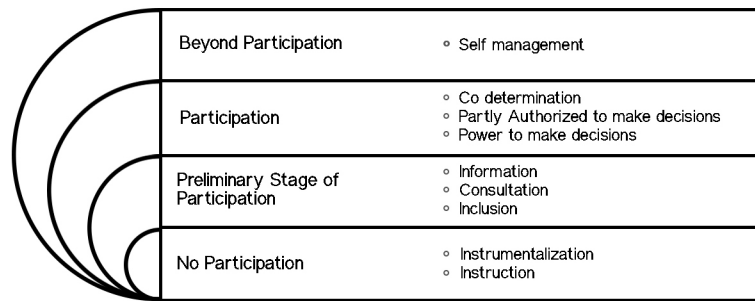


Figure 2. Stage model of participation
Adapted from Wright et al. (2010), translated into English by Bustamante Duarte et al (2018)

It seems unlikely (and certainly not what we as researchers have experienced) that the inclusion of children and youth would fit into Halskov and Hansen’s (2015) implicit category of participation (“taken for granted”), given the legal standing of youth and the barriers to access that surround them. However, thinking of participation as an expression of the user point of view seems representative of much of the PD work with young people. The third category of participation—*mutual learning*—is more in line with co-design.

Several studies reviewed below illustrate various degrees of children participation in technology projects. Large et al (2006, 2007), whose Bonded Design research project developed web portals with children, gives a nod to Halskov and Hansen’s *mutual learning* (2015). Large et al. argue that the co-design process is conceptually compatible with Vygotsky’s notion of socially supportive climates for learning, where over time, individual expertise becomes common knowledge shared by the community. The intergenerational team consisted of adults “with special knowledge about technology design and children with special knowledge of what it means to be a child” become a community” (2007, p. 70). An equal partnership between adult and child, however, was not claimed nor were the adult-child dynamics explored further.

A study with 12 former child design partners looked at ethical issues in PD, one of which is the adult-child power structure in the context of intergenerational participatory design (McNally et al., 2016, p. 3601). The results allude to an open atmosphere of mutual respect but say little about specific interaction between child and adult nor does it set out a series of stages of participation. The children said the co-design process was like a “big group of friends” but at the same time, they recognized that adults had additional responsibilities and that they, the children, took direction from adults: “The adults just told us what [the design session] had to be about. They didn’t tell us what we couldn’t do or could do” (p. 3601).

Co-design with children and youth, at least in the context of technology design, seems at times to be a black box. It is not enough to say that children are design partners. What actually happens in this collaborative space? Yip et al. (2017) explored this question further, examining adult-child relationships in 36 co-design sessions. The study juxtaposed the complementary roles of children and adults in the design of children’s technologies. On the child-side of the equation, children’s roles moved from passive to active, user to partner (see Figure 3 below). Adult roles mirrored and complemented child roles, from observer to design partner. Presumably, a true co-design situation would exist when children and adults serve as mutually supportive design partners.

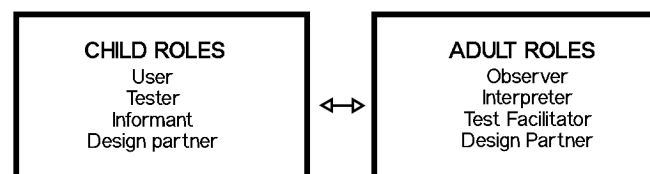


Figure 3. Complementary child-adult roles in intergenerational participatory design
Adapted from Yip et al, 2017.

Digging deeper, the study also found that design partnerships span four dimensions—*facilitation*, *relationship-building*, *design-by-doing*, and *elaborating together*. Each dimension travels along a spectrum of interaction, from balanced to unbalanced. For example, the *Facilitation Dimension* was unbalanced when only adults facilitate the design session. Alternatively, balance occurred when children and adults facilitate together. The *Design-By-Doing*

Dimension contrasts adults observing while children do the design work (unbalanced) with adults and children designing closely together, exchanging dialogue and ideas (balanced). The *Relationship Building Dimension* is about how socially distanced adults are from children while the *Elaborating Dimension* reflects the process of negotiating ideas. When children do all the talking and adults ask all the questions, this is an unbalanced elaboration. Alternatively, sharing ideas and negotiating design solutions is balanced (Yip et al., 2017, pp. 5746-5749). A stance on involving children and youth as equals in co-design might therefore suggest that aiming for balance is the key, rather than focusing on a set of progressive stages.

Participatory Design in the Context of Library Services for Youth

The interactions modeled by Yip et al. (2017), developed within the context of technology design, could be easily transferred to other modes of co-design with children and youth, including library programs and services. For example, many public libraries have Teen Advisory Boards facilitated by a youth librarian, where youth design programs and policies for the library. Researchers in the area of library and information science (LIS) have argued that the techniques of PD are an essential skill set for youth librarians. Subramanian suggests that methods of cooperative inquiry, an approach commonly practiced in technology design but also associated with action research, can be applied to the co-design of youth-focused library services, with teens and librarians working collaboratively (Subramanian, 2016). Exploring this further, Yip et al. (2019) modeled participatory librarianship, informed by the four dimensions of interaction set out in their earlier work—*facilitation*, *relationship-building*, *design-by-doing*, and *elaborating together*. The librarian role reflected degrees of interaction, from supportive to co-design.

Participatory Action Research with Youth

Participatory Action Research (PAR) with youth is often associated with the goal of creating a pedagogical product (a curriculum, after-school program, a learning experience or health intervention), a social innovation (a new process, a service, or restructured systems, or a physical object), and even the re-design of space (parks, libraries, etc.). Media products, developed with youth, on issues that are meaningful to youth, can also be situated within a PAR frame (Soep, 2006; Soep & Chávez, 2010).

The library can be a locale for PAR, such as a project led by the Free Library of Philadelphia, to plan and design a teen center. The project, which self-identified as participatory design *and* action research, involved multiple stakeholders, including teens, the library staff, and community partners (Steele, 2013). Another example comes from the world of academic libraries, where participatory action research informed Somerville and Brown's project (2011) to re-design space. While the study addressed a wider "campus constituency", some of the students in an architectural design class may have provided a young adult component (Somerville & Brown, 2011). We include this study, not as an example of youth-oriented research but rather, as one of the rare instances of library-focused research that clearly self-identifies as PAR, in order to provide readers with a library context.

As with the co-design of technology with children, the roles, relationships, and interactions within PAR are not always transparent. Reports on PAR often describe the techniques used but have less to say about the nature of interaction between co-participants, the roles they move in and out of, and their relationship to each other. Rather, a set of guiding principles is highlighted. For example, Somerville and Brown (2011) identify "*participatory and collaborative*" and "*emancipatory*" as central to the PAR approach, writing that "researchers are co-workers conducting research with and for the people concerned" and the process is "egalitarian rather than hierarchical, because all participants are assumed to be participating equally to the inquiry" (p. 671).

Fabian and Huber (2019, p. 161) outline "participation steps" in their project *Quaktiv*, a PAR design project with children, to create places and natural spaces that embody children's lifeworlds. Fabian and Huber's model demonstrates degrees of empowerment within the PAR project and represents participation as a set of stages reminiscent of Hart's Ladder of Participation described above (See Figure 4).

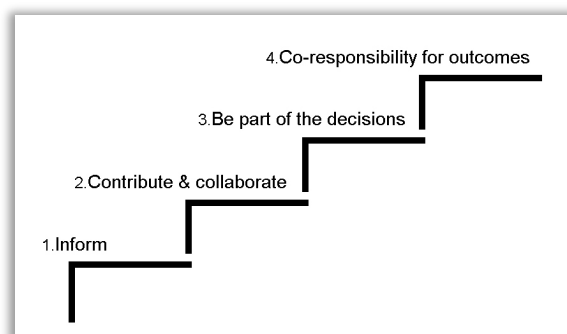


Figure 4. Participation steps in QuAKTIV. Adapted from Fabian et al, 2019, 161

Fabien and Huber (2019) note that principles of participation alone will not lead to the full and comprehensive participation of children in PAR: It is dependent on the conditions in the community (p. 165) and must be addressed in a situated manner (p. 171). This suggests that the roles, relationships, and interactions in PAR can only be understood in the moment, rather than planned for in advance (p. 171). The authors faced the conundrum of participatory research with children and youth: *For meaningful participation, who should initiate a PAR project?* “Is it more useful to wait until the community and children become active themselves...[or is it] more useful to intervene from the outside, from the world of adults and administration, in order to initiate projects that resemble PAR in the attempt to strengthen the community and children” (p. 175).

It is interesting to consider what participation in action research means from a youth perspective, on a youth-initiated project. Tuck et al. (2008), write about CREDD (which stands for Collective on Educational Disappointment and Desire), a co-design project led by group of youth aged 16 to 22. The collective conducted a self-study about New York City public schools, investigating how education failed them and actions that they, as young people, can take in order to change the system. This was not an intergenerational research experience shared with adults. Participation in the CREDD meant nothing less than total ownership of the research process:

“There is transparency on all matters of the research;
The research questions are co-constructed;
The project design and design of research methods are collaboratively negotiated and co-constructed;
Analysis is co-constructed; and
The products of the research are dynamic, interactive, and are prepared and disseminated in collaboration”.
(p. 51)

As Cahill et al. (2008) note, PAR should, in the true, Freirian-sense, allow participants to hold up a mirror and come to terms with the roots of their oppression (p. 91). CREDD’s approach fulfills this emancipatory goal of critical pedagogy, without the guidance of adult experts in research. But the reality is that many PAR (and PD) projects with children and youth are initiated by adults, guided by adults, and often rely on the domain expertise of adults, in order to create change. (In the context of informal STEM learning, this may be all the more true). At what point does the research move from guided inquiry with children, toward children as participants in research? Barnikis et al. (2019) capture this tension as they describe their own roles in participatory research:

“Issues of power, present in all research encounters, are heightened when adults do research with children...There is a tension in adult-initiated research between the desire to reduce power imbalances by involving participants more fully in all stages of the research process, and the need to employ knowledge and theoretical understanding that may not be available to the participants...” (pp. 19-20)

In terms of power and positionality, another consideration is the multiple relationships that the researcher may have with youth participants—as educator (or librarian, as the case may be) and often (since it is difficult to recruit children and youth for research), as a family friend. Action research is inherently embedded in social context, so this is not meant as a critique of the method. Rather, as Barnikis et al. (2019) note, researchers must consider how pre-existing relationships can weave their way into the co-design process in PAR and be conscious of their social location to children and youth (p. 8). Adult members of a co-design team with children and youth need to articulate their role, as Tiffany, an adult researcher, does here in a self-study of her work with children.

“I, an adult, established the research questions, design, and intentions. I also co-constructed the conversations with the children, but still framed, analyzed, and interpreted the data alone” (Tiffany, as quoted in Barnikis et al., 2019, p. 6).

One is left asking if the inclusion of adults in PAR co-design projects automatically distorts group dynamics, inevitably bending power away from children and youth? An approach to PAR that allows for adult expertise, while maintaining the generosity of spirit needed for deep, collaborative partnerships, comes from the work of YR (Youth Radio) Media, a national network of young journalists and artists collaborating with adults in a process called *collegial pedagogy* (Soep, 2006; Soep & Chávez, 2010). YR Media creates cultural products for youth audiences but is also a space for theorizing about community action and participatory processes for co-learning and co-design with youth.

Collegiality transmits a clear sense of a “relationship in which two or more people jointly engage in a significant task for a shared purpose, with collective responsibility”, building on the notion of a “community of practice” (Lave & Wenger, 1991, p. 53). Rather than see youth as recipients of learning in the co-creation of media, the learning is something that the community creates, alongside the production of media. Adults are not to be phased out as participation progresses. Rather, youth and adults are joined in a shared purpose, which in the case of YR Media, is

to reach an audience. This positioning is similar to Halskov et al.'s *mutual learning* in PD (2015) and Large et al.'s notion of socially supportive climates for learning within *Bonded Design* (2007). Which is to say that when an adult shares their expertise with youth for a shared purpose, this does not necessarily equate to the downgrading of youth participation but rather, a growth experience for all.

What are the conditions for a *collegial pedagogy*? Soep and Chávez (2010) outline three factors: *Collaborative Framing*, *Youth-led Inquiry*, and *Public Accountability*. *Collaborative Framing* means that co-design/co-learning has to have a mutually agreed-upon starting point. The frame is negotiated, through trial and error. Youth put forward different approaches, try it out, and then discuss with adults (in the case of YR Media, this might be an adult producer). As youth explore ways to frame a topic, they become informed. *Youth-led Inquiry* connects personal meaning to information learned through the creative process. This does question the role of adults in transmitting complex information, as might be the case in STEM learning, but it clearly asks youth to shoulder some of the burden. The last factor is *Public Accountability*. A PAR (or PD) product is meant for *someone* – a person, a community, an institution. Too often in co-design, young people's ideas are not operationalized and shared with a real public. If reaching an audience drives participation, then a real audience is needed.

DISCUSSION

This exploration into the meaning of participation in the context of co-design with youth sets out models that perhaps raise more questions than they answer. We highlight below some of our own reflections to arise from this inquiry:

- What happens in co-design projects where some level of disciplinary, technical, or craft knowledge is required? Young people, simply by virtue of having fewer years of life experience, may not have acquired this knowledge and need the scaffolding provided by adults with “expertise”. Does this imbalance necessarily translate to a situation of adult dominance over youth participation? Soep and Chávez's model of *collegial pedagogy* (2010) and Yip et al.'s model of *complementary child-adult roles* (2017) both point to a more mutually beneficial perspective, where co-design is an experience of shared growth.
- How is youth participation influenced by the context and medium of the co-design project? For example, discussing how a physical or digital object works versus brainstorming ideas around a social construct like privacy and data might look like two very different participatory processes. The models presented here do not acknowledge this. One has the sense that giving a tool to teens and saying ‘take it apart and make it better’ would lead to a different level of autonomy and participation from that which might arise around abstract concepts that require some explanation.
- If we, as researchers, initiate a co-design project with youth, are the higher-levels of participation (as set out by the models in this paper) then even possible? In our own reflections on our work with young people - co-designing STEM activities for after-school learning environments—we suggest that there can be many forms of participation within a single project. In a research project, perhaps funded by external agencies, the researchers often begin by generating the research questions and protocols, without first consulting youth. However, in the “Vygotskian” sense, perhaps a project can begin with adults doing the heavy lifting in terms of conceptualizing the overall project and then they deliberately fade into the background as youth move toward greater autonomy. As long as researchers are transparent and self-aware about the co-design process, we suggest that researchers can accept a certain level of fluidity in interaction types. This does not, however, resolve the question as to who frames the initial problem.
- This latter point leads us to emphasize that co-design with youth requires a baseline level of self-consciousness, transparency, and intentionality on the part of the adults who initiate the process. The models and concepts we've presented in this paper point to particular factors that can lead to greater youth participation. But we think there is something more. We call for *conscious co-design*—the self-reflective and deliberative planning for participation in co-design, particularly on the part of adults working with vulnerable populations - so that problematic dynamics that may only benefit those already empowered are not reinforced by the very act of co-design. Notions of the “reflective practitioner” have long woven their way into professional practice (Schön, 1983) and more recently into the design of technology (Malinverni, & Pares, 2017). We simply argue that a self-reflective critical practice also applies to co-design with youth, a journey that we, the authors, have begun in our own co-design project, *Data Literacy with, for, and by Youth*. We hope to generate further discussion on the meaning of participation in information science research.

CONCLUSION

In their paper reviewing ten years of PD, Halskov and Hansen (2015) note that “it is crucial that researchers be more precise about users' roles...who drives the process between sessions, with regard to interpretation, planning, and decision-making in the design process” (p. 90). In this paper we have attempted to examine the roles, relationships, and interactions between partners in co-design in a holistic way, by reviewing the literature on co-design concepts, frameworks and models drawn from the literature in both PD and PAR. While our review of existing resources on

participatory co-design was not meant to be exhaustive, we identified a range of interaction models. The stage models (Hart, 1992; Wright et al., 2010, as cited in Bustamante Duarte et al., 2018; Fabian & Huber, 2019) show that interactions in participatory processes can be designed in alignment with a higher stage (or rung on the ladder) or, start at a lower level and evolve. Yip et al.'s model of complementary child-adult roles (2017) is interesting in that it includes adult roles and aims for balance in addition to shared growth. Soep and Chávez's collaborative framing, situated within the broader perspective of collegial pedagogy, emphasizes the mutuality of youth-adult participation (2010). Such models, and others, can serve as a *map*, guiding the way to design *for* participation. The same models can be applied as a *diagnostic tool*, helping to analyze, post-research, the nature of interaction in co-design projects with children and youth. We, the authors, find that our own awareness of the potential roles, "rituals to share power" (Cahill, 2016, p. 162), relationships, and forms of interaction is invaluable in planning our own research co-designing data literacy activities with youth, and we will continue reflecting upon these models as the project progresses.

Acts of *conscious co-design* can raise the adult researcher's self-awareness of their own role in co-design with young people. It is an ethical stance: Design work that makes claims to "co-design" should be transparent as to its stance on the role of *all* participants during the design process and importantly, evident to the adults who initiate participatory projects with youth. Transparency impacts the reliability and replicability of research, and demonstrates respect for all participants, no matter their level of involvement. More importantly, telling young people that they are helping to make a difference in the world is problematic if they have a decorative role in participatory research. We hope that this paper will not only offer methodological guidance to fellow researchers and practitioners interested in co-designing with children and youth, but will stimulate further research and discussions on the ways to empower youth by engaging them in all phases of the design process, from initiation to implementation.

ACKNOWLEDGEMENTS

The project *Data Literacy with, for, and by Youth* is supported through a grant from the National Science Foundation, USA. Award ID 2005608.

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Understanding Research Data Repositories as Infrastructures

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ABSTRACT

This study discusses the properties of research data repositories and explores metadata about 2,646 entries in the Registry of Research Data Repositories (re3data.org) to identify the characteristics attributed to infrastructures they exhibit. The results reveal how research data repositories function as information infrastructure for scientific community members and contribute to the small body of literature that examines data repositories through a socio-technical lens.

KEYWORDS

Data infrastructures, Infrastructure characteristics, Platforms, Research data repositories, re3data.org.

INTRODUCTION

The importance of *research data repositories* to the scientific community has grown over the past decade due to data management and sharing requirements from funders and journals, concern about scientific reproducibility, increasing interest in replication studies and secondary data analysis, and other factors (Baker, 2016; Johnston, 2017; McNeil, 2015; Thøgersen, 2015). They play a vital role in the research lifecycle, ensuring that data deposits remain findable, accessible, interoperable, and reusable (FAIR) (Wilkinson et al., 2016). Research data repositories are special-purpose databases that house digital *research data* and related *data context* such as metadata and supplementary files to support reliable, long-term access and discovery of data for the scientific community, known as *data sharing* ("Data Repository," 2020; Johnston et al., 2018, p. 5). In this context, research data includes digital materials such as surveys, images, observations, and tabular files that serve as evidence in scientific arguments (Borgman, 2012, p. 1062; Borgman, 2015; "Dataset," 2020; Leonelli, 2015, p. 811). Research data is linked to scientific infrastructures and communities of practices by the instruments, tools, and methods that scientists use to collect and create it (Borgman et al., 2019, p. 4).

Repositories are also sites of socio-technical engagement where the interests of members of the scientific community—including funders, research administrators, regulators, and researchers—their social and cultural practices and research artifacts, such as datasets, intersect and interact with information technologies. The research data management (RDM) literature extensively explores the technical characteristics of research data repositories and the practices of the communities they serve, including data curation and sharing. However, the information infrastructural qualities of research data repositories are less well-examined. My study explores this knowledge gap by addressing the following question: *Which infrastructure characteristics do research data repositories exhibit?*

For this study, I examined the recent literature about data repositories for evidence that they exhibit the nine properties widely attributed to information infrastructures (Star & Ruhleder, 1996; Star, 1999). I explored metadata about 2,646 repositories indexed by the Registry of Research Data Repositories (re3data) to observe the variety with which repositories may express infrastructure characteristics. My findings reveal how research data repositories function as information infrastructure for members of the scientific community and contribute to the small body of literature that examines their characteristics through a socio-technical lens.

BACKGROUND

The word *infrastructure* evokes images of railways and roadways, power grids, telecommunications networks, and other omnipresent but taken-for-granted and always-in-the-background constructions that tirelessly knit together the activities and lives of millions of people. What is it about the form and function of research data repositories that feels similar? In the following sections, I define concepts related to research data repositories and socio-technical infrastructures to discern their similarities. I also establish the infrastructure criteria that I use to investigate my research question.

Socio-Technical Infrastructures

According to Star and Ruhleder (1996), "[a]n infrastructure occurs when the tension between local and global is resolved" (p. 114), where widely available technologies provide affordances to users to serve their local needs. Star (1999, p. 381-382) identifies nine characteristics that signal *when* a constellation of dynamic relations functions as

an infrastructure, and that form the analytical framework of my study. The characteristics are: 1) embeddedness; 2) transparency; 3) reach or scope; 4) learned as part of membership in a group; 5) links with conventions of practice; 6) embodiment of standards; 7) built on an installed base; 8) becomes visible upon breakdown; and 9) is fixed in modular increments, not all at once, globally.

The landscape of socio-technical infrastructures also features boundary objects and boundary infrastructures. *Boundary objects* are "objects that are plastic enough to be adaptable across multiple viewpoints, yet maintain continuity of identity" (Star, 1989, p. 251). Boundary objects are created by members of disparate groups and stakeholders across scientific communities and enable participants to collaborate effectively without in-depth knowledge of their divergent goals and practices. Star identified four categories of boundary objects during her investigation of scientific workplaces within bio-medicine and museums (1989, p. 253-255): 1) repositories, which are modular, well-ordered, and indexed aggregates of objects, including libraries and museums; 2) ideals or Platonic objects; 3) terrains with coincident boundaries; and 4) forms and labels. Boundary objects that operate at a larger scale are called *boundary infrastructures*. Boundary infrastructures coordinate networks of smaller-scale, diverse boundary objects to link disparate disciplines and communities of practice (Bowker & Star, 2000, p. 287, p. 313-314).

Research data repositories are well-ordered, well-described, and indexed aggregates of research datasets that coordinate diverse stakeholders' work within and across scientific disciplines, geographically dispersed groups, and over long periods. Therefore, they may serve as boundary objects and boundary infrastructures within more extensive scientific knowledge infrastructures. Research datasets themselves do not comfortably compare to boundary objects. Their data files and supplementary materials are too heterogeneous to be described as repositories or well-defined terrains, and they are too specific to be considered ideal or Platonic. However, the research context that supports their interpretation and reuse, such as descriptive metadata describing datasets and supplementary materials, meets Star's criteria for forms and labels.

Data Infrastructures, Platforms, and Scholarly Infrastructures

Data infrastructures are complex, socio-technical systems concerned with data. They are situated in a dynamic landscape of shifting interests and stakeholders, including researchers, corporations, institutions, and governments. Research data repositories are data infrastructures that preserve and share scientific knowledge to support future research (Kitchin, 2014, p. 37) and support data preservation and reuse within scientific knowledge systems (Borgman, 2015, p. 225-227).

Plantin et al. (2018) examines a commercially owned research repository called Figshare (<https://figshare.com>) from an explicitly socio-technical perspective. The authors draw upon *infrastructure studies* and *platform studies* to analyze Figshare's data archiving and sharing functions. As the term suggests, infrastructure studies arose from information science and science and technology studies. Platform studies emerged from the media studies discipline and is influenced by game design and social media research (Plantin et al., 2018, p. 294).

Platforms are modular and programmable software systems that enable integration and interoperability with other programs through technologies such as application programming interfaces (API) (Plantin et al., 2016, p. 299). Many research data repositories support standard platform functionality or use existing platforms, such as DSpace, Dataverse, or Comprehensive Knowledge Archive Network (CKAN). *Scholarly infrastructures* are the set of relations between researchers, institutions, funders, academic publishers, data repositories, and other stakeholders in the scientific community (Plantin et al., 2018, p. 2). Figshare is a commercial software application that allows researchers to deposit and share their data, supplementary materials, and publications with others. It is an example of a platform that serves as a research data repository and scholarly infrastructure.

Plantin et al. (2018) acknowledge the value of research data repositories to the scientific community. However, the authors also assert that "nothing close to infrastructure for data currently exists" (p. 5) because research data is not well-integrated into the scholarly lifecycle. Instead, they argue that data repositories, such as Figshare, serve as *infrastructuralized platforms* that "insert themselves within infrastructures to organize data sharing" (p. 2). Their conclusions suggest that research data repositories may not exhibit all nine infrastructure characteristics and that the functionality of repositories' platforms may influence or contribute to their properties.

METHODS

To investigate my research question, I first examined the literature about data repositories. I also wrote Python 3 software to download, aggregate, and explore descriptive statistics about metadata values related to Star's infrastructure characteristics for each of the 2,646 repositories indexed by re3data.org on March 10, 2021 (Boyd, 2021). This approach reflected my awareness that Star's characteristics may be more visible across a large population of repositories; an individual repository may exhibit only a few. Re3data metadata values illustrate some of the many ways that repositories may express these characteristics and reveal concrete connections between Star's

characteristics and specific platform features, such as the APIs they support. The approach also allowed me to develop and test software for future, more extensive quantitative studies of re3data metadata.

The Registry of Research Data Repositories, known as re3data, was established in 2012 as a global registry of research data repositories (*About Re3data.Org*, n.d.). Re3data staff describes each repository in the registry using 41 required and optional properties, modified by 50 attributes (Rücknagel et al., 2015). For this brief study, I selected nine properties—eight required and one optional—that illustrate five of Star's infrastructure characteristics. My choice and mapping of the metadata elements to infrastructure characteristics were exploratory and opportunistic. For example, I surmised that required metadata fields were more likely than optional fields to be present in the data and might exhibit a broader range of values. The fields did not always have obvious infrastructure analogs, therefore, four of the characteristics are unassigned. I describe my rationale for the element mappings in the list below.

- 1) *r3d:type*. The type of repository indicates the community it serves, such as an institution or a specific academic discipline, and speaks to the communities within which it is embedded.
- 2) *r3d:repositoryLanguage*. The language used by the repository's user interface indicates its cultural scope.
- 3) *r3d:startDate*. The repository's creation date indicates its temporal scope and may also suggest the degree to which it is embedded in the practices of its user community.
- 4) *r3d:subjectName*. The academic subjects supported by a repository reflect its scientific community.
- 5) *r3d:enhancedPublication*. This element indicates that the repository allows bidirectional links between their datasets and related publication. The presence of this feature indicates support for its user communities' conventions of practice.
- 6) *r3d:versioning*. This element indicates that a repository supports versioning for its datasets, a practice that some research communities use.
- 7) *r3d:metadataStandardName*. Repositories support a variety of domain-specific metadata standards for describing datasets. This element indicates the different standards that a repository supports.
- 8) *r3d:apiType*. Repositories may make their metadata or datasets available programmatically via various standard APIs, including the Open Archives Initiative Protocol (OAI-PMH) and File Transport Protocol (FTP).
- 9) *r3d:softwareName*. This element indicates the name or names of the software the repository uses. It may indicate a database such as MySQL, or a software platform, such as DSpace or Dataverse, with a large installed base.

INFRASTRUCTURE CHARACTERISTICS OF RESEARCH DATA REPOSITORIES

In the following sections, I discuss the extent to which research data repositories and their software platforms exhibit Star's nine infrastructure characteristics and explore how re3data repositories express infrastructure properties through nine metadata elements. Table 1 summarizes my analysis and shows the relationship between the re3data metadata elements, infrastructure qualities, and whether repositories' platform functionality contributes to satisfying infrastructure criteria.

Infrastructure Characteristic	Satisfies Criteria?	Supported by Platform Functionality?	re3data.org Metadata Elements Explored
Embeddedness	Yes	No	r3d:type
Transparency	No	No	-
Reach or scope	Yes	No	r3d:repositoryLanguage r3d:startDate r3d:subjectName
Learned as part of membership in a group	Yes	No	-
Links with conventions of practice	Yes	No	r3d:enhancedPublication r3d:versioning
Embodiment of standards	Yes	Yes	r3d:metadataStandard r3d:apiType
Built on an installed base	Yes	Yes	r3d:softwareName
Becomes visible upon breakdown	No	No	-
Is fixed in modular increments, not all at once, globally	Yes	Yes	-

Table 1. Summary of Infrastructure Characteristics of Research Data Repositories

Embeddedness

Infrastructures do not stand alone. They are embedded in and interconnected with other technical and socio-cultural systems (Star, 1999, p. 381). Research data repositories are the sites of practice and coordination for those who participate in data management, curation, preservation, and dissemination. The repository's type indicates the scientific community that it serves (McNeill, 2016). For example, the discipline-specific repository the Genomic Data Commons (GDC) (<https://gdc.cancer.gov/>) and the institution-specific CERN Open Data Portal (<http://opendata.cern.ch>) are connected to specific networks of funders, large-scale instruments and resources, universities, and research institutes. In contrast, generalist repositories like Harvard Dataverse (<https://dataverse.harvard.edu>) and Zenodo (<https://zenodo.org/>) serve the broader pan-discipline research community (Stall, Shelley et al., 2020).

Based upon my analysis of the *r3d:type* metadata element, the re3data team designated 2,073 of the 2,646 registered repositories as disciplinary (78%, $n = 2,073$), with 677 institutional repositories (26%, $n = 677$), 291 other (11%, $n = 291$), and 30 repositories designated as unknown (1%, $n = 30$). The team assigned more than one designation to 416 (16%, $n = 416$) of the repositories. A graph of the results is shown in Figure 1.

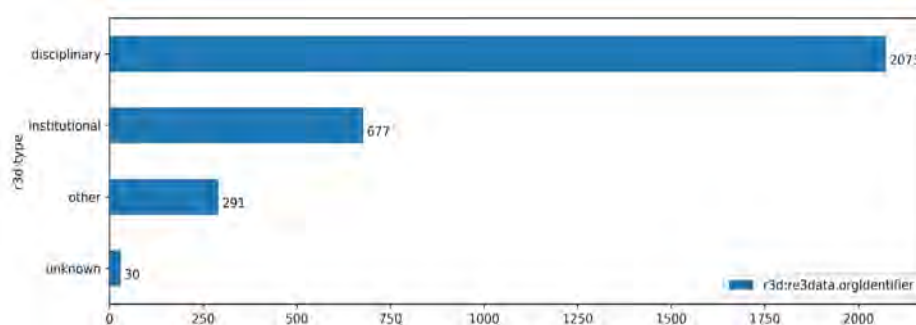


Figure 1. Re3data Repository Types

Transparency

Infrastructures are notable because their users do not notice or remark upon their use; they are well-integrated into workflows and common practices (Star, 1999, p. 381). Unfortunately, research data repositories are not well-

incorporated into most research workflows. For instance, consider the prevalence of the peer-reviewed research journal article as a unit of scholarship across all disciplines. In contrast, what counts as research data depends upon the field, and data sharing attitudes and practices vary by discipline and research role (Kim, 2019; Johnson et al., 2016; Tenopir et al., 2011; Thøgersen, 2018). Even in cases where funders, institutions, journals, and community norms require that researchers make their data available, the data sharing process itself is neither standardized nor seamless. Prospective data sharers may need to choose from amongst many suitable repositories. Once they select a repository and deposit their data, they may encounter additional challenges due to a lack of standards for descriptive metadata standards or file formats for their discipline or unfamiliarity with data curation practices.

Fortunately, most data repositories exhibit characteristics common to software platforms, including drag-and-drop file uploading, drop-down menus, option selection panels, and Web forms for entering and editing metadata. As data sharing becomes more widely accepted and expected, these features and functionality will ease the path to adoption for new users and minimize some of the barriers and disruptions they would otherwise encounter.

Reach or scope

Infrastructures are not single-use and serve many users, groups, and communities across time and space (Star, 1999, p. 381). The stakeholders involved in data sharing using repositories include researchers and research teams, funders, publishers, data curators, and repository managers (Plantin et al., 2018; Plantain, 2019). My analysis of the re3data element *r3d:subjectName* indicates that research data repositories also serve a broad spectrum of disciplines: more than 234 subject areas. The five most prevalent subject areas are: Life Sciences (54%, $n = 1435$), Natural Sciences (51%, $n = 1324$), Medicine (39%, $n = 1013$), Humanities and Social Sciences (35%, $n = 920$), and Biology (34%, $n = 879$).

Online research data repositories have the added benefits of serving individuals and groups separated by geography and time. For example, the Inter-University Consortium for Political and Social Research (ICPSR) is a consortium of over 750 academic institutions and research organizations (*Inter-University Consortium for Political and Social Research (ICPSR)*, 2020). It operates a data archive that has collected and provided access to social and behavioral sciences research data since its founding in 1962. The earliest repository start date in the re3data registry is the Sammlungportal Georg-August-Universität Göttingen, established in 1773.

Based upon my analysis of the 1,730 repositories in the registry with a valid *r3d:startDate*, the majority (52%, $n = 1,383$) were established in the 21st century, as the distribution of repository start dates in Figure 2 show, with 99 new repositories established in 2008 and 100 repositories established in 2011.

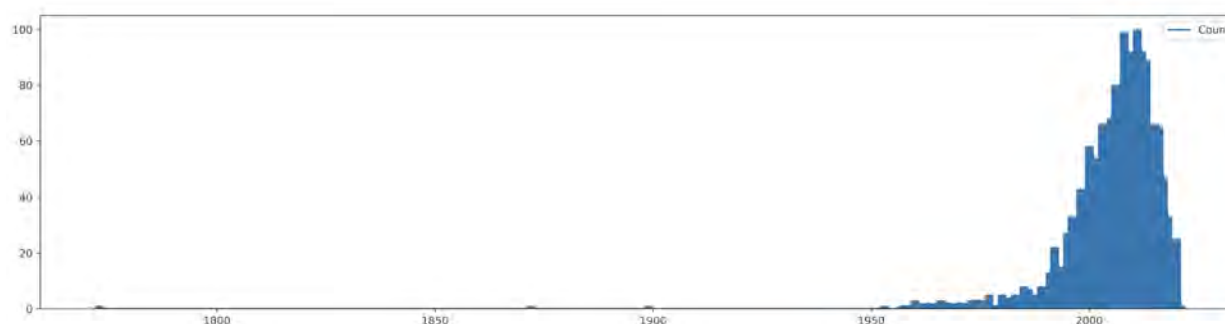


Figure 2. Distribution of Start Dates for Re3data Repositories

The language of the user interface (UI) of the repository implies the audience and cultural scope for the repository. My analysis of the *r3d:repositoryLanguage* metadata element reveals that the five most common UI languages are: English (21%, $n = 567$), German (7%, $n = 193$), French (7%, $n = 176$), Spanish (3%, $n = 87$), and Chinese (2%, $n = 53$).

Learned as part of membership in a group

Users acquire infrastructure-related knowledge and skills through membership in communities of practice; this infrastructure literacy may contribute to experts' perception that infrastructures are intuitive or transparent (Star, 1999, p. 381). Because data repositories are not seamlessly integrated into scientific workflows, researchers new to data sharing or work across multiple disciplines may experience a steep learning curve when depositing to a repository.

Repositories adopt a variety of approaches to streamlining the data curation process for new and experienced researchers. Self-service repositories rely upon copious online documentation and a graphical user interface (GUI) with a familiar look-and-feel to assist new depositors. Other repositories, such as those associated with institutions

or funding agencies, require that researchers submit their data for review by the organization before deposit. Once approved, the depositor may apply some metadata description themselves, or the repository manager may perform all data curation tasks on their behalf. Some repositories, such as the Odum Institute Data Archive, Harvard Dataverse, and the Qualitative Data Repository, offer an array of data curation services for researchers and teams who have large quantities of research data to publish or lack the experience to share the data themselves (*Curation and Data Management Services*, n.d., *Odum Institute Data Archive*, n.d., *QDR's Services*, 2020).

Links with conventions of practice

Infrastructures' reach and scope link them to communities of use and common user practices. As a result, users may be resistant to changes to infrastructures that disrupt established practices (Star, 1999, p. 381). For example, specific research data repository functionality is linked to long-established scholarly citation and research data management practices described below. Data citation practices (Silvello, 2018) and the assignment of unique identifiers, such as DOIs and URNs to datasets and files, mirror the conventions used to publish and cite research articles. Likewise, repositories may further the peer review process by supporting related software and documentation, submit-for-review workflows, and private and anonymous links to draft datasets.

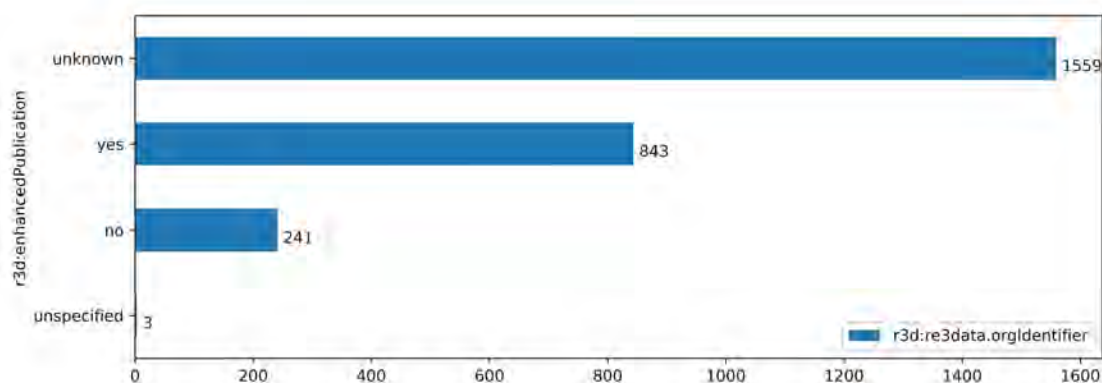


Figure 3. Re3data Repository Support for Linking Datasets to Publications

Repository support for bidirectional linking between a dataset and its related publications also reflects standard citation practices. Support for this functionality in re3data repositories is reflected by the element *r3d:enhancedPublication*. The bidirectional linking support for most of the repositories in the re3data registry was unknown (59%, $n = 1,559$), as shown in Figure 3. The presence or absence of the functional was unspecified for three repositories (0.1%, $n = 3$), however 843 (32%, $n = 843$) repositories are known to support the practice, while 241 (9%, $n = 241$) do not.

Over the lifetime of a project, such as a longitudinal study, a researcher or team may make incremental additions to their datasets, known as *versioning* their data. Versioning allows researchers to continue generating research data and publishing their results in conference papers or journals while making earlier versions of the data available for current and future use. Versioning also allows researchers to redact data, such as in cases where they inadvertently identified human subjects. Not all re3data repositories support dataset versioning, as the values for *r3d:versioning* show in Figure 4. However, 1,057 (40%) of the 2,646 repositories explicitly support the functionality, 203 (8%) do not. The support provided by 1,386 (52%) is unknown.

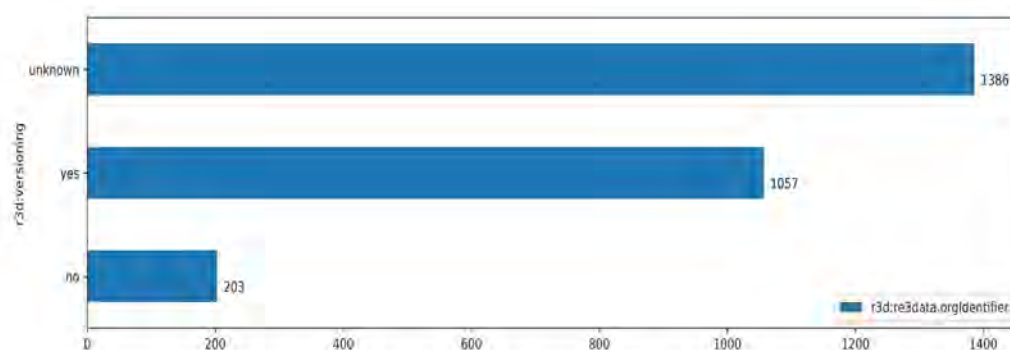


Figure 4. Re3data Repository Support for Dataset Versioning

Embodiment of standards

Infrastructures often codify technological standards and professional best practices, reflecting and reinforcing their reach and scope (Star, 1999, p. 381-382). Research data repositories implement standards related to the scholarly communities they serve, including descriptive metadata and metadata sharing standards. As platforms, they also support interoperability with other systems using APIs.

Of the many domain-specific metadata and file format standards possible, repositories typically support the formats of interest to their user communities. Repositories indexed by the Registry of Research Data Repositories support over 27 different metadata standards, as evidenced by my analysis of *r3d:metadataStandardName*. The most prevalent standards are: Dublin Core (DC) (67%, $n = 213$), DataCite Metadata Schema (40%, $n = 127$), ISO 19115 (31%, $n = 98$), DDI Data Documentation Initiative (29%, $n = 94$), and the Federal Geographic Data Committee Content Standard for Digital Geospatial Metadata (FGDCC) (17%, $n = 54$).

Repositories also share their metadata with other repository networks and library catalogs using protocols, such as OAI-PMH, and use API standards like REST, SPARQL, and SOAP to allow applications to query repositories and share the results between applications. The Dataverse Network is an example of a network of repositories, each implemented using Dataverse software, that share metadata with one another to support discovery and access of research datasets across installations. Most (55%, $n = 1,448$) of the 2,646 repositories registered in re3data did not offer an API, as my analysis of *r3d:apiType* indicates in Figure 5. However, repositories supported the following common API protocols in order of prevalence: REST (18%, $n = 478$), FTP (15%, $n = 410$), Other (13%, $n = 343$), OAI-PMH (10%, $n = 252$), NetCDF (3%, $n = 88$), SOAP (2%, $n = 63$), SWORD (2%, $n = 62$), OpenDAP (2%, $n = 59$), followed by SPARQL (2%, $n = 40$).

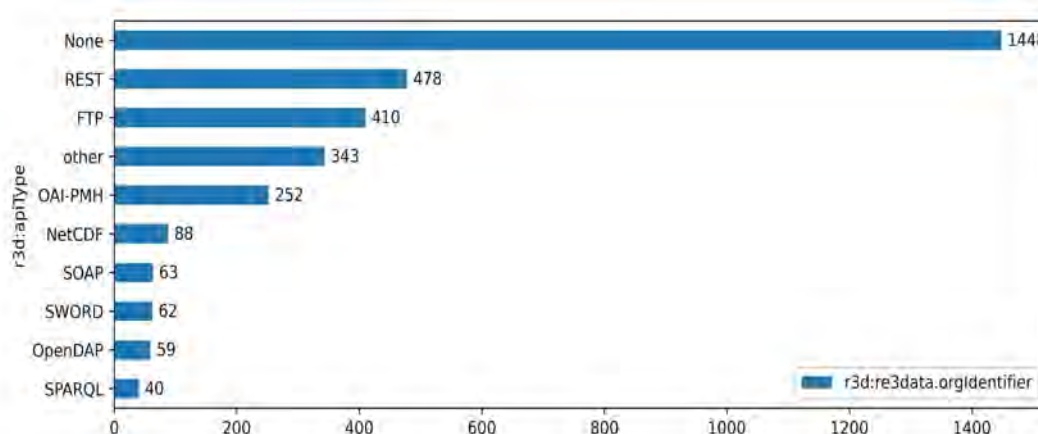


Figure 5. APIs Used by Re3data Repositories

Built on an installed base

Rather than being built, infrastructures emerge from pre-existing socio-technical relations; they leverage existing technologies with which users are already familiar (Star, 1999, p. 382). Previously, I discussed how research data repositories implement many of their user communities' standards and best practices. Here, I describe how data repositories use commonplace software technologies to provide users with the functionality they need and expect.

Many data repositories are built upon well-known relational databases or database platforms. For instance, platforms used by repositories listed in the Registry of Research Data Repositories include Comprehensive Knowledge Archive Network (CKAN), bepress' Digital Commons, Fedora, MySQL, and the Dataverse software used by all installations in the Dataverse Network. The codebases for these databases and platforms are well-supported within the software development community. As Plantin explains, "users benefit from the platform's standardized interface, while independent developers benefit from the platform's codebase, large audience, and marketing power" (Plantin et al., 2016, p. 298).

Figure 6 below shows the common software applications and platforms used by re3data repositories. The software platform (*r3d:softwareName*) for the majority of repositories was unknown (47%, $n = 1233$), followed by the catchall categories, other (20%, $n = 528$) and unspecified (17%, $n = 457$). The prevalence of other software infrastructures was: Dataverse software (4%, $n = 98$), DSpace (4%, $n = 98$), MySQL (3%, $n = 79$), CKAN (3%, $n = 74$), Fedora (1%, $n = 39$), EPrints (1%, $n = 34$), Nesstar (1%, $n = 21$), eSciDoc (0.1%, $n = 3$), DigitalCommons (0.1%, $n = 3$), dLibra (0.1%, $n = 2$), and Opus (0.1%, $n = 2$). Some repositories use more than one software system.

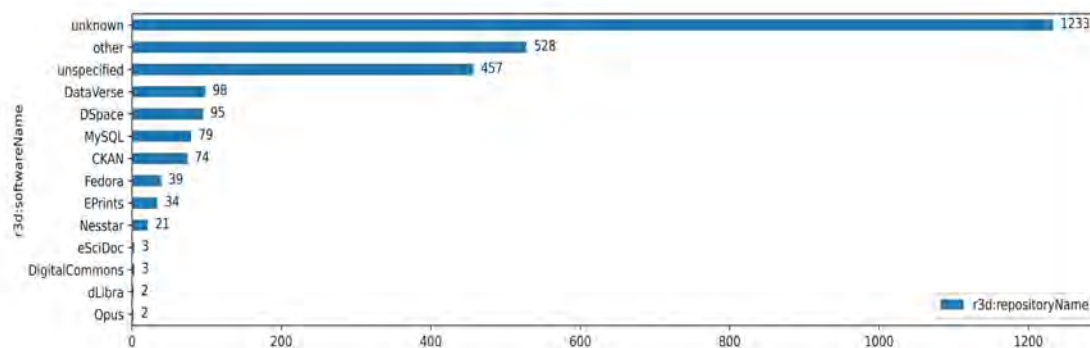


Figure 6. Software Used by Re3Data Repositories

Becomes visible upon breakdown

The seamless integration of infrastructures into users' practices means that users immediately notice when infrastructure fails. Previously invisible relations suddenly become visible as users cannot perform their tasks (Star, 1999, p. 382). What happens to users when a data repository experiences a service interruption or failure?

There are documented cases involving the accidental destruction of physical data holdings. For instance, the National Personnel Records Center (NPRC) Fire destroyed over 16 million Official Military Personnel Files (OMPF) in 1973 (Stender & Walker, 1974). The National Museum of Brazil in 2018 also was destroyed by fire (Escobar, 2018). In contrast, the research data management literature is silent about digital research data repositories' failures at comparable scales. One possible reason for this gap is that research data repositories serve a digital preservation function: they are engineered to be resilient and redundant. They follow digital preservation recommended practices, including storing data on multiple mediums, ensuring that digital copies are not co-located, and separating archival and access or use copies (Perkel, 2019). These practices, coupled with modern computer storage, backup, and networking technologies, help reduce the likelihood of a catastrophic, permanent loss of data. Furthermore, researchers' use of data repositories may not be frequent enough to have generated enough well-documented instances.

However, we can speculate about how scientific communities and future research might be affected by repository failure or closure. For example, in a repository failure event, researchers engaged in active research storing live research data are likely to be affected first; their data analyses may be interrupted, and their projects delayed. Data depositors will be unable to deposit and share their data with peer reviewers or others. The publishing workflows of journal editors and peer reviewers will also be interrupted. Finally, prospective data re-users may be unable to download a known dataset or locate other promising datasets.

The permanent closure of a repository also has significant consequences. We know that the availability of the underlying research data from its creators declines with the article's age; sharing data in a repository can help mitigate this problem (Pepe et al., 2014, Vines et al., 2014). In a sudden repository closure, researchers may not have kept copies of their past datasets that they can share upon request, and they may not be reachable via email. A planned repository closure would require rehousing all stored datasets, metadata, and supplementary materials to one or more different repositories. If individual researchers need to migrate their datasets, inevitably, some data will be lost. The discovery and access of datasets might also be affected by differences in features, such as metadata and file format options, between the source and destination repositories. Bulk migration of repository contents would entail significant coordination between repository owners, managers, and policymakers.

These thought experiments illustrate the degree to which research data repositories are part of research and publishing workflows. The temporary or permanent interruption of service for a repository will be disruptive for a diverse set of stakeholders across space and time, even if only a small amount of traffic traverses those pathways.

Is fixed in modular increments, not all at once, globally

The distributed and relational qualities of infrastructure mean that it cannot be repaired or upgraded simultaneously, everywhere. Instead, components of the infrastructure must be modified separately (Star, 1999, p. 382). I described the practice of dataset versioning earlier when discussing how repositories support conventions of practice. The versioning process illustrates how different participants in the research data repository ecosystem maintain, repair, and improve upon the individual research datasets, the metadata that describes them, and the repository platform itself to benefit users. In the context of software systems, versioning enables systems' developers and maintainers to make incremental improvements, such as bug fixes, feature enhancements, and enriched documentation, while

preserving access to prior versions. It also enables software users to decide when to upgrade components of their repository systems to a new version and possible if they should consider migrating to a different platform.

The developers who maintain the repository and its database also practice versioning at the platform level. Developers fix bugs, add new features, improve domain-specific metadata, APIs, persistent identifiers, and other features, and incrementally release them to production. Repositories with Open Source codebases, such as Dataverse, typically release new versions to software distribution sites like Github; repository managers then choose when to upgrade their installations.

DISCUSSION AND OPPORTUNITIES

Based upon my review of the literature and my evaluation of several re3data metadata fields, I have determined that research data repositories explicitly exhibit seven of the nine characteristics that Star (1999) attributes to infrastructures, as summarized in Table 1. The functionality of repositories' platforms was relevant for only three of the nine characteristics: 1) embodiment of standards, 2) built on an installed base, and 3) modularity. Perhaps research data repositories are more infrastructure-like than suggested by Plantin et al. (2018).

Research data repositories are embedded within knowledge workflows associated with different disciplines and institutions. However, my study results do not indicate how their degrees of embeddedness may vary. A follow-up study would be needed to assess this factor. Likewise, a quantitative analysis of the relationship of repository language, location, and type might provide more insight into the prevalence of English language user interfaces. My Python re3data metadata processing software can support these types of investigations.

Repository platforms aspire to transparency, or easy and seamless use, by leveraging familiar user interface and Web-based application features. Unfortunately, scientific data sharing is not ubiquitous across all disciplines, and research data is not yet fully integrated into scientific and scholarly publishing workflows. Therefore, from the researcher's perspective, data sharing practices, which vary by discipline, are neither intuitive nor effortless. This situation signals an opportunity for repository managers, funding agencies, and publishers. Better outreach and training for researchers and repository features such as automated or machine-assisted metadata creation could reduce barriers for data depositors. Increased user experience (UX) testing of repositories, leading to user interface and data curation workflow improvements, might also make data repositories more transparent to use.

Overall, the results suggest that we have several options for modeling research data repositories. Modeling repositories as either boundary objects or boundary networks enables us to explore how they span the social, cultural, and temporal borders between scientific communities and inform researchers' interactions and practices. Viewing data repositories as infrastructuralized platforms allows us to analyze how their technical affordances shape the links between repositories and the communities they serve. These two approaches support a holistic analysis of the form and function of research data repositories. They also serve as a bridge to the socio-technical literature allowing us to leverage insights about infrastructure design and workflows to improve research data repositories.

CONCLUSION

This study investigated the research question: *Which information infrastructure characteristics do research data repositories exhibit?* After reviewing the literature and exploring re3data metadata, I determined that research data repositories are socio-technical systems; we may model them as boundary objects, boundary infrastructures, or infrastructuralized platforms to support analyses of their roles in scientific and publishing workflows. The Python software I developed to explore how re3data repositories express infrastructure characteristics may be used to support more extensive quantitative studies of their metadata values.

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Predicting Surrogates' Health Information Seeking Behavior via Information Source and Information Evaluation

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ABSTRACT

This study investigates surrogates' health information sharing behavior through information sources and information evaluation. A lab-based experiment was conducted. Twenty-five participants read five scenarios, each with three preselected webpages from a government, a commercial, and an online forum source. Participants had to decide whether to share the information with an imaginary friend of theirs and provide rationales (an indication of information evaluation). Content analysis and mixed effects logistic regression models were performed. Government websites were recommended for sharing the most, followed by commercial and online forum sources. Criteria predicting participants' intention to share information were different for each information source. The content's usefulness and trustworthiness were two criteria predicting participants' intention to share commercial websites. Source's trustworthiness and individual relevant criterion were two significant predictors for government sources. Source's trustworthiness had negative effects on sharing information from online forums. 13.3% of the information evaluation involved using both positive and negative criteria.

KEYWORDS

Surrogates' health information seeking; Online health information; Information source; Information evaluation; Information sharing

INTRODUCTION

With the rapid development of online technologies, health consumers have become highly dependent on the Internet to access health information. However, due to structural inequalities and individual limitations, not everyone has the same resources and abilities to search health information online. For example, residents living in rural areas are less likely to benefit from health information technologies due to a slower development of online technology infrastructures compared to urban cities (Greenberg, Haney, Blake, Moser, & Hesse, 2018). Individuals with lower health literacy, educational level, income, and English-proficiency are less likely to engage in online information seeking (Estacio, Whittle, & Protheroe, 2019). Other demographic factors that have similar negative effects include age and health status. Older adults, who are more likely to suffer from severe illness, tend to be unfamiliar with online technologies (Berkowsky & Czaja, 2018). As these user groups face obstacles to search information online, one possible way to access online health information (OHI) is through surrogate information seekers (Abrahamson, Fisher, Turner, Durrance, & Turner, 2008).

Surrogate seekers are usually friends, family members, or caregivers who seek health information on behalf of others. This is a common behavior as around 66% of Internet users reported seeking information for others (Cutrona et al., 2015). For instance, rather than turning to their parents, college students are more likely to receive sexual health information shared by their close friends (Rittenour & Booth-Butterfield, 2006). Parents usually will search for vaccine information online for their children (Jones et al., 2012). Caregivers will use the Internet to seek and learn about health conditions that a family member is suffering from (Oh, 2015). The goal of surrogate seeking is to identify, transmit, and translate information (Abrahamson et al., 2008). This may eventually assist decision-making for others and bridge the information inequalities (Cutrona et al., 2015). Nevertheless, surrogate information seeking does not always lead to positive outcomes. Some people may use surrogate information seeking and information sharing to socially control their family members, which can negatively affect the relationship between the two parties (Brown & Veinot, 2020). Regardless outcomes, surrogate information seeking poses a challenge to surrogate seekers as they need to understand others' information needs and then seek information from various online sources, evaluate, and deliver relevant information. Most prior studies focused on information seeking for oneself (Sun, Zhang, Gwizdka, & Trace, 2019). Limited research has been conducted on surrogates' information seeking. This study intends to explore this behavior by investigating how information source and information evaluation affect

surrogate seekers' intention to share health information. The results of the study can assist in understanding surrogate seekers' evaluation process in sharing health information from different online sources.

RELATED WORK

Surrogate Health Information Seekers

Marginalized populations and patients suffering from serious health issues are usually the ones in need of surrogate information seekers. For instance, Ramirez, Leyva, Graff, Nelson, and Huerta (2015) studied Latinos as they were more likely to face obstacles such as lack of health insurance, lower health literacy, and English language ability. Other studies focused on cancer (Jones et al., 2012) or depression patients' need for surrogate information seekers as those patients needed social support and information from significant others (Reifegerste, Blech, & Dechant, 2020).

Most studies on surrogate health information seekers focused on surrogate seekers' demographic characteristics, namely, what types of people were more likely to seek health information for others. By comparing surrogate seekers and self-seekers, surrogate seekers were more likely to have good health status and have someone close with medical conditions or chronic illnesses (Oh, 2015; Sadasivam et al., 2013). Caregivers who helped others keep track of medications were also more likely to seek information for others (Noureldin, Murawski, Mason, Hyner, & Plake, 2017). Age, gender, and living status were also strong predictors as people younger in age, being female, and living with others tended to be surrogate seekers (Cutrona et al., 2015; Oh, 2015; Ramirez et al., 2015; Reifegerste, Bachl, & Baumann, 2017). Although these studies provided important knowledge of surrogate seekers' demographic characteristics, they were all survey studies. There have not been many studies focusing on surrogate seekers' actual online health information seeking behaviors.

Online Health Information Seeking

Health consumers are increasingly selecting the Internet as their primary information source. Seeking health information online has created many positive outcomes for the health consumers, such as making them feel engaged in their health decision making (Broom, 2005); improving patient-physician relationship through discussing online information (Tan & Goonawardene, 2017); and providing a sense of community support on social networking sites (SNSs) (Nambisan, 2011). Despite the positive outcomes of seeking health information online, the quality of online information has become concerning (Sun et al., 2019). The technical requirements to generate information are relatively low in the era of Web 2.0. Laypeople can easily share their thoughts and provide subjective information on SNSs. Different information sources also put forward information with different purposes and agendas. As a result, it is essential for Internet users to learn how to select information source and evaluate information. These two actions are essential processes in health information seeking.

Y. Zhang (2012) adapted Savolainen's (2006) model and proposed a health information seeking process involving four components: recognizing information needs, identifying information sources, evaluating information, and interpreting information. Information needs occur whenever a user's knowledge cannot solve a problem or task at hand. To fill the knowledge gap, a user must first identify a source to acquire information; then evaluate the relevance and credibility of information (Metzger, 2007; Saracevic, 1975); and finally determine how to use the information to solve a problem. The whole process will be repeated or modified until the information need is met.

One of the main differences between surrogate seekers and self-seekers is the origin of information need. Self-seekers' information needs are usually intrinsically motivated to satisfy their own knowledge gap. Surrogate seekers' information needs are mostly extrinsically motivated, having to make additional efforts to understand and solve others' information needs. Based on this difference, surrogate seekers may differ in their source selection and information evaluation behaviors (Y. Zhang, 2014).

Health Information Source Selection

The selection of health information sources is influenced by both individual and information characteristics (Chi, He, & Jeng, 2020; Sbaffi & Zhao, 2020; Y. Zhang, 2014). Y. Zhang (2014) interviewed participants about their real-life health information seeking experiences and categorized knowledge status, personal preferences, socioeconomic status, and the intention to search for information as four main individual factors affecting source selection. Health status was also found to be a significant predictor. Healthier consumers were less likely to choose SNSs (Sbaffi & Zhao, 2020). Health-specific pages were visited more often for severe health conditions, but search engines were visited the most for mild health conditions (Chi et al., 2020). As for information characteristics, the source's credibility, usefulness, familiarity, accessibility, and recommendation from others could affect source selection (Sbaffi & Zhao, 2020; Y. Zhang, 2014).

Online technologies have enabled consumers to seek health information through various sources, such as search engines, government websites, commercial websites, SNSs, and online forums (Sun et al., 2019; Y. Zhang, 2012). Information from government websites is most likely to be evaluated as having higher levels of credibility (Choi & Stvilia, 2015; Sun et al., 2019). Nevertheless, a recent study found that college students went to commercial sources

(75%) the most for OHI, followed by government and educational websites (Chi et al., 2020). Like self-seekers, surrogate seekers also gather and filter information from various sources, including offline and online sources (Cutrona et al., 2015; Reifegerste et al., 2017). Some offline sources include radio, family and friends, and healthcare providers. In general, surrogate seekers still seek information online the most (Noureldin et al., 2017). Furthermore, surrogate seekers are more likely than self-seekers to engage in health activities involving user-generated content (UGC), such as communicating with others, participating in an online support group, and sharing medical information via SNSs (Cutrona et al., 2015). Given these findings, in this study, we focused on three information sources: government websites, commercial websites, and online forums.

Information Evaluation

Credibility evaluation is important for online health information seeking as believing in and using misinformation may lead to detrimental health consequences. The concept of website credibility originated from source credibility in interpersonal communication (Hovland, Janis, & Kelley, 1953), where the focus is on individuals' trustworthiness and expertise. As websites started to become an important information source, new frameworks were proposed to conceptualize website credibility. The Prominence-Interpretation Theory (Fogg, 2003) posited that a user needs first to notice website indicators and then applies criteria to make credibility assessments. The dual processing model (Metzger, 2007) explained that users with higher ability and motivation would be more rigorous in evaluating information. Otherwise, users will evaluate information based on heuristic judgments. Hilligoss and Rieh (2008) proposed a unifying framework that involved the construct, heuristic, and interaction levels of credibility judgments.

Choi and Stvilia (2015) developed a two-dimensional framework of credibility assessment. The first dimension categorized website elements into source, content, and design. The second dimension consisted of credibility criteria: trustworthiness and expertise. By cross-mapping the indicators and criteria, six categories were produced to describe webpage credibility evaluation. Kakol, Nielek, and Wierzbicki (2017) analyzed crowdsourcing workers' comments on 5532 webpages and came up with 25 criteria, which were organized into six categories: type of content, commercial character, authorship, webpage design, content quality, and webpage verification. Choi (2020) conducted semi-structured interviews with 21 older adults about their credibility assessment of OHI and found that source criteria were used the most, followed by content- and design-related criteria. Sun et al. (2019) reviewed studies on consumers' credibility evaluation of OHI and identified 25 criteria. The criteria were used to evaluate websites' source, content, and design-related elements. Based on how the criteria were used, they were labeled as positive or negative.

Identifying positive and negative aspects of criteria could enable building more effective information relevance systems (Greisdorf, 2003). Hence, past studies analyzed the use of positive and negative criteria in information evaluation. Greisdorf (2003) identified five criteria used to evaluate an information retrieval system interaction. The results showed that users employed both positive and negative criteria to evaluate partially relevant information. (Maglaughlin & Sonnenwald, 2002) found that participants applied 29 criteria to judge the relevance of documents. 24% of the judgments used only positive criteria, 10% used only negative criteria, and in 66% cases participants used both positive and negative criteria. As for studies related to health information evaluation, Sbaffi and Rowley (2017) found that the design and content elements of a webpage can have a positive or negative impact on forming trust.

Information evaluation tends to vary by information sources. In general, information from government websites is viewed as having higher levels of trustworthiness and expertise (Freeman & Spyridakis, 2004). Nevertheless, some consumers suspect that government websites have an agenda and are biased (Williams, Nicholas, & Huntington, 2003). Consumers tend to perceive commercial websites as less credible because of their for-profit nature (Choi & Stvilia, 2015); however, some users view commercial sites as a familiar source that provide comprehensive information (Sun et al., 2019). Consumers also have mixed opinions toward UGC. For some, UGC is viewed as a valuable source for first-hand experiences and social support from similar others (R. Zhang, 2017). For others, information on UGC websites is considered lacking objectivity and expertise due to its anonymity (Sun et al., 2019).

As for surrogate seekers, information evaluation is even more important as they have to understand and transmit information accurately. Cutrona et al. (2015) reported that one-third of surrogate seekers felt frustrated that it took them a lot of efforts to find needed information. 56% of the surrogate seekers were even concerned about the information quality they found. Despite these findings, there is a lack of research on how evaluating health information from different information sources can affect surrogate seekers' intention to share health information.

CONCEPTUAL FRAMEWORK

We adapted Savolainen's (2006) model on information seeking process as the theoretical foundation of the study. The model has been used to guide consumer health information seeking behavior research (Y. Zhang, 2012). Given that surrogate seekers' information needs are externally motivated by others, we focused on the latter three stages in the model: information source, information evaluation, and information use. Specifically, we aim to understand how

information sources and information evaluation affect surrogate seekers' information use. In this study, information use is viewed as a cognitive behavior: the intention to share health information. Figure 1 shows the conceptual framework used for this study.

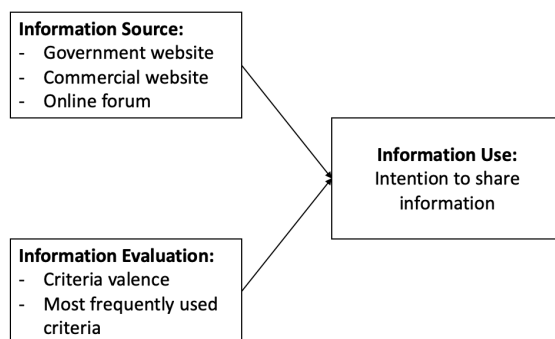


Figure 1. Conceptual Framework

For information sources, we selected commercial websites and government websites because they were visited the most by consumers (Chi et al., 2020). Furthermore, research on surrogate seekers revealed that they were more likely to engage in UGC, especially online support communities (Cutrona et al., 2015). Hence, we included online forums as a representative source of UGC. As past studies concluded (Freeman & Spyridakis, 2004), government websites are generally viewed as more credible than profit-oriented sources or UGC. We expected that surrogate seekers would also have similar perceptions of different health information sources. Thus, we proposed our research hypothesis as:

H1: Surrogate seekers are more willing to share government websites over commercial websites and online forums.

As for information evaluation, we chose to examine what criteria were used by surrogate seekers to evaluate OHI. In this study, criteria refer to rules people apply to an information element to evaluate its value or worth (Sun et al., 2019). Past research showed that criteria can be applied positively and negatively to evaluate information. It is expected that when users use all positive or negative criteria, they are more likely to accept or reject a webpage. Nevertheless, there is a lack of understanding of consumers' information use when they use a mix of positive and negative criteria to evaluate information. It is also known that not all criteria are used equally when evaluating information. For instance, trustworthiness, expertise, and objectivity were some of the most mentioned criteria in past research on OHI credibility evaluation (Sun et al., 2019). Moreover, since consumers have varying opinions toward different information sources, they may use criteria differently to evaluate information from different sources. As most literature on health consumers' information behaviors focused on self-seekers, there are not enough studies on surrogate seekers to assist in building hypotheses. Thus, we proposed three exploratory research questions to examine the relationship between information evaluation and surrogate seekers' information use:

1. What is the relationship between criteria valence and surrogate seekers' intention to share information?
2. What are the most frequently used criteria that influence surrogate seekers' intention to share information?
3. What is the relationship between the most frequently used criteria and surrogate seekers' intention to share information from different information sources?

METHOD

We conducted an in-lab study to answer the proposed research hypothesis and questions. The in-lab study was selected for a better comparison among the three information sources. It also allowed us to use an eye-tracker to capture participants' eye movement (results not reported in this paper).

Participants

Twenty-five participants (15 females; mean = 23.8 years; SD = 5.50) were recruited. A recent survey found that 32.2% and 32.5% of the respondents between 18-34 and 35-49 years old had searched online health information for others, which made them more likely to become surrogate seekers than those who were older than 50 (26.6% or less) (Cutrona et al., 2015). As a result, we recruited participants who were between 18 to 49 years old. For participants' educational level, 80% were college students or college graduates, 12% had graduate degrees, and 8% were high school graduates. In terms of ethnicity, 52% were Caucasian, 28% Hispanic, 12% Asian, 4% African American, and 4% multiple ethnicities. A screening survey was used to ensure that participants had experience searching for health information online and rated task familiarity below medium on a five-point Likert scale.

Tasks

Five task topics were selected to represent different health topics, including vaccine, side effects, treatment, and monitoring symptoms (an example is shown in Table 1). To realistically situate the search, all tasks were simulated tasks (Borlund & Ingwersen, 1997). Each task depicted a scenario in which participants need to decide whether to share three webpages with a friend facing a health problem. Webpages were preselected to ensure that participants were able to view and evaluate information from the three types of information sources: government, commercial, and online forum. The preselected websites were categorized into the three information sources based on top-level domain in the URL (.gov and .com) and the nature of the website (for-profit or online discussion). All webpages were selected from Google's search engine result pages (SERPs) returned by searching keywords relevant to the tasks. The researchers examined the retrieved websites from SERPs and agreed that the 15 preselected websites' content and design were representative of the three source types.

Topic	Scenario Description	Source
Zoloft	Imagine that one of your good friends was recently diagnosed with depression. He told you that his doctor prescribed him Zoloft oral. You are concerned about your friend and want to find out what potential side effects this medicine may cause. You conducted an online search and these three webpages are among the pages that show up in the search results. Now you want to determine whether you want to share any or all of the pages with your friend.	Government: DailyMed Commercial: RxList Online forum: Everyday Health

Table 1. An Example of the Search Tasks

Procedure

The study was conducted in a lab setting. Participants first received an instructional sheet that explains the experiment process. Then they performed a training task (one scenario with one commercial webpage) that guided them through the experiment's procedure. After the training task, they performed five tasks. Each task included three webpages each from a different information source. A Graeco-Latin Square design that considered the order of the tasks and webpages was used to minimize order effects (Kelly, 2009). When participants finished viewing a webpage, they were presented with a Qualtrics survey. The first part of the survey asked participants to select "yes" or "no" to indicate their intention to share the webpage with their imaginary friend. The second part of the survey was an open-ended question asking participants to provide reasons for their decision. The reasons were an indication of information evaluation. The overall session lasted one-and-a-half hours. Participants received incentives after completing the experiment.

Data Analyses

Content analysis was conducted on responses to the open-ended question. The analysis focused on the criteria participants used to evaluate webpages. A coding schema created from a systematic literature review (Sun et al., 2019) was applied to facilitate data analysis. The coding schema includes four main types of criteria: source, content, design, and individual-specific criteria. Source criteria are used to evaluate elements related to the identity or characteristics of the information container. Content criteria refer to the evaluation of information features presented on the webpage. Design criteria refer to the evaluation of elements that facilitate the interaction, navigation, and security of a website. Individual-specific criteria refer to the evaluation of information relevance to one's information need (prompted by the task scenarios) and personal belief. Each criterion was labeled as positive or negative, depending on whether it was used to support or negate information acceptance. New criteria were allowed to emerge from the data. MAXQDA 12 (VERBI Software, 2019) was used to facilitate the analysis. YC coded all the transcripts. YZ verified all the codes. Discrepancies were resolved by discussion between the two coders. JG was brought in when disagreements remained. The final codes were agreed upon by all three researchers.

Since intention to share information was a dichotomous decision (yes or no), mixed effects logistic regression was conducted to analyze the effects of information source and criteria valence on information sharing behavior. Tasks and participants were treated as random effects. Separate mixed effects logistic models were also performed for each information source to investigate how the most used criteria affected intention to share information. Data analyses were performed using R (version 3.5.1) (R Development Core Team, 2018)

RESULTS

Information Sources' Effect on Intention to Share Information

The research hypothesis proposed that surrogate seekers are more willing to share government websites over commercial websites and online forums. The results show that the sharing rate is highest for government websites (76.8%), followed by commercial websites (57.6%) and online forums (26.4%). Table 2 presents the results of the mixed effects logistic regression model. Commercial websites served as the baseline in the model. The odds ratio of

accepting a government website over a commercial website is 2.60. The odds of accepting an online forum over a commercial website is 0.24. A Tukey test was performed, and the result showed that the acceptance rate between government websites and online forums is significantly different ($p < .0001$).

	Est.	Odd Ratio	SD	Z value	P value
Intercept	0.33	1.39	0.27	1.21	0.23
Government	0.95	2.60	0.29	3.30	< 0.001***
Forum	-1.43	0.24	0.29	-5.00	< 0.001***

**Table 2. Mixed effects logistic regression model:
Information source predicting the intention to share information**

Criteria Valence's Effect on Intention to Share Information

The criteria that participants used to evaluate the 15 webpages are shown in Table 3. The definition of each criterion is from the systematic literature review article (Sun et al., 2019). Source criteria were used to evaluate elements on webpages related to the identity or characteristics of the information source, which accounted for 16.28% of all criteria used. Content criteria were used to assess features of the information on the webpage, such as substance, authorship, advertisement, and references. Content criteria (12 in total) were used the most (64.16%). Design criteria, which were used the least (4.24%), were applied to evaluate elements that facilitate the readability, navigability, aesthetics, and accessibility of a website. Individual specific criteria were individual characteristics that could influence credibility evaluation, which included relevance and personal beliefs (15.32%).

Based on participants' use of positive and negative criteria to evaluate each webpage, criteria valence was categorized as positive, negative, or mixed. Positive valence indicates that participants only used positive criteria and negative valence means only negative criteria were used. Mixed valence means participants used both positive and negative criteria in their evaluation. For instance, a participant decided to share a commercial webpage based on the rationale, "The information was written by an educated author, the article includes facts from government agencies among other credible resources. Although it only shows one side of the argument, it is an educated opinion based on facts (P21)". The participants used three positive criteria (Content-Expertise-Expert-Pos.; Content-Objectivity-Objective-Pos.; Source-Trustworthiness-Trustworthy-Pos.) and a negative criterion (Content-Balance-One-Sided-Neg.) to evaluate the webpage. Despite recognizing that the webpage only presented one-sided information, the participant still decided to share it because of other positive characteristics of the information.

Criteria Type	Criteria		Count	%	Sum
Source	Trustworthiness	Trustworthy	pos.	59	8.07
		Untrustworthy	neg.	52	7.11
	Transparency	Transparent	pos.	8	1.09
Content	Objectivity	Subjective	pos.	23	3.15
		Subjective	neg.	65	8.89
		Objective	pos.	31	4.24
	Usefulness	Useful	pos.	67	9.17
		Not Useful	neg.	31	4.24
	Trustworthiness	Trustworthy	pos.	47	6.43
		Untrustworthy	neg.	48	6.57
	Balance	Balanced	pos.	23	3.15
		One-sided	neg.	10	1.37
	Specificity	Specific	pos.	16	2.19
		Too specific	neg.	8	1.09
		General	pos.	5	0.68
		Too general	neg.	3	0.41
	Expertise	Expert	pos.	11	1.50
		Non-experts	neg.	15	2.05
	Quantity	Much information	pos.	10	1.37
		Lengthy	neg.	7	0.96
		Short information	pos.	4	0.55
	Completeness	Complete	pos.	10	1.37
		Incomplete	neg.	4	0.55
	Safety	Safe info.	pos.	2	0.27
		Unsafe info.	neg.	11	1.50
	Understandability	Easy to understand	pos.	8	1.09
		Hard to understand	neg.	4	0.55
	Currency	Up to date	pos.	2	0.27
		Outdated	neg.	2	0.27
	Learnability	Learnable	pos.	2	0.27
Design	Readability	Easy to read	pos.	15	2.05
		Hard to read	neg.	4	0.55
	Navigability	Easy to navigate	pos.	4	0.55
		Hard to navigate	neg.	1	0.14
	Aesthetics	Negative appeal	neg.	3	0.41
		Positive appeal	pos.	1	0.14
	Accessibility	Accessible	pos.	3	0.41
Individual specific	Relevance	Relevant	pos.	45	6.16
		Irrelevant	neg.	51	6.98
	Personal Belief	Against bias	neg.	6	0.82
		Information should be shared by professionals	neg.	6	0.82
		Lack expert knowledge	neg.	2	0.27
		Support bias	pos.	2	0.27

Table 3. Criteria Used to Evaluate Webpages

Table 4 presents the distribution of criteria valence and intention to share information. There were 375 records of criteria valence on the webpage level given that 25 participants evaluated 15 webpages. 46.6% of the evaluations involved only using positive criteria, 40% involved only using negative criteria, and 13.3% involved using mixed-valence criteria. When using positive criteria to evaluate webpages, the webpages' acceptance rate was 99%; when using negative criteria to evaluate webpages, the webpages' acceptance rate was only 1%. There was a 52% chance that participants would accept a webpage when using mixed criteria.

The mixed effects logistic regression model is presented in Table 5. Negative criterion is served as the baseline. The odds ratio of accepting a webpage by using mixed criteria over negative criteria is 79.83. The odds ratio of accepting a webpage by using positive criteria over negative criteria is 6374.11. The result from a Tukey test shows that acceptance rates differ significantly between using mixed and positive criteria ($p < .0001$).

Valence	Accept	Reject	Total (%)	Acceptance rate
Negative	2	148	150 (40%)	1%
Mixed	26	24	50 (13.3%)	52%
Positive	173	2	175 (46.6%)	99%

Table 4. Distribution of Criteria Valence and Information Sharing Decision

	Est.	Odd Ratio	SD	Z value	P value
Intercept	-4.30	0.01	0.71	-6.046	< 0.001***
Mixed	4.38	79.83	0.76	5.723	< 0.001***
Positive	8.76	6374.11	1.01	8.710	< 0.001***

**Table 5. Mixed effects logistic Regression Model:
Criteria Valence Predicting the Intention to Share Information**

Most Frequently Used Criteria

The most frequently used criteria were determined by adding up the usage percentage for each criterion (for both valences) and then ranking all criteria. The top five criteria used were: “Content-Objectivity” (16.28%), “Source-Trustworthiness” (15.18%), “Content-Usefulness” (13.41%), “Individual Specific-Relevance” (13.14%), and “Content-Trustworthiness” (13%). These criteria accounted for 71.01% of the overall criteria usage. The usage percentages for the rest of the criteria were all less than 5%. The sixth most used criterion “Content-Balance” only accounted for 4.52% of the total usage. As a result, we only identified and considered the top five most used criteria.

The Effect of the Most Frequently Used Criteria on Intention to Share Information

A mixed effects logistic regression model was performed for each information source to investigate the relationships between the top five most frequently used criteria and participants’ intention to share information. The predictor variables were the top five criteria. Each criterion was labeled as 1 if participants used the criterion in information evaluation and 0 if participants did not use the criterion. The outcome variable was the intention to share information, either yes or no. Due to multiple predictor variables in the model, a Bonferroni correction was used to adjust the alpha value at $p = 0.01$ (.05 divided by 5). Table 6 shows the three mixed effects logistic regression models.

Source	Contrast	Est.	O.R.	SD	Z value	P value
<i>Commercial</i>	Intercept	0.15	1.16	0.37	0.41	0.68
	C-Objectivity	-0.37	0.69	0.53	-0.71	0.48
	S-Trustworthiness	-0.17	0.84	0.52	-0.34	0.74
	C-Usefulness	1.30	3.67	0.49	2.64	0.008*
	I-Relevance	0.82	2.27	0.44	1.89	0.06
	C-Trustworthiness	-1.40	0.25	0.48	-2.95	0.003*
<i>Government</i>	Intercept	1.74	5.67	0.60	2.89	0.004*
	C-Objectivity	0.37	1.44	0.98	0.38	0.71
	S-Trustworthiness	3.09	22.0	1.11	2.79	0.005*
	C-Usefulness	-1.45	0.23	0.65	-2.24	0.025
	I-Relevance	-2.11	0.12	0.74	-2.86	0.004*
	C-Trustworthiness	0.46	1.59	0.60	0.76	0.45
<i>Online Forums</i>	Intercept	-0.91	0.40	0.82	-1.11	0.26
	C-Objectivity	0.79	2.20	0.64	1.23	0.22
	S-Trustworthiness	-3.56	0.03	1.15	-3.11	0.001**
	C-Usefulness	1.14	3.13	0.78	1.47	0.14
	I-Relevance	-1.82	0.16	0.87	-2.09	0.03
	C-Trustworthiness	-2.06	0.13	0.98	-2.10	0.03

Bonferroni correction was applied thus * p-value < 0.01, ** p-value < 0.002

**Table 6. Mixed effects logistic Regression Models:
Most Used Criteria Predicting the Intention to Share Information**

For commercial websites, “Content-Usefulness” and “Content-Trustworthiness” were two criteria that affected intention to share information. By using the criteria “Content-Usefulness,” the odds ratio for accepting a commercial source was 3.67 while holding other predictors constant. By using the criteria “Content-Trustworthiness,” the odds ratio for accepting a commercial source was 0.25 while holding other predictors constant. For government website, the odds ratio for accepting a government source was 22.0 when using the criteria “Source-Trustworthiness.” The odds ratio for accepting a government source was 0.12 when using the

criterion “Individual Specific-Relevance.” For online forums, the odds ratio for accepting online forums was 0.03 when using the criterion “Source-Trustworthiness” while holding other predictors constant.

DISCUSSION

Our study adapted Savolainen’s (2006) model of information seeking process and proposed a research framework to investigate how information source and information evaluation affect surrogate seekers’ information use (intention to share information). As past studies on surrogates’ health information seeking were largely based on survey data and focused on the demographic difference between surrogate seekers and self-seekers (Cutrona et al., 2015; Oh, 2015; Ramirez et al., 2015; Reifegerste et al., 2017), our study contributes to the literature by investigating surrogate seekers’ information seeking behavior in-depth in a lab setting. The findings show that information source and information evaluation behavior both had significant effects on information sharing.

In terms of information sources, participants were most likely to share government websites. This may be related to how health consumers perceive the credibility of different information sources. Government websites are generally viewed as a credible source for health information as their goal is to have experts provide accurate information (Choi & Stvilia, 2015; Freeman & Spyridakis, 2004), which explains why three-fourth of the government webpages were shared. This explanation is also supported by the mixed effects logistic model showing that participants were more likely to share government webpages when they used the criterion “Source-Trustworthiness.” When evaluating government webpages, if participants used “Individual Specific-Relevance,” they were less likely to share the information. This finding indicates that, despite being viewed as a trustworthy source, government websites may not always provide relevant information to meet surrogate seekers’ specific information needs. For example, a couple of participants stated that their friend, who is a patient needing more specific information, may already know the basic information provided on the government websites. When viewing information about Zolofit on DailyMed (a website operated by the U.S. National Library of Medicine), one participant thought the information did not provide additional relevant information by writing, “while reading the information, it really just looks like someone took a package of Zolofit and just wrote out everything on the box. It doesn't really tell anything necessary that you wouldn't get from reading the box (P20).”

When searching information for others, surrogate seekers may be more cautious in selecting and sharing information as the information is intended to serve others’ needs and health problems. This is especially prominent when participants were deciding to share commercial webpages. Surrogate seekers may feel responsible for others’ health outcomes if others were to believe and use the shared health information. This awareness of one’s responsibility as a surrogate seeker is shown with the use of the criteria “Content-Safety” and “Individual Specific-Personal Belief-Information Should be Shared by Professionals”. For example, one participant explained his/her rejection to share a commercial webpage by stating, “I feel this type of info would be shared to him/her by the doctor beforehand (P13)”. As for the effect of information evaluation on intentions to share commercial information, the results showed that participants were more likely to share information when they used “Content-Usefulness” but less likely to share information when they used “Content-Trustworthiness.” This result aligns with past studies showing that consumers tend to have mixed opinions toward commercial websites: some found the information less credible because of the appearance of ads and the websites’ for-profit nature (Choi & Stvilia, 2015) while others thought the provided information was comprehensive and useful (Sun et al., 2019). This also reflected why participants intended to share more than half of the commercial webpages with their friends despite the source.

As for online forums, participants only shared 26.4% of the webpages. Although Cutrona et al. (2015) found that surrogate-seekers were more likely to seek UGC, the result was drawn from comparing surrogate seekers to self-seekers. Among 1,461 surrogate seekers, 6.8% reported participating in online support groups, whereas 2.9% of 710 self-seekers were engaged in online support groups. The results of the mixed effects logistic model showed that participants were less likely to share information from online forums when they valued “Source-Trustworthiness.” Consistent with previous studies (Sun et al., 2019; Zhang, 2014), many participants rejected to share information from forums for personal preferences. For instance, a participant stated, “I like to stay away from medical forums (P17)”. Some participants only left a brief comment such as “from a forum” or just a word “forum” as the reason to not share the webpage. Some participants provided a more specific explanation, stating that information on forums was a collection of personal and subjective experiences and the information reliability is unclear.

There was also direct effect of information evaluation on information sharing. Among the top five most used criteria to evaluate information, four of them were able to predict participants’ intention to share information from various sources. Although “Content-Objectivity” was not a significant predictor, it was the most used criterion (16.28%) to evaluate information. This indicates that participants valued information objectivity equally among all three information sources. The main difference is whether the criterion was used positively or negatively to evaluate

information. As shown in Table 3, subjective content is mostly viewed negatively, while objective content is always viewed positively. Only a few participants appreciated subjective content from online forums as they thought others' experiences can be useful as a reference. For instance, one participant thought personalized information can be shared with doctors for further discussion, "I think reading people's personal experiences on medication is a good idea just to see the general consensus or people's thoughts and then you can discuss them with a doctor or something (P3)".

One main contribution of the study is to shed light on how criteria valence affects surrogate seekers' intention to share information. Not surprisingly, participants were willing to share information with others when using all positive criteria, vice versa. A split of 50/50 chance of sharing information was found when information evaluation involved using both positive and negative criteria. This finding indicates that information evaluation is not a black and white decision-making process. Consumers weighed each criterion differently and then decided how to use the information.

There are limitations to the study. First, we provided participants with preselected scenarios and webpages to allow us to examine the effect of information sources and evaluation behavior on their intentions to share information. Participants' behavior may be different if they were to search information freely with real information needs in natural settings. Second, the participants' age mostly was between 18-34. As Cutrona et al. (2015) pointed out, younger adults (18-34) and middle-aged adults (35-49) were both more likely to become surrogate seekers. Future research should increase the variance in age and focus more on middle-aged adults. Lastly, the sample size was relatively small, which may limit the statistical power and generalization. Nonetheless, each participant performed five search tasks and viewed three webpages per task, leading to 15 information evaluations. This approach yields effectively more data points and compensates for the small sample size. If the sample size were to be larger, the effect of some predictors (e.g. content-usefulness for government source and content-trustworthiness for online forums) might become more prominent than their currently found marginal significance.

CONCLUSION

This study examined the influence of information source and information evaluation behavior on surrogate health information seekers' intention to share the information found online. As past studies mostly relied on survey to understand surrogate seekers' demographic characteristics, our study focused on surrogate health information seekers' actual information search behaviors in a lab setting. We found that participants were more likely to share information from government websites, followed by commercial websites and online forums. Moreover, intention to share different information sources could be predicted by the use of different criteria. Although the content's objectivity was not a significant predictor, it was still the most used criteria to evaluate information across different information sources.

There are some practical implications of our study. The findings should help information providers to improve their websites by enhancing the information characteristics that are negatively affecting surrogate seekers' evaluation of information from different sources. For instance, due to online forums' nature of allowing laypeople to share information online freely and health consumers' concern of the source's trustworthiness, online forums should provide warning messages when health consumers receive the information shared from the sites. Another implication of the finding is to facilitate the development of educational programs as currently there is a lack of studies on understanding surrogate seekers' OHI evaluation behaviors. Health professionals may benefit from learning what are the important criteria used by surrogate seekers to evaluate information from different sources.

ACKNOWLEDGMENTS

This project was funded, in part, by the Portuguese Foundation for Science and Technology and the Digital Media Program at UT-Austin.

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Research Trends from a Decade (2011-2020) for Information Literacy in Higher Education: Content and Bibliometric Mapping Analysis

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ABSTRACT

New terms and theoretical concepts in information literacy have emerged over the last decade, and these have led to revisions in the standards for information literacy. In order to determine whether information literacy research has reflected these trends, we collected SSCI literature for the 2011 to 2020 period related to information literacy in higher education (ILHE) and conducted analysis using bibliographic mapping and content analysis. Our research found that the volume of research on ILHE has increased in the last five years as compared to the five years before that, and that keywords related to literacy (such as “digital literacy” and “multiliteracies”) have been getting a great deal of discussion. After the Framework for Information Literacy for Higher Education (FILHE) was announced, curriculum design research based on the Information Literacy Competency Standards for Higher Education (ILCSHE) continued to outnumber that done based on the Framework.

KEYWORDS

Information Literacy Competency Standards for Higher Education; Framework for Information Literacy for Higher Education; Information Literacy, Higher education; Bibliometric mapping analysis.

INTRODUCTION

The term “Information Literacy” was coined by Zurkowski in the 1974 report to the National Commission on Libraries and Information Science. The Final Report of the American Library Association Presidential Committee on Information Literacy (1989), in which IL was defined as “To be information literate, a person must be able to recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information.” (p.1). However, with the development of technology and the diversification of media, new terms related to information literacy have continued to appear. In 1994, McClure stated that information literacy is the ability to use information to resolve a problem; and as types of information are hugely varied, so, too, are the ways of putting it to use and the abilities emphasized in that usage. McClure further divided information literacy into four classes of skills: “Traditional Literacy” (including reading, writing, and calculation abilities); “Media Literacy” (including the ability to understand non-printed media); “Computer literacy” (including the ability to use computer software); and “Network literacy” (including the ability to apply and evaluate network resources). Later, as a result of technological development, new literacy requirements arose, and so the term “new literacy” arose with them. New literacies are requirements that have developed in response to the rise of the internet and other information technologies such as text messages, wikis, blogs, social media, video platforms, music platforms, and emails. The vast majority of the combination of text, audio, and video; these digital technologies have changed and expanded our abilities to interact. As a result, the usefulness of the new literacies lies in the abilities to understand and learn from reading online. But these skills don’t just require the ability to “read”, but also to browse, to find online information, critically evaluate and synthesize (Miners and Pascopella, 2007). In 1996, the New London Group proposed the term “multiliteracies” (Cope and Kalantzis, 2009). “Multiliteracies” refer to being able to engage in textual literacy and expression in non-paper media, including identifying, explaining, creating, and interacting with meaning through

visual, oral, gestural, musical, and textual means. Above and beyond the linguistic concept of “literacy”, multiliteracy also includes understanding of social, economic, and wider cultural factors; these factors create frameworks for interaction. The meaning of “multiliteracy”, viewed from a linguistic perspective, has two major aspects. The first major aspect is making differentiated meaning within different cultural, social, or unique contexts (Cope and Kalantzis), 2020. This implies that reading and writing education that focuses solely on standard national language forms is insufficient; on the contrary, modern interaction and expression of meaning increasingly requires learners to be able to clarify differentiated meanings in different linguistic contexts. These differences may arise as a result of any factors including culture, gender, life experience, topic, society, subject field, etc.; every interaction in meaning is to a certain extent a multicultural one. The second major aspect is that, as a result of new information and communications technology (ICT) and media characteristics, methods for producing meaning and presenting information are growing by the day; modes of meaning in written language have an effect on oral, visual, aural, gestural, tactile, and spatial modes of meaning (Cope and Kalantzis, 2020). “Metaliteracy” is a new literacy mode proposed by Mackey and Jacobson. “Metacognition” is recognition and understanding through the self-reflection process; the concept focuses on how people learn and deal with information and takes into consideration people’s understanding of how they learn. Thus, “metaliteracy” refers to students’ reflection on their own literacy abilities. As defined by Mackey and Jacobson, metaliteracy is a term developed to understand how digital citizens reflect on their literacy needs within affective, behavioral, cognitive, and metacognitive domains in a global internet culture (Mackey and Jacobson, 2014).

Within the literature 2010-2019 on information literacy, the most notable thing is the changes in orientation regarding information literacy theory. The ACRL published the ILCSHE in 2000, but later exploration and discussion of information literacy theory and concepts caused the ACRL to revise the ILCSHE. Prior to the revisions, many academic libraries had published many learning outcomes, tools, and resources for information literacy education. However, in a rapidly changing environment, the information ecosystems for everyday life and work are dynamic and uncertain; many scholars believed that the focus of information literacy should be placed on basic concepts for these ecosystems, and not solely within abilities related to information retrieval. The FILHE was announced in 2015, and formally took effect January 11, 2016. The Framework uses metaliteracy as its core concept. Metaliteracy refers to a set of comprehensive, general skills that students need to be information consumers and successfully participate in collaborative fields; it opens a completely new vision for information literacy. Metaliteracy requires students to participate in information ecosystems in terms of behaviors, emotions, cognition, and metacognition. Based on the concept of metaliteracy, the Framework puts special emphasis on metacognition, also called critical self-reflection, because this becomes even more critical in a rapidly changing ecosystem (ACRL, 2015). In addition, based on the basis of interconnectedness between core concepts, the Framework also places a great deal of import on threshold concepts in school subjects; and states that in a complex information ecosystem, students must play an important role in creating new knowledge, understanding the contours and dynamics of the information world, and using information and data in a way that complies with academic ethics. Teachers have a responsibility to design curriculum that allow students to participate in and invest in academic information and academic core concepts; librarians have the responsibility to identify how they can extend the core concepts of what students have learned in related academic fields, to build cohesive new information literacy curricula, and to collaborate more broadly with teachers.

As technology has continued to develop, so, too, new terms in information literacy continued to arise. Rapid changes in society and culture affect conceptual orientations for information literacy and have led to changes in the standards for information literacy. These, then, are the major developments in information literacy over the past decade. However, research studies related to information literacy reflected these changes over the past decade. Diachronic bibliographic mapping allows viewing the full picture for academic development over a specific period; visualization tools allow us to use a connection map and display the major contents of that academic domain. Thus, this study used the literature related to ILHE from 2011 to 2020, using bibliographic mapping and the VOSviewer visualization tool to perform analysis and gain an understanding of orientations and developmental trends in information literacy research over the past decade.

METHOD

Article selection process

This study collected data from the Web of Science’s SSCI (Social Sciences Citation Index) database, with keywords related to “information literacy in higher education” (ILHE) and publication dates from Jan 1, 2011 to December 31, 2020. This yielded a total of 1056 articles. Then, we screened out non-article publications, leaving 916 articles. We then performed manual examination of all article contents (including titles and abstracts), and eliminated repetitions, non-English content, retrospective reviews, and articles unrelated to the topic. This finally left 371 articles. We then performed a quantitative analysis of the articles. In addition, in order to gain a greater understanding of ILHE

research, we consulted Cheng, Hwang and Lai's research (2020), and from the 371 articles, 100 most-cited articles were selected to perform content analysis.

Theoretical model, coding schemes, and analysis

In order to understand the development of ILHE, we first adopted bibliometric mapping analysis, using the VOSviewer tool to analyze the field's most commonly used keywords, most-cited authors, main journals, and contributing countries/areas. Next, to gain an in-depth understanding of the research topics related to ILHE studies over the past decade, this review adopted the Technology-based Learning Review model proposed by Hsu, et al. (2012) and Tu and Hwang (2020) and selected the 100 most-cited ILHE studies to perform content analysis. We examined five major areas: research objects and sample size, research methods, information literacy standards, research domains, and educational objectives. In addition, the most-cited papers and authors, journals, and most-used keywords were discussed. The coding methods used for the different dimensions were as follows:

- 1) Research Objects and Sample Size: Research objects were divided into librarians, teachers, undergraduate students, graduate students, and mixed. Sample size were divided into small (<30), medium (30-150), large (>150), and unspecified.
- 2) Research Methods: Quantitative research, qualitative research and mixed methods.
- 3) Research Domains: Science (Physics, Chemistry, Biology, Mathematics, Arts, Language, and Social Studies (including History), Engineering (including Computer courses), Health, Medical and Physical Education, Business and Management, Library and Information Science, mixed disciplines and unspecified.
- 4) Educational Objectives: Cognitive, affective, skills, learning behavior, correlation, information literacy and others.
- 5) Information Literacy Standards: Information Literacy Competency Standards for Higher Education, Framework for Information Literacy for Higher Education, courses with other reference standards, and no reference standards.

Data distribution

Since the FILHE was formulated in 2015, we separate the decade of our survey into two periods (i.e., 2011-2015 and 2016-2020). From 2011 to 2015, there were 137 ILHE papers; from 2016 to 2020, there were 234. Of the 100 most-cited papers, 71 were from the 2011-2015 period, and 29 were from 2016-2020. See Figure 1.

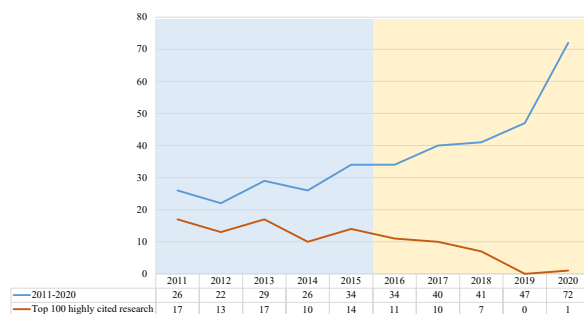


Figure 1. Distribution of ILHE studies and 100 top-cited papers for the 2011-2020 period

FINDINGS

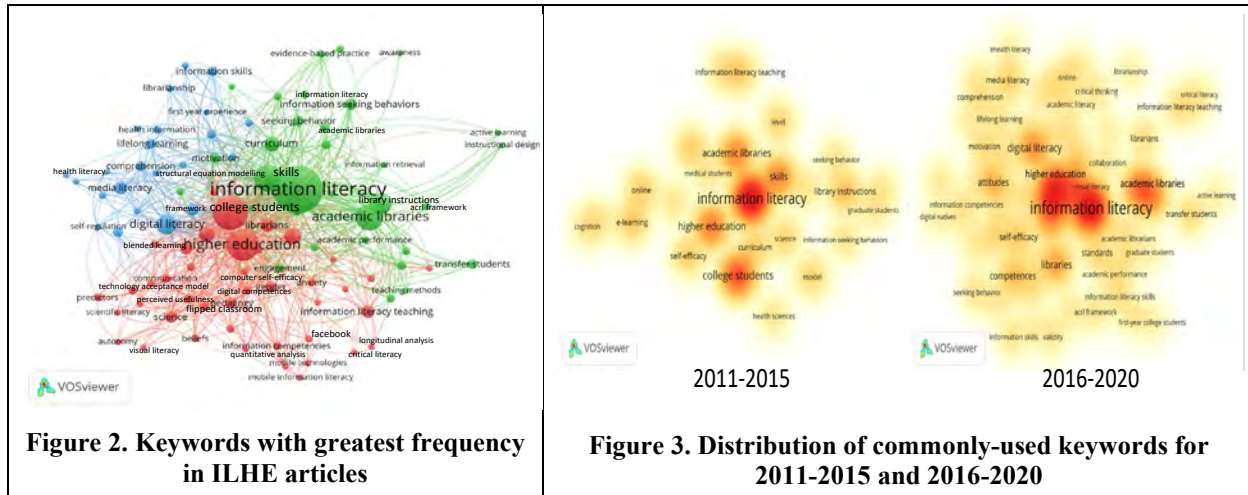
Bibliometric mapping analysis findings

Most frequently-used keywords in ILHE articles

As Figure 2 shows, the four most common keywords for ILHE studies are information literacy ($f=162$), college students ($f=81$), higher education ($f=72$) and academic libraries ($f=51$). In addition to these most-frequently-seen keywords, skills ($f=50$), library instruction ($f=33$) and digital literacy ($f=27$) are also commonly-seen keywords. Within the 371 articles, there were 88 articles in which the keywords appeared at least 5 times. Using VOSviewer to display the cluster relations for these keywords, Figure 2 shows that these keywords fall into three major clusters. Keywords in the first cluster (red) include college students, higher education, models, self-efficacy, and information literacy teaching. This cluster is primarily about exploring students' self-efficacy, pedagogical models for information literacy, and information literacy in the classroom (e.g., Latham and Gross, 2013; Chen, 2015; and Pilerot, 2016). Keywords in the second cluster (green) primarily include information literacy, academic libraries, skills, library instruction, curriculum, information seeking behaviors, and seeking behavior. This cluster is primarily focused on researching student information literacy skills, how school curricula are implemented, and student behaviors when seeking information (e.g., Kingsley et al., 2011; Korobili et al., 2011; Gross, 2012; and Kim and Shumaker, 2015). Primary keywords for the third cluster (blue) are: digital literacy, media literacy, frameworks, comprehension, critical thinking, information skills, etc. This cluster primarily discusses the importance of media

literacy and digital literacy and emphasizes how using the ILCSHE can increase curriculum extensibility, and can also cultivate students', teachers', and librarians' problem-solving, collaboration, critical thinking, and reflection abilities (e.g., Junisbai et al., 2016; Douglas and Rabinowitz, 2016; Greene et al., 2018; and Blau et al., 2020).

As Figure 3 shows, keyword used in the literature for the two periods 2011-2015 and 2016-2020 were overall similar, with only minor differences. The primary keywords were information literacy, college students, higher education, and academic libraries; during the 2016-2020 period, digital literacy and media literacy appeared more often than in the previous five years.



Most-cited authors

In 371 articles about ILHE, the most frequently-cited authors were, in order, Gross (citations= 193, documents= 8), Latham (citations= 193, documents= 8), Pinto (citations= 128, documents= 19), Walton (citations= 60, documents= 3), and Lupton (citations = 49, documents = 3). See Figure 4.

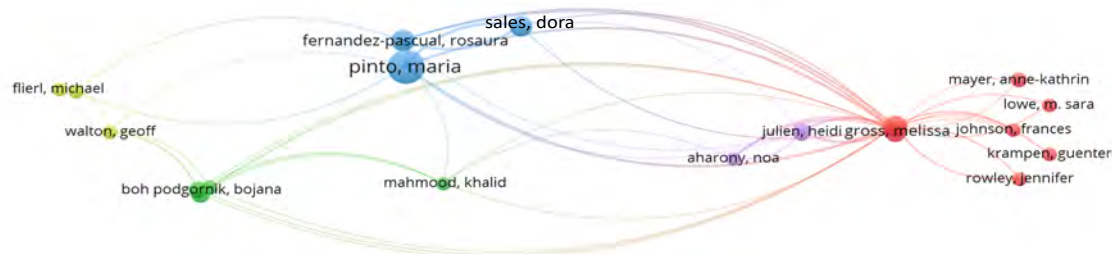


Figure 4. Authors with greatest number of citations (citation analysis; documents ≥ 3)

Details on highest co-citation are shown in Figure 5. In order, they are Pinto (citations= 124), Gross (citations= 107), Julien (citations= 71), Bruce (citations= 62), Lloyd (citations= 54), Association of College & Research Libraries (ACRL) (citations= 54), Oakleaf (citations= 52), and Bandura (citations= 51). Comparing the ten most-cited authors with the ten most co-cited authors shows that Pinto and Gross are authors both highly cited and highly co-cited in the ILHE field.

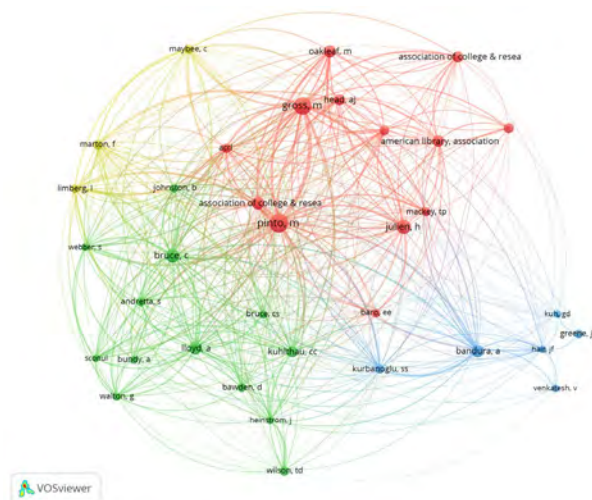


Figure 5. Authors with greatest number of citations (co-citation analysis)

Most-cited journals

The 371 articles come from 98 different journals. Figure 6 shows the distribution of highly-cited articles in the various journals. The most-cited journal was the *Journal of Academic Librarianship* (citations= 477, documents= 53), followed in order by *College & Research Libraries* (citations = 194, documents= 22), *Portal: Libraries and the Academy* (citations= 132, documents= 23), *Library & Information Science Research* (citations= 124, documents= 13), and *Studies in Higher Education* (citations= 102, documents= 5). Figure 7 shows that the most co-cited journal was the *Journal of Academic Librarianship* (citations= 497), followed in order by *College & Research Libraries* (citations= 351), *Computer Education* (citations= 222), *Portal: Libraries and the Academy* (citations= 206), the *Journal of Documentation* (citations= 178), the *Reference Services Review* (citations= 177), *Library & Information Science Research* (citations= 166), *Information Research* (citations= 110), the *Journal of Information Literacy* (citations= 106), and the *Journal of the American Society for Information Science and Technology* (citations= 105).

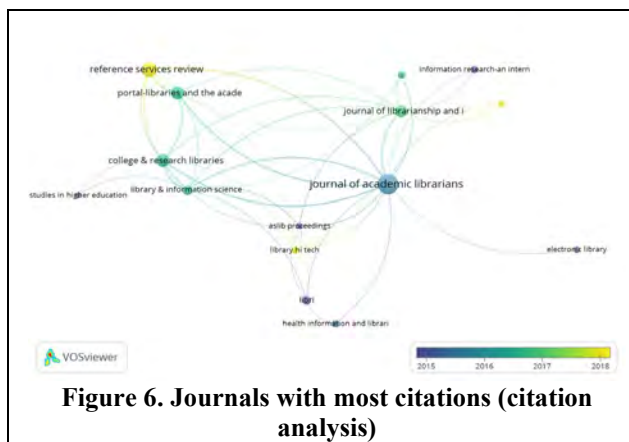


Figure 6. Journals with most citations (citation analysis)

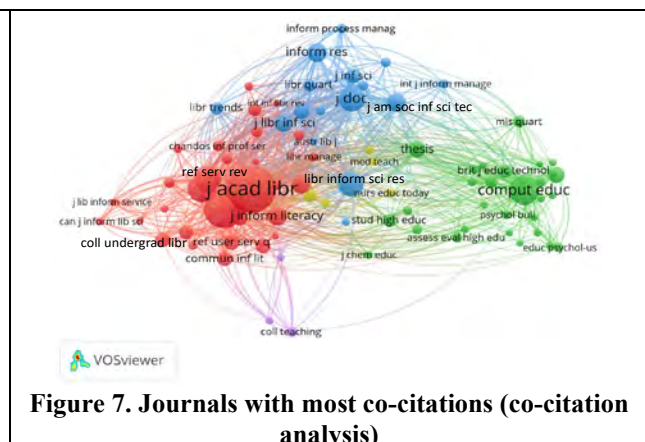


Figure 7. Journals with most co-citations (co-citation analysis)

Content analysis findings

Research Objects and Sample Size

Over the 2011-2015 period, the research subjects for the 100 most-cited papers among ILHE studies were predominantly undergraduate students (46.65%). Second was mixed (10.14%); librarians and graduate students were tied for third (4.6%). For the 2016-2020 period, research subjects were still predominantly undergraduate students (22.76%), with second being graduate students (4.14%) and third being librarians (2.7%). See Figure 8. Generally speaking, undergraduate and graduate students are the main research subjects of ILHE studies. As Saunders (2012) put it, information literacy is a popular topic in the library and information science field, and is widely considered to be a foundational skill required for college students. Mery et al. (2012) also pointed out that students who join information literacy classes test higher than students who do not join such classes.

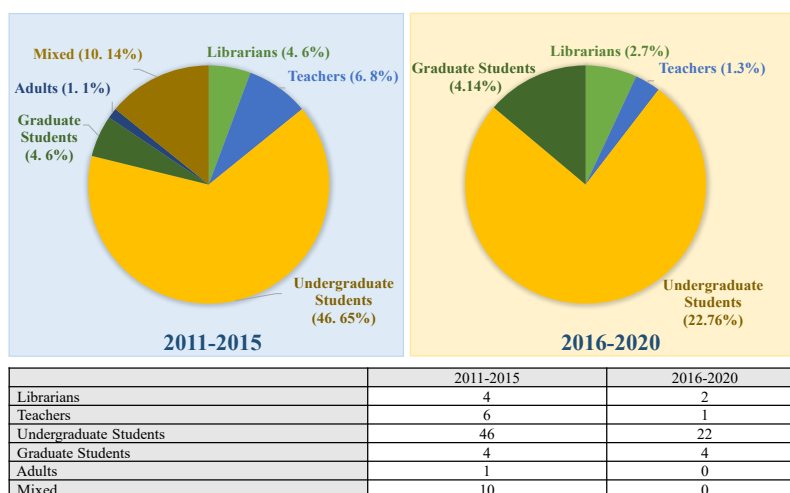


Figure 8. Distribution of research objects for the periods

For the 2011-2015 period, the most common sample size was Large (>150), at 35.49%. Second was Medium (30-150), at 19.27%, and third was Small (<30), at 15.21%. The 2016-2020 period resembled the 2011-2015 period. For example, in 2017, Lanning and Mallek used a large sample size to explore what factors affect college students' possession of information literacy. See Figure 9.

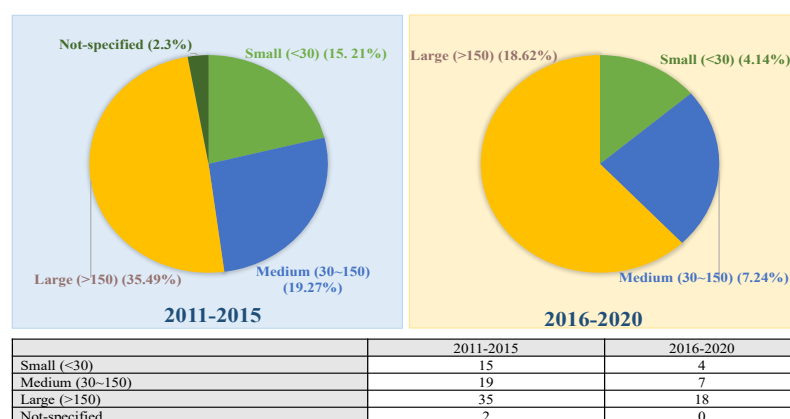


Figure 9. Distribution of sample size for the periods

Research methods

Within the 2011-2015 period, the research methods for the 100 most-cited papers among ILHE studies were predominantly quantitative research (35.49%), followed by qualitative (18.26%) and mixed methods (18.25%). The situation for 2016-2020 was similar; see Figure 10.

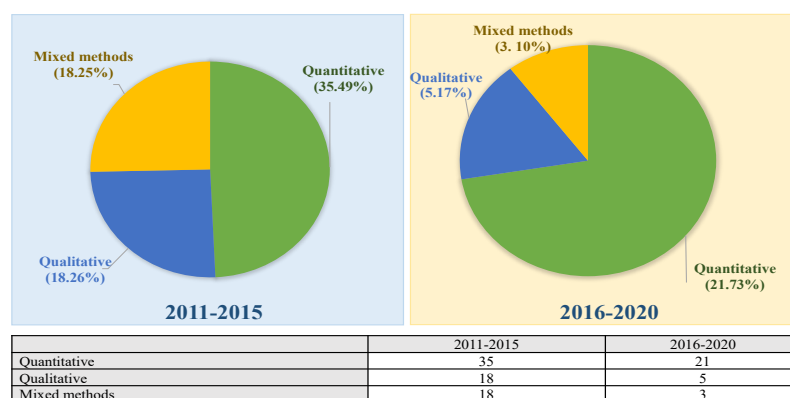


Figure 10. Distribution of research methods for the periods

Research domains

The research domains for the 100 most-cited papers among ILHE studies were predominantly unspecified (25%), followed by library and information science (23%), mixed domains (13%), and language (11%). For example, the study by Marshall et al. (2012) focuses primarily on multilingual, multicultural, and practical literacies, and does not focus on any single academic subjects; the multi-subject approach of Boer et al. (2011) explores how to promote whole-brain information literacy; the study by Julien et al. (2018) primarily focuses on how librarians in college libraries provide information literacy guidance, and also probe into their methods and challenges they face; while Tong and Moran (2017) focuses on transfer students' information literacy skills and differences between them and native students. See Figure 11.

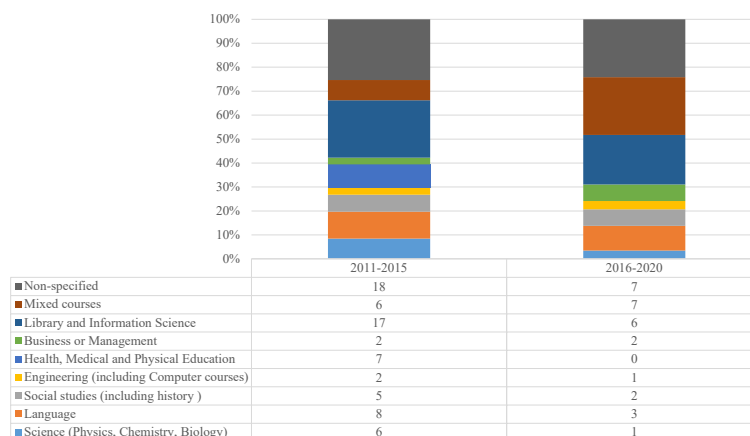


Figure 11. Distribution of research domains for the periods

3.2.4 Educational Objectives

In educational objectives for the 100 most-cited papers of information literacy, learner in affect is predominated, accounting for 41.22% of the total over the 2011-2015 period and 37.93% over the 2016-2020 period. Next was the cognitive dimension, accounting for 29.05% of studies 2011-2015 and 32.76% of studies 2016-2020. Roughly tied for third were learning behavior and correlation dimensions, with skills as a relatively un-studied dimension. This shows that information literacy education is primarily about increasing student confidence, guaranteeing students possess higher-order thinking abilities, and further cultivate their abilities to resolve problems either alone or in a group (Junisbai et al., 2016; Sin, 2016); it is not just about information retrieval skills. See Figure 12. It is of note that these methods and the metaliteracy emphasized in the FILHE are different but equally worthy approaches to the same noble goal.

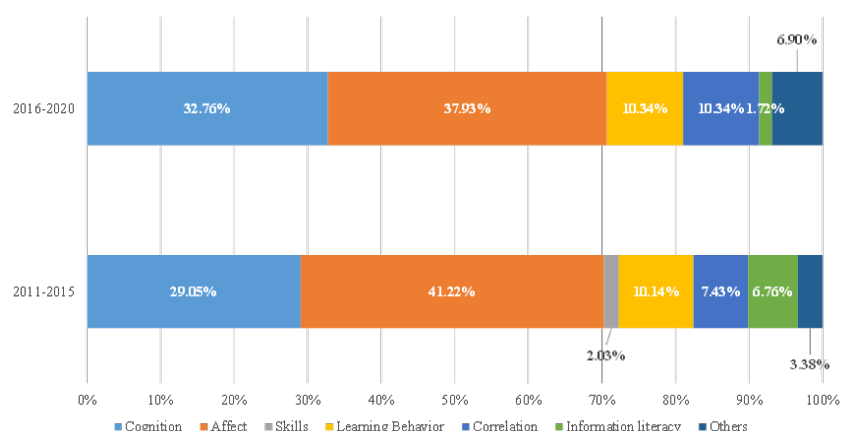


Figure 12. Distribution of educational objectives for ILHE studies in the two periods

In terms of the cognitive dimension, most studies over the 2011-2015 and 2016-2020 focused on learning performance topics. Next was higher-order skills, and third was the orientation toward collaborative learning. For example, Bryan and Karshmer (2013) point out that their study used non-linguistic modes (kinesthetic, graphic, and physical models) to do library curriculum instructions, and that enhanced students' learning abilities and aided in advancing students' information literacy. See Figure 13.

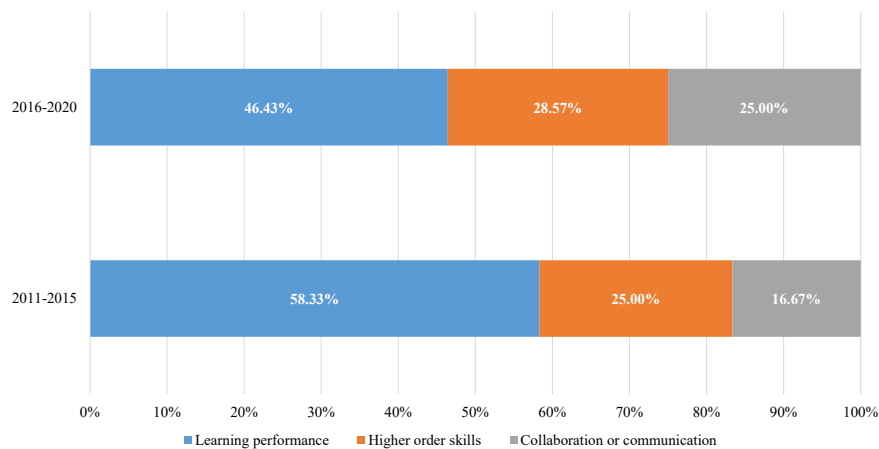


Figure 13. Cognition.

The affective dimension primarily focuses on acceptance of/intention to use technology, attitude/motivation, self-efficacy/confidence/expected outcomes, satisfaction/interest, and learner opinions/learning experiences (interviews/open-ended questions). As Figure 14 shows, the largest proportion (44.09%) of the 100 most-cited papers for the 2011-2015 explored learners' opinions and learning perceptions regarding information literacy; learners' attitude/motivation was second (34.41%), and third was learners' self-efficacy/confidence (15.05%). For the 2016-2020, learners' opinions/learning perceptions and attitude/motivation were highest (34.48% each), with self-efficacy/confidence second (at 27.59%) and acceptance of/intention to use technology third (3.45%). Generally speaking, learners' self-efficacy/confidence is an important research topic within information literacy education. For example, Chen (2015) and Squibb and Mikkelsen (2016) point out that students' learning achievement is enhanced when their schools integrate information literacy into the curriculum, and that students gain confidence from the learning process. Maybee et al. (2017) also point out that when teachers integrate information literacy into their curricula, students are able to effectively use information on topics that they want to explore. MacLeod (2018) stated the study contributes knowledge that can direct student training of digital literacies for improving the learning processes of cloud classrooms in higher education.

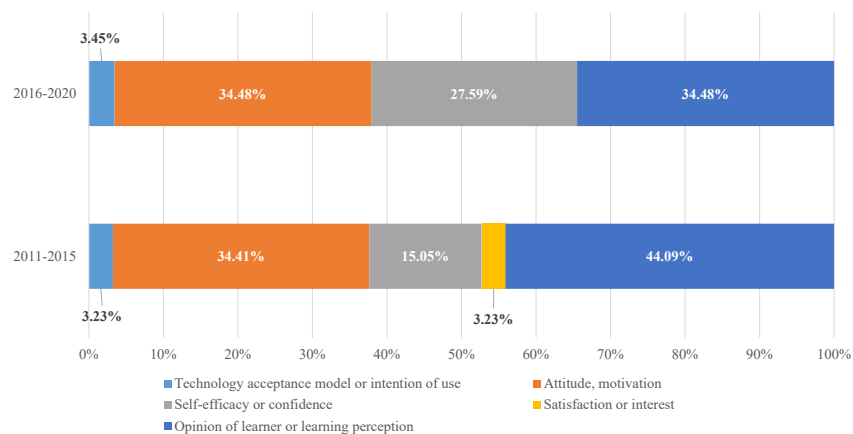


Figure 14. Affect

Information literacy standards

Of standards referred to by the 100 most-cited papers, the ILCSCHE accounted for the largest proportion (43%), with no standard next (42%), other standards third (9%), and the FILHE fourth (6%). See Figure 15. The Framework wasn't released until 2016, so we performed period-based analysis. Within the 100 most-cited papers 2011-2015, the ILCSCHE accounted for the largest number (34 articles); second was unspecified (31 articles), third was other standards (5 articles), and fourth being the Framework (1 article). That one article referring to the Framework is Zhao and Mawhinney (2015), which primarily explores differences in information literacy between native English-speaking engineering students and non-native English-speaking engineering students. The article mentions that the students gradually moved from being consumers to being producers; put another way, when students become "contributors to scholarship rather than only consumers of it" (ACRL, 2015), they already possess metaliteracy. In

light of this new situation and current research results, the researchers recommend that librarians use this opportunity to put their skills to use; librarians should not only guide students in how to retrieve information, but also in how to effectively use that information, which will be of benefit to both native and non-native English speakers. For 2016 to 2020, the majority of papers referred to unspecified (11 articles), with the second-largest number referring to the ILCSHE (9 articles), third referring to the Framework (5 articles) and fourth referring to other standards (4 articles). The five articles that referred to the Framework are Squibb and Mikkelsen (2016), Dempsey and Jagman (2016), Pilerot (2016), Julien et al. (2018) and Gross et al. (2018). They primarily explore how using the Framework allows greater clarity in how it is beneficial to students, and how using the Framework effectively enhances students' academic participation and cultivates students' information literacy skills. Julien et al. (2018) and Gross et al. (2018) both state that, while there may have been some resistance to the FILHE during the implementation process, not only did using the new standard improve their teaching, it also opened new doors to information literacy.

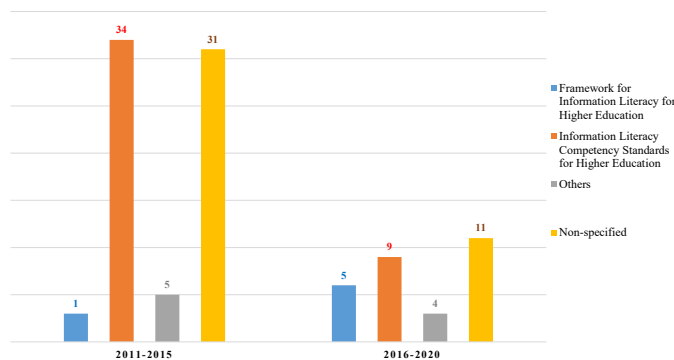


Figure 15. Distribution of information literacy standard, by period

CONCLUSIONS AND DISCUSSION

This study used bibliometric mapping analysis and content analysis to explore information literacy in higher education (ILHE) research trends from 2011 to 2020. The primary findings are as follows:

- 1) From 2011 to 2015, there were 137 ILHE articles, and 234 articles from 2016 to 2020, which shows that information literacy research has grown over the past five years. Viewed in terms of keyword distribution, higher education, college students, information literacy, and digital literacy were high-frequency keywords. Over the 2011-2020 period, digital literacy, media literacy, multiliteracies, and metaliteracy were also frequently-explored keywords. This shows that information literacy is affected by social and technological development; content becomes richer and richer, but also becomes more and more divergent. The *Journal of Academic Librarianship* is the most highly-cited journal; and the *Journal of Academic Librarianship* is also highly co-cited. This demonstrates this journal's importance in ILHE studies. In ILHE research, the two most highly-cited and highly-co-cited scholars are Melissa Gross and Maria Pinto. They are the most-cited (co-citation) authors in this field. In terms of research methods, quantitative research predominates; most studies use questionnaires or rating scales to investigate subjects' opinions on information literacy pedagogy, then analyze students' thoughts about information literacy pedagogy, information-seeking behavior, etc. In terms of research objects, undergraduate students predominate; and large (>150) is the most common sample size. "Unspecified" was the most common research domain.
- 2) In terms of information literacy educational objectives, most studies focus on affective dimension, including acceptance of/intention to use technology, attitude/motivation, self-efficacy/confidence, satisfaction/interest, and learner opinions/learning experiences. Within these, there was a relatively high proportion of studies on learner opinions/learning experiences. This shows that within the affective dimension, studies primarily focus on investigating learner opinions of and experiences with information literacy education. This was followed by the cognitive dimension, including learning performance, higher-order skills, and collaboration/communication. Within these, learning performance accounted for the highest proportion, primarily exploring learners' outcomes after applying informational literacy in the classroom. The skills dimension within the educational objectives was relatively little-discussed. Almost no studies related to metaliteracy – as emphasized in the Framework published in 2016, and which requires students to participate in research within information ecosystems in terms of behaviors, emotions, cognition, and metacognition – have appeared (ACRL, 2015).

- 3) The standards applied in information literacy education were, for the 2011-2015 period, primarily the ILCSHE; and for the 2016-2020, the largest number of studies applied unspecified. There remain few studies that refer to the FILHE, though there is a growth trend.

Based on the preceding research conclusions, this study makes the following recommendations:

- 1) As times have changed, terms related to information literacy have continued to arise. Information literacy content has become rich and diverse; it is no longer merely a topic of concern to the traditional library and information science but has become an issue that scholars in all domains care about. The question of whether librarians have the strength to handle multiliteracies, digital literacy, metaliteracy, and other educational content is a topic worthy of concern; multidisciplinary collaboration and study are a necessity. Librarians need even more to collaborate with teachers in designing the pedagogical goals, contents, and teaching methods used in information literacy curricula. Although information literacy is a core skill that college students need to acquire, information literacy teaching methods and content in different domains vary, and there is still not much research about this. Also, multidomain and multidisciplinary collaboration has become an important trend in academic research. The ability to dialogue between domains is an issue that information literacy education must face.
- 2) Changes in concepts about information literacy have led to changes in the standards for information literacy and have gradually produced influences on information literacy curriculum design. The Framework for Information Literacy for Higher Education emphasizes metacognition, critical self-reflection, and threshold concepts. These concepts varied from the information literacy of the past, which placed its greatest emphasis on college library retrieval skills. Librarians need even more to collaborate with teachers in designing the pedagogical goals, contents, and teaching methods used in information literacy curricula. Although information literacy is a core skill that college students need to require, information literacy teaching methods and content in different domains vary, and there is still not much research about this. Also, multidomain and multidisciplinary collaboration has become an important trend in academic research. The ability to dialogue between domains is an issue that information literacy education must face. In addition to the frequently applied domains (e.g., health, medical and physical education), it could be valuable to try to explore the relationship between students' information literacy skills (i.e., their ability to collect, evaluate, and utilize the various types of information) and higher-level thinking. As this study shows, Europe and North America still lead in research on information literacy in higher education. However, information literacy in higher education systems is intimately tied with the environment. There remains a lack of research into what information literacy circumstances and issues exist in different educational environments. Discuss the relationship among students' information literacy skills, problem-solving, and critical thinking.
- 3) The future possibility for ILHE can be rooted in technologies and different fields, it is suggested that educators and researchers consider discussing the influence of social media and new technologies (e.g., artificial intelligence) on the information literacy abilities of students, teachers, and librarians. The ILCSHE have been rescinded; the FILHE has been revised and released. However, during the 2016-2020 timeframe, only five of the most-cited articles referenced the Framework; most research continued to be based on ILCSHE curricula, and there is still a dearth of empirical research done on Framework-based pedagogy. Teachers interested in this should refer to the ACRL Framework for Information Literacy Sandbox in designing curricula, shorten the time required to get off the ground, and engage in empirical evaluation research on pedagogy.

This study was subject to some limitations. For example, this study used primarily the SSCI database; the literature was limited to articles; and the language was limited to English. The time were limited so that we just selected the 100 most-cited ILHE studies from 2011 to 2020 for content analysis. The full picture of the research of ILCSHE may still not be presented. In addition, this study used bibliometric mapping analysis, and therefore, the results were also subject to limits in terms of analytical dimensions. The various dimensions await further and deeper analysis to grant fuller understanding.

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Exploring the Perceived Attractiveness of Online Celebrities Who Sell Knowledge: A Self-Branding Perspective

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ABSTRACT

Given the limited understanding of the attractiveness among online celebrities, this study explores the perceived attractiveness of “Knowledge Wanghong,” an emerging class of online celebrities who sell knowledge products in China. Drawing on the self-branding perspective, which argues that individuals may construct and manage their distinctive online image deliberately through various information practices, as the theoretical lens, we attempt to answer two questions: (1) What are the antecedents of the perceived attractiveness of Knowledge Wanghong? (2) How do Knowledge Wanghong make themselves attractive to users? From semi-structured interviews with 28 Knowledge Wanghong, we derive two findings. First, the antecedents of the perceived attractiveness include perceived professionalism, perceived familiarity, and perceived intimacy. Second, Knowledge Wanghong make themselves appealing to users in two ways: (1) they disclose personal and professional information to users; (2) they employ multiple approaches to interacting with users. This study sheds light on the perceived attractiveness of Knowledge Wanghong in terms of the antecedents and how it is achieved. Also, it provides a novel reference point for discussing the information practices of online celebrities in a global context.

KEYWORDS

Information practices; Knowledge Wanghong; Online celebrity; Perceived attractiveness; Self-branding.

INTRODUCTION

By leveraging the connectivity and reach of the internet to share personalized content packed with sensational elements, anyone has the chance to be popular and attract a sizable following (Abidin, 2018; Djafarova & Rushworth, 2017). When these individuals eventually become online celebrities, they could be poached by firms for marketing purposes. Their appeal can effectively drive up the sales figures of the products and services they endorse (Lou, Tan, & Chen, 2019). However, what makes online celebrities attractive in the first place has drawn limited attention.

To address this research gap, we draw on the self-branding perspective that has been widely used to explain how individuals brand themselves in the digital environment (Geva, Oestreicher-Singer, & Saar-Tsechansky, 2019). This perspective holds that individuals may construct and manage their distinctive online image deliberately through various information practices (Labrecque & Milne, 2011), which refer to how information is sought, applied, and shared in a given daily environment (Savolainen, 2007). When used in the online context, the concept of information practices highlights the interconnections among people, information, and digital technology (Lloyd & Olsson, 2019).

Online celebrities’ attractiveness may reflect such interconnections. Related literature suggests that the perceived attractiveness of online celebrities could stem in part from the unique features of self-image that they consciously cultivate on an online platform (e.g., Duffy & Pooley, 2019; Khamis, Ang, & Welling, 2017). Unfortunately, the understanding of the antecedents of their appeal is limited. Furthermore, the literature is currently silent regarding how online celebrities engage in information practices to make themselves attractive. As a result, the particular information practices that enable online celebrities to draw users remain unknown.

In this paper, we focus on an emerging class of online celebrities in China—also known as “Knowledge Wanghong”—who sell knowledge products to users. The term—“Wanghong”—has been used to describe anyone who manages to attract attention within the vast ecology of Chinese internet users (Abidin, 2018). For Knowledge Wanghong, they initially attracted users on online platforms by creating knowledge-intensive content for free (Wang, Hui, & Li, 2018). As the demand for high-quality online content grows, these platforms evolved into pay-for-knowledge outfits where payment functions are incorporated to empower these “knowledge celebrities” to monetize their efforts (e.g., Kuang, Huang, Hong, & Yan, 2019; Zhao, Liu, Chen, & Zhu, 2019). Unsurprisingly, the more attractive a Knowledge Wanghong is, the more alluring their knowledge products appear to users (Chen & Fu, 2019).

The case of Knowledge Wanghong is appropriate to explore for two reasons. First, the perceived attractiveness of Knowledge Wanghong is the basic premise that affects users' willingness to pay. Knowledge Wanghong are constantly trying to win users over as fans by offering high-quality outputs (Tao, 2017). Fans are known to go the extra mile for their idols, including expressing their adoration by giving financial support (Duffy & Pooley, 2019). Second, using the online image constructed on a pay-for-knowledge platform as self-branding, Knowledge Wanghong favorably transfer their attractiveness to the knowledge products they create (Zhao, Zhao, Yuan, & Zhou, 2018). The more congruent their online image with their knowledge products, the more effective they can monetize their perceived attractiveness.

Accordingly, we propose two research questions as follows.

RQ 1: What are the antecedents of the perceived attractiveness of Knowledge Wanghong?

RQ 2: How do Knowledge Wanghong make themselves attractive to users?

Using qualitative data from semi-structured interviews with 28 Knowledge Wanghong, this paper attempts to conceptualize the perceived attractiveness in terms of the antecedents and how it is achieved. The study makes three primary contributions. First, from the self-branding perspective, it provides a detailed and grounded description of why and how Knowledge Wanghong—a particular group of online celebrities—became attractive. This paper also extends the information science literature by investigating the information practices of such an increasingly visible population on the internet. Second, it proposes a preliminary conceptual model that depicts the antecedents of the perceived attractiveness of Knowledge Wanghong. The model lays the ground for further theorization and empirical research on the role of the perceived attractiveness in users' willingness to pay. Third, it may offer fresh insights into the design and management of related digital technology-enabled platforms. These insights will help platform designers improve the visibility of online celebrities' self-image.

THEORETICAL LENS: SELF-BRANDING PERSPECTIVE

The theoretical lens used to explore the perceived attractiveness of Knowledge Wanghong is the self-branding perspective (Labreque et al., 2011). Based on this perspective, related literature points out that online celebrities may gradually develop online fame by intentionally establishing self-image on a given platform (Duffy & Pooley, 2019). Such an online image is seen as a “self-brand” that they show to the public (Khamis, Ang, & Welling, 2017). This is achieved in two ways—online image construction and management. Online image construction requires them to put much effort into what and how to present themselves, thereby signaling a unique identity (Geve et al., 2019). After the construction, online celebrities need to keep identity authenticity and consistency on the platform through the careful management of the online image (Duffy & Pooley, 2019). Despite this, current research has not delved deeper into any specific unique features of one's online image, contributing to perceived attractiveness. Therefore, this paper seeks to address this gap by explicating the antecedents of the perceived attractiveness of Knowledge Wanghong based on the features of their online image.

Moreover, online celebrities may employ technology-enabled tools provided by online platforms to maintain their popularity (Abidin, 2018). The purpose of using these tools is to engage in information practices such as information-sharing and other information activities (Savolainen, 2007). Related literature indicates that online celebrities tend to selectively share information with the audiences and purposely conduct certain activities (Lou et al., 2019). For example, they tend to generate highly sought-after information and share it with audiences to strengthen their engagement. After that, online celebrities may capitalize on audiences' attention to promote some content or services. Such information practices may enhance audiences' loyalty and emotional attachment (Jarrahi & Thomson, 2017). Building on such advantages, they might exhibit further influences on audiences, including shaping their behavioral intentions (Khamis et al., 2017). How online celebrities engage in such information practices could depend on the distinctive online image they wish to project.

METHODOLOGY

Research design

The research questions call for exploratory rather than confirmatory analyses as the perceived attractiveness of Knowledge Wanghong is not yet well theorized. Previous research, especially the literature using the self-branding perspective, provides a helpful theoretical background but no answers to our research questions. Thus, it is necessary to use a qualitative and interpretive approach to “develop a theoretical account of the general features of a topic while simultaneously grounding the account in the empirical observations or data.” (Martin & Turner, 1986, p.141). Such an approach is particularly suitable as it permits new constructs integrated into a theoretical model (Kitzie, Wagner, & Vera, 2020; Wu, 2019).

Semi-structured interviews are used to surface, explore, and probe for key elements in the process and ask follow-up questions (Spradley, 1979). Guided by the two research questions, we designed the interviews around two objectives, each of which includes two dimensions, respectively. Table 1 shows the semi-structured guide. The first

objective is to study the antecedents of the perceived attractiveness of Knowledge Wanghong. For this purpose, questions of the interviews were designed based on two dimensions, namely, construction of one's online image and management of one's online image. The second objective is to investigate how Knowledge Wanghong make themselves attractive. Similarly, the questions were designed based on two dimensions: information sharing and other information activities. The questions for the interviews were intended to explore and understand the "what," "why," and "how" behind each dimension (Wee & Chua, 2013).

Objective	Dimension	Key questions of the interviews
To study the antecedents of the perceived attractiveness	Construction of online image	<ul style="list-style-type: none"> • What online image do you attempt to establish to draw users? • Why do you think the online image can draw users? • How do you construct the online image?
	Management of online image*	<ul style="list-style-type: none"> • How do you manage your online image and control others' impressions of you? • Why do you manage your online image in this way?
To study the ways to achieve their perceived attractiveness	Information sharing	<ul style="list-style-type: none"> • What information do you share with users? • Why do you share such information with users? • How do you share such information with users?
	Other information activities	<ul style="list-style-type: none"> • What information activities do you do? • Why do you do the information activities? • How do you do the information activities?

Note: * "What" question is not appropriate in this dimension.

Table 1. Semi-structured interview guide

Participants

This qualitative study was approved by the authors' affiliated university's Institutional Review Board (IRB) for exempt review. After that, the authors sought help from a leading pay-for-knowledge platform in China to contact the Knowledge Wanghong on the platform. The platform has developed unique proprietary algorithms to identify such Knowledge Wanghong. From an initial pool of about 200 Knowledge Wanghong interested in participating in our research, we randomly chose 40 and contacted them individually to obtain their informed consent.

In total, 28 interviews were conducted between December 2019 and February 2020. Table 2 summarizes the demographic information of the 28 participants. Among them, 12 were male, and 16 were female, all between 22 and 38 years old ($M = 28.8$, $S.D = 4.14$). Over 93% of them obtained a bachelor's or above degree, and over 75% had over two years of experience in selling knowledge products on the platform.

Six of the interviews were conducted on Skype, while the rest was done via WeChat. Each interview lasted approximately 40 to 60 minutes. Interviews were recorded in an audio format, then fully transcribed into texts, and edited to remove identifiers and other references that might identify the participants.

Demography	Category	Count
Gender	Male	12
	Female	16
Age	20~25	5
	26~30	15
	>30	8
Education level	Below Bachelor	2
	Bachelor	14
	Master or above	12
Education background	Humanity & social sciences	13
	Science and engineering	11
	Others	4
Occupation in reality	Manager or administrators	9
	Professionals	10
	Self-employed	6
	Student	2
	Others	1
Experiences in selling knowledge products	1~2 year	7
	2~4	12
	> 4	9

Table 2. Demographic information of the participants (N=28)

Data analysis

The first author and another research assistant conducted data analysis using open coding and constant comparison (Urquhart, Lehmann, & Myers, 2010) to identify key factors and mechanisms in each question of the interview guide described in Table 1. The two coders initially read the transcripts to familiarize the content. They also met regularly to practice coding some sentences from the transcripts. The purpose is to debrief and discuss the inconsistent results to achieve an agreement.

The two coders then independently identified themes and subthemes through several close readings of the transcripts. After distinct concepts and categories were identified, extracted, and agreed upon, the focused coding was employed to systematically apply thematic codes to all the data to analyze the findings. The coders discontinued the coding of the transcripts after they reached theory saturation, suggesting that no new codes or themes were emerging from the interviews. The inter-rater reliability was satisfied (Kappa $\alpha = 0.92$).

After focused coding, the coders wrote up in-depth memos. The memos compared the codes to participants' variations in responses, theory, recurring themes, and possible relationships among major categories (Chang et al., 2018). These memos form the basis for our analysis and findings described below. Because all interviews were conducted in Chinese, the transcripts were analyzed and coded in Chinese. However, the results were translated into English by bilingual coders for reporting the results (Pee, Pan, & Cui, 2019).

RESULTS

RQ 1: What are the antecedents of the perceived attractiveness of Knowledge Wanghong?

The qualitative results showed that their perceived attractiveness originated from three antecedents: perceived professionalism, perceived intimacy, and perceived familiarity. The analysis of each antecedent is as follows.

Perceived professionalism: "Users are attracted to my expertise."

Perceived professionalism refers to the extent to which someone's outputs are perceived as expertise and credibility (Zhang, Lu, Phang, & Zhang, 2019). Virtually all interviewees highlighted the importance of establishing the image of being professional contributors in some knowledge domains. Typical phrases regarding this antecedent include

“users are attracted to my expertise,” “I have much professional experience in the domain,” and “I hold a credential to support my expertise.” The qualitative analysis showed that the perceived professionalism of Knowledge Wanghong seems a salient factor promoting Knowledge Wanghong to monetize their efforts. Illustrative excerpts from the interviews are given below:

“I [Knowledge Wanghong] feel that I’ve already formed an impression on them [users] that I’m an expert in this area. [...]” (Interviewee 3)

“They [users] wanted me to answer their unknown and curious questions and give them useful approaches to solving their problems. [...]” (Interviewee 8)

“Because I [Knowledge Wanghong] have much professional experience working in this area. ... They [users] believe me [...] and [users are convinced that] I’m qualified in providing knowledgeable outputs with them [users]. [...] That’s why I’m able to draw them to pay for my knowledge. [...]” (Interviewee 11)

Perceived familiarity: “Users are attracted to my responsive feedback.”

Perceived familiarity refers to the extent to which someone is perceived intensely as being known (White & Shapiro, 1987). The literature in social psychology suggests that familiarity with a target, which helps to promote one’s attraction, can be developed by offering timely responses (Reis, Maniaci, Caprariello, Eastwick, & Finkel, 2011). Our qualitative results also provided evidence about this point. Most of the interviewees said that they tended to respond to users’ knowledge needs actively. Users, in turn, could gradually adapt to the style and knowledge outputs of a certain Knowledge Wanghong. Typical phrases regarding this antecedent include “users are attracted by my responsive feedback.” Illustrative excerpts from the interviews are given below:

“Once I [Knowledge Wanghong] received any requests and queries from others [user], actually, [...] I [Knowledge Wanghong] felt very motivated to create and edit relevant knowledge-intensive content to satisfy the users’ demand... as soon as possible. The sense of enjoying helping others also triggers myself to explore further and share intriguing information and knowledge elements in their domains.” (Interviewee 1)

“For my users, they acknowledge my warm-hearted attitude to creating knowledge, [...], they also very knowledgeable about my status [in this area], and... [Users] have been used to my [Knowledge Wanghong’s] own style, [...] they (users) know under which circumstances my knowledge [products] can benefit them to the maximum extent. [...]” (Interviewee 7)

Perceived intimacy: “Users are attracted to my presented charisma.”

Perceived intimacy refers to the extent to which someone is perceived as being closely connected to others (Hu, Wood, Smith, & Westbrook, 2004). It is evident from the interviews that the perceived intimacy plays an important role in forming their perceived attractiveness. In brief, Knowledge Wanghong manipulated the perceived intimacy to construct “parasocial relationships” with users. Such a relationship is “enduring, long-term, and usually positive, one-sided intimacy at a distance.” (Dibble, Harmann, & Rosaen, 2016: pp. 24). As a result, users might feel themselves being psychologically connected with their favorite Knowledge Wanghong. Typical phrases regarding this antecedent include “users are attracted by my presented charism.” Illustrative excerpts from the interviews are given below:

“To me [Knowledge Wanghong], to some extent, I was like [...] a performer to my users. ...I mean, you (Knowledge Wanghong) have to “perform” like [...], you’re “friends” to your users [...]. This means, you (Knowledge Wanghong) understand them, (you understand) their needs, what they thought, how they would react [...]” (Interviewee 5)

“In summary, you have to be liked by users. [...] So far, I [Knowledge Wanghong] often consciously establish an atmosphere, where we [Knowledge Wanghong and users] can connect to each other tightly. [...] I think this is important to help [Knowledge Wanghong] to maintain my charism and attractiveness to them (users). [...]” (Interviewee 13)

RQ 2: How do Knowledge Wanghong make themselves attractive?

Our analyses of the interviews showed that Knowledge Wanghong employed two primary ways to achieve their perceived attractiveness. The first way involves information disclosure—sharing their personal and professional information with users. The second way involves interaction approaches that they used to communicate with users, thereby serving particular purposes.

Self-disclosure of personal and professional information

The self-disclosure of personal and professional information is significant to form their perceived attractiveness. This way helps to enhance perceived professionalism, perceived intimacy, and perceived familiarity, respectively.

However, what and how much the information they disclosed to users is strategically different across the three antecedents.

In terms of enhancing perceived professionalism, all interviews indicated that they disclosed professional information about their knowledge expertise so as to convince users. Most of them stressed the significance of self-disclosure authenticity because it would bring a long-term benefit to them. Thus, they were less likely to exaggerate the self-disclosed professional information but cared about ensuring their online reputation by informing what knowledge they can offer. Several interviewees described a similar experience, and a representative one is as below:

“It is undoubtedly important to disclose my professional information to the public. ... [because] this makes them [users] know about what my advantages are [in some knowledge domains] [...]” (Interviewee 8)

“Of course, I can say that you may do so [disclosing fictitious information], that’s not a wise choice [for Knowledge Wanghong], though. It would be horrible to do that. [...] They (users) are not foolish. They could be deceived by you once, but they would not make a mistake again. [...] They would switch to another one (Knowledge Wanghong’s outputs), wouldn’t they? [...]” (Interviewee 12)

In terms of enhancing the perceived familiarity, many interviewees stated the importance of disclosing personal and professional information to facilitate users’ knowledge-seeking. In this case, Knowledge Wanghong tended to share personal information such as how to contact them for further knowledge queries and demands, and professional information such as where and how to strengthen users’ ability and learning skills in a certain knowledge domain. Such information self-disclosure helped users learn about the trajectory of learning knowledge in a domain and promote their trustworthiness in Knowledge Wanghong’s knowledge outputs. Representative examples are given below:

“I [Knowledge Wanghong] realized that it would be effective and helpful for users if I share my own information about how I learned and thought in the knowledge domain. [...] I tell those [users] about my failure lessons when I was initially involved in the area. [...]” (Interviewee 6)

“This helps me (Knowledge Wanghong) a lot. [By disclosing such information], they’ve known about how and why I became an influential expert in this area. [...] They’ve known what they have to learn and where to learn, and importantly, they’ve known that it’s not easy [to become Knowledge Wanghong like me]. [...]” (Interviewee 9)

In terms of enhancing perceived intimacy, most interviewees acknowledged the role of disclosing personal information. Such personal information involved their hobbies, personal stories, and previous life experiences. Our analysis showed that Knowledge Wanghong understood users’ curiosity about their personal information. Because users treated Knowledge Wanghong as micro-celebrities akin to YouTubers and Instagram influencers, the users want to explore unknown aspects beyond Knowledge Wanghong’s expertise to comprehend them fully. In turn, Knowledge Wanghong also highlighted that personal information disclosure might not affect their privacy concerns seriously as they determined what personal information to disclose. Representative examples are given below:

“Proper self-disclosure of personal information is necessary to improve my attractiveness, especially in terms of making users like me. [...]” (Interviewee 2)

“I find them would love to ask something irrelevant to their knowledge needs after I provided them with my knowledge. [...] I tend to disclose something like my interests, favorite music, books, and movies on my profiles. [...]” (Interviewee 11)

Multiple approaches to interacting with users

Our analyses of the interviews suggested that all Knowledge Wanghong appreciate the necessity to interact with users. Among the interviewees, however, the relative importance of such online social interactions varies. Different Knowledge Wanghong perhaps had different preferred approaches to interact with users. Many interviewees mentioned that they liked to use one or more interaction approaches to maximizing their efforts and promote attractiveness. From the interviews, we identified three primary purposes that motivate Knowledge Wanghong to use particular approaches to interact with users. They are, namely, interaction for responding to users’ information demand, interaction for knowledge-intensive content sharing, and interaction for self-expression.

First, most interviewers said they were more likely to respond to users’ information demands during their online interactions. This is because Knowledge Wanghong were keen to create knowledge products that target users’ needs. In this case, Knowledge Wanghong employed approaches such as questioning, answering, commenting, and replying to users’ reviews to learn about their potential consumption desires and post-consumption experiences. In turn, users played the role of “receivers” of the information outputs of Knowledge Wanghong in the interactions. For example, representative interviewees, who explained why they were willing to interact with her users, are listed below:

“I’m not a passive responder to users’ demands, that’s not a good way to keep your consumer size. [...] You [Knowledge Wanghong] have to know your users or your potential consumers. But how? To me, I always interact with them online using many ways. [...]” (Interviewee 1)

“I may post small questions about daily life or related to my expertise so as to raise their interests. Sometimes I answered such questions, or sometimes, I highlighted the answers from them that I think are very good. [...]” (Interviewee 6)

Second, several interviewees suggested that they interacted with users for knowledge-intensive content sharing. This is also known as “reciprocity”—a mutual obligation in the act of favor giving and receiving (Wu, 2019). In this case, Knowledge Wanghong engaged primarily in online interactions such as sharing opinions, thoughts, and articles relevant to their knowledge domains. Also, they would like to receive feedback or advice from users. Users, in turn, might actively take part in such “conversations” and similarly share their knowledge and thoughts with Knowledge Wanghong. In brief, in such interactions, users tended to play the role of “partners” of Knowledge Wanghong. Moreover, Knowledge Wanghong used the approaches to improve their knowledge products or serve other related knowledge services such as revising and updating content they offered to users. For example, representative interviewees, who explained why they were willing to interact with her users, are listed below:

“I [Knowledge Wanghong] gradually realized that selling my knowledge products to users successfully is a two-sided process. Although I’m satisfied with all the knowledge products I created, some cannot be monetized well. [...]” (Interviewee 7)

“I want to know why this happened, so I shared my opinions and thoughts about that with users. Surprisingly, they told me a lot. Lots of the things [that users told me] are what I never thought before. [...]” (Interviewee 15)

DISCUSSION AND CONCLUSION

Although the “attractiveness” is significant for online celebrities like Knowledge Wanghong, related literature has not well-theorized this concept. From the self-branding perspective, this paper explores the perceived attractiveness of Knowledge Wanghong—an emerging class of online celebrities who sell knowledge products—by considering their antecedents and how it is achieved. Using qualitative analysis of the interviews with 28 Knowledge Wanghong, this study has addressed two research questions. **RQ 1:** *What are the antecedents of the perceived attractiveness of Knowledge Wanghong?* **RQ2:** *How do Knowledge Wanghong make themselves attractive?* We summarize the detailed findings in Table 3.

Regarding RQ 1, the perceived attractiveness of Knowledge Wanghong includes three antecedents: perceived professionalism, perceived intimacy, and perceived familiarity, which are deeply embedded in their online image. Previous research suggests that online celebrities establish self-brands by cultivating an online image consciously (Khamis et al., 2017). However, such an online image has not been associated with their perceived attractiveness (Labrecque et al., 2011). This qualitative study offers an understanding of the perceived attractiveness as a function of unique features of their online image. This helps to explicate how, through branding their unique online image, Knowledge Wanghong are able to draw target audiences.

Regarding RQ 2, there are two primary types of information practices making Knowledge Wanghong appealing to users. First, they disclose personal and professional information to users. Second, they employ multiple approaches to interacting with users. Related literature argues that online celebrities cannot construct and manage their online image successfully without effective information practices (Duffy & Pooley, 2019; Labrecque et al., 2011).

Unfortunately, previous studies do not give fine-grained knowledge about how such information practices enhance one’s attractiveness. Our research shows that Knowledge Wanghong disclose their own information to users strategically in order to promote users’ perception of each antecedent of the perceived attractiveness. Meanwhile, the approaches they use to interacting with users serve different purposes, such as responses to knowledge needs, strengthening users’ emotional bonds, and self-expression.

This paper holds both theoretical and practical significance. Theoretically, it represents one of the first attempts to conceptualize the perceived attractiveness of online celebrities by investigating the case of Knowledge Wanghong. This paper also contributes to the information science community by analyzing information practices of Knowledge Wanghong from the self-branding perspective. Practically, the findings may inspire related platform designers and managers on how to enable Knowledge Wanghong to explicitly present unique aspects of their online image so as to draw users. The designers may benefit from our findings to consider improving functionalities and affordances of platforms to facilitate diverse social interactions between Knowledge Wanghong and users.

Study objective	Dimensions	Findings
To study the antecedents of the perceived attractiveness of Knowledge Wanghong	Perceived professionalism	<ul style="list-style-type: none"> Establishing and maintaining an image of being experts in some knowledge domains; A salient factor promoting Knowledge Wanghong to monetize their efforts
	Perceived familiarity	<ul style="list-style-type: none"> Responding to users' knowledge needs actively Users may gradually adapt to the style and knowledge outputs of a certain Knowledge Wanghong
	Perceived intimacy	<ul style="list-style-type: none"> Manipulating the perceived intimacy in the form of keeping "parasocial relationships" with users; Users might feel themselves being psychologically connected with their favorite Knowledge Wanghong
To study the ways to achieve their perceived attractiveness	Self-disclosure of personal and professional information	<ul style="list-style-type: none"> For enhancing perceived professionalism, they disclosed professional information about their knowledge expertise to convince users; For enhancing perceived intimacy, they acknowledged the role of disclosing personal information; Such personal information is about their hobbies, personal stories, and previous life experiences; For enhancing perceived familiarity, they stated the importance of disclosing personal and professional information to facilitate users' knowledge-seeking
	Multiple approaches to interacting with users	<ul style="list-style-type: none"> Different Knowledge Wanghong had different preferred approaches to interact with users; They were more likely to respond to users' information demands during their online interactions; They interacted with users for knowledge-intensive content sharing, which helps to improve their knowledge products; They could interact with users for self-expression, which might help increase users' emotional bond to the Knowledge Wanghong

Table 3. Summary of the qualitative study's results

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Racist Framing through Stigmatized Naming: A Topical and Geo-locational Analysis of #Chinavirus and #Chinesevirus on Twitter

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ABSTRACT

During the COVID-19 pandemic, racists remarks accompanied by racist hashtags were disseminated via social media. Particularly, Asian Americans in the U.S. have been suffered from racism and xenophobia, resulting in physical violence and mental harassment in many cases. Despite the major function of the social media as an open-access platform for unedited and free speech for people with a diverse background, the global episodes of the soaring racism and xenophobia occurred in online public arenas reaffirmed that the platforms could be used for a nurturing ground of racism and xenophobia. This study examined the top influencers in the racist hashtag Twitter network and top shared neighboring hashtags with #Chinavirus or #Chinesevirus. We extracted topics from the racist hashtag Twitter network applying the state-of-the-art BERTopic modeling technique and conducted a geo-locational analysis of the participants of the network globally and by U.S. states. Trump was identified as the most influential actor in the #Chinavirus and #Chinesevirus Twitter network. This study confirmed previous literature that the political elite's public communication strategy to deviate the attention of the public suffered from the new disease and went through hardships under the epidemic crisis.

KEYWORDS

Chinesevirus; Twitter; COVID-19; Trump; racism.

INTRODUCTION

During the COVID-19 pandemic, racists remarks accompanied by racist hashtags were disseminated via social media. Particularly, Asian-American people in the U.S. have been suffered from racism and xenophobia, resulting in physical violence and mental harassment in many cases. For example, in the mass shooting event that occurred on March 16, 2021, six Asian-American women were killed at the Asian-owned businesses in Atlanta described as an aspect of the global anti-Asian attacks (Haynes, 2021, March 22). The World Health Organization (WHO) stated "Disease names really do matter... We've seen certain disease names provoke a backlash against members of particular religious or ethnic communities (World Health Organization, 2015). In the beginning of the pandemic, on February 1, 2020, the WHO announced the official name of the novel coronavirus as "COVID-19," an intermixture of "coronavirus," "disease," and "2019" (World Health Organization, 2020a). The WHO advised, "Don't attach locations or ethnicity to the disease, this is not a 'Wuhan Virus,' 'Chinese Virus' or 'Asian Virus,'" and the U.S. Centers for Disease Control and Prevention (CDC) provided the equivalent guidelines regarding the indication of the new epidemic disease (World Health Organization, 2020b).

Ignoring the WHO and the CDC's recommendations, on March 16, 2020, Trump tweeted: "The United States will be powerfully supporting those industries, like Airlines and others, that are particularly affected by the Chinese Virus. We will be stronger than ever before!" (Yam, 2020, March 17). Since his first-time public use of the "Chinese Virus" on that day, Trump repeatedly applied the term to indicate the new epidemic disease, including during the COVID-19 pandemic briefing as he spoke with his coronavirus task force at the White House on March 19, 2020 (Mangan, 2020, March 19). After Trump's frequent use of "Chinese Virus," hate crimes against Asians rapidly increased (Bostock, 2021, March 22; Hong, 2020, April 12). The popular use of #Chinesevirus and #Chinavirus on Twitter was often accompanied by other racist hashtags, such as #Kungflu, #sinophobia, #bateatingchinese, and #yellowmanfever (Hswen et al., 2021; Pei & Mehta, 2020). Mental abuse and violence to Asian Americans spiked during the COVID-19 pandemic and many of the victims had to be hospitalized due to the severeness of violence while charges for hate crimes are rare (Hong & Bromwich, 2021, March 18).

Hubi (2019) claimed that social media functioned as a medium to disseminate racism and xenophobia. Despite the major function of social media as an open-access platform for unedited and free speech for people with diverse background, the global episodes of the soaring racism and xenophobia that occurred in online public arenas

reaffirmed that the platforms could be used for a nurturing ground of racism and xenophobia (Alkiviadou, 2019; Ben-David & Fernández, 2016). This study analyzed the racist hashtags, #Chinesevirus and #Chinavirus, on Twitter in March after Trump's first use of #Chinesevirus in his tweet on March 16, 2020. Although two studies examined the use of #Chinesevirus so far, they either mainly focused on the negative sentiment or the associated sentiments between the use of #covid19 and #Chinesevirus (Hswen et al., 2021; Pei & Mehta, 2020). By filling the gap with the previous studies regarding the adoption of racist hashtags under the new coronavirus pandemic, we examined the top influencers and neighboring hashtags in the #Chinavirus and #Chinesevirus Twitter network. In addition, we extracted topics from the racist hashtag Twitter network applying the state-of-the-art BERTopic modeling technique. We also conducted a geo-locational analysis of each tweet in the network globally as well as by U.S. states. The remainder of this paper is featuring a discussion of related literature followed by the data collection and analysis measures. Then, the study results are provided followed by the conclusion and discussion section.

LITERATURE REVIEW

Politicizing an Epidemic by Political Elites and its Impact on Public Opinion

The history of populism traces back to the People's Party in the South and Midwest area of the U.S. and the Narodniks in Russia in the late 19th century, McCarthyism in the mid-1950s in the U. S. and 1960s in Latin America (Moffitt, 2016, pp. 14–16). Populism is not associated with any particular time, ideology, or geo-location, i.e., Evo Morales in Bolivia, Geert Wilders in the Netherlands, Donald Trump in the United States, Carlos Menem in Argentina, Thaksin Shinawatra in Thailand, and conceptual debates within the literature are “in a relatively staggered and disjointed manner” (Moffitt, 2016, p. 17). Yet, some elemental approaches to populism are presented, which are ideology, strategy, discourse, and political logic (Moffitt, 2016). These methods often appeared in political leaders' communication to the public.

In *The Nature and Origins of Mass Opinion*, Zaller (1992) said, “when elites uphold a clear picture of what should be done, the public tends to see events from that point of view, with the most politically attentive members of the public most likely adopt to elite position” (p. 8-9). Politically attentive liberals in the public moved toward the stance of liberal opinion leaders, while politically attentive conservatives were apt to take the stance of elites traditionally identified as conservatives. Zaller (1992) also claimed political elites' communication to the general public matters whether and to what extent elites influence the public conversation about the new epidemic disease. A recent study by Adida and her colleagues about politicization of an epidemic and public attitudes on elections and immigration illustrated that political elites were capable of influencing public opinions in one subject area by exploiting a divided but implicitly linked subject area (Adida, Dionne, & Platas, 2020). Their survey revealed that introducing partisan cues into the framing of Ebola crisis turned especially republican participants against immigration, which supports the “flash potential” and the polarizing effect of immigration politics (Adida et al., 2020; Hopkins, 2014; Sniderman et al., 2004). In addition, political communication researchers indicated the ruling government energized severe partisanship and populism via social media platforms to confirm its declining hegemony under the national crisis (Bulut & Yörük, 2017; Chong, 2018, March; Urman, 2020). The literature suggests that Trump's intentional use of racist hashtags could affect opinions and emotions of the public, especially the conservatives and his supporters, with respect to the new coronavirus and its consequences. The use of #Chinesevirus in his tweets and for the Covid19 media briefing at the White House on March 16, 2020 and March 19, 2020 spiked the adoption of the racist hashtags, #Chinavirus and #Chinesevirus and many racist incidents in U.S. society (Bostock, 2021, March 22; Hong, 2020, April 12). In this study, we examined the rise of racism and xenophobia cultivated and shared via social media platforms in the beginning of the COVID-19 pandemic. Little is known about major actors and discourses in the racist Twitter networks generated during the COVID-19 pandemic, and the following research questions were examined.

RQ 1. Who were the top influencers in the #Chinavirus and #Chinesevirus Twitter network in March 2020?

RQ 2. How were racist or racial ideologies presented in the #Chinavirus and #Chinesevirus Twitter network in March 2020?

Growth of Racial Attack and Xenophobia on Social Media under the COVID-19 Pandemic

Social media affordance could maximize a user's freedom of expression by way of an anonymous post. While previous research has more focused on affordance as a significant power to expedite civic engagement to pursue democracy (Kow, Kou, Semaan, & Cheng, 2016), it could serve the growth of racist hype (Ben-David & Matamoros-Fernández, 2016; Farkas, Schou, & Neumayer, 2018). Moreover, the real-time and global-scale interactivities on social media enabled racist mis and disinformation to attract like-minded international participants, which often promptly created xenophobic clusters in online public spheres (Klein, 2017). Recently, scholars have investigated whether the freedom of expression in digital spheres advanced the rise of expressing racism and xenophobia (Alkiviadou, 2019; Ben-David & Matamoros-Fernández, 2016). Matamoros-Fernández (2017) dubbed this platform-centered racism as “platformed racism.” This online-cultivated racism often allowed a large-scale

distribution of bigoted and hate speeches against the racial minority groups in society, such as Islamophobia after the 9/11 Attack. Xenophobia nurtured and amplified via social media platforms could help justify racism as usual part of online public conversations, which could increase possibilities to circulate xenophobic discourses on social media (Pei & Mehta, 2020).

Researchers identified the outburst of racism and xenophobia under the crisis due to its often unpredictable and unprecedented nature (Salaita, 2006). The insecure and panic-like emotional condition could trigger people's continuous irrational decision-making (Sweeny, 2008). Particularly, the serious developments of the crisis, mis and disinformation in online, and elites' agenda-setting toward public opinion for a targeted political purpose could contribute together to the public opinion made during the crisis (Khaldarova & Pantti, 2016; Jones, 2019). To analyze the regional characteristics in the diffusion of the racial hashtags, #Chinavirus and #Chinesevirus, on Twitter, the following research questions were investigated:

RQ 3. What were the geo-locational characteristics in the diffusion of #Chinavirus and #Chinesevirus on Twitter in March 2020? In other words, who actively adopted #Chinavirus and #Chinesevirus on Twitter?

RQ 4. What hashtags were associated with #Chinavirus and #Chinesevirus on Twitter in March 2020?

METHODS

Data Collection

We retrieved tweets that included #Chinavirus or #Chinesevirus, including their user information per each tweet. The datasets were acquired via Application Programming Interface using NodeXL import function, and the collection period was between March 17, 2020 and March 25, 2020. We specifically set this period to investigate the top influencers and major topics shared via the #Chinavirus and #Chinesevirus Twitter networks directly after Trump's intentional use of #Chinesevirus on March 16, 2020. A total of 43,783 vertices (Twitter handle) and 75,797 relationships (edges), such as tweets, mentions, replies to, and retweets, were acquired, respectively. Additionally, we collected each tweet's geo-locational information via latitude and longitude coordinates as well as adjacent hashtags accompanied with #Chinavirus or #Chinesevirus.

Data Analysis

This study applied a multimethod approach adopting data science and qualitative methods to answer the proposed four research questions. To identify top influencers in the #Chinavirus and #Chinesevirus Twitter network, we employed social network analysis (SNA), including degree centrality, eigenvector centrality, page rank score, and betweenness centrality. Degree measures the number of edges incident to a vertex. Eigenvector centrality, or a prestige score, is a measure of a vertex that describes its connectivity in a network. A vertex with a high eigenvector score means that it is relatively linked with many vertices in a network (Negre et al., 2018). Page rank is a variant algorithm of eigenvector centrality, which is popularly known as the Google Search algorithm that classifies website pages depending on the search results. It is often used to measure the popularity of a website page based on the assumption that more important website pages are likely to obtain more links from other website pages (Austin, 2006). This study used degree centrality, eigenvector centrality, and page rank scores in addition to betweenness centrality to determine top influencers in the #Chinavirus and #Chinesevirus Twitter network.

To identify conversational topics and racist ideologies in the network, we performed topic modeling using BERTopic algorithm. BERTopic is a topic modeling technique that leverages BERT embeddings (Devlin et al., 2019) and c-TF-IDF to create dense clusters that allow easily interpretable topics whilst keeping important words in the topic descriptions (Grootendorst, 2021, January 12). BERTopic modeling mainly includes three steps: (1) Sentence-bert was used to get the embeddings for input documents (Nils & Iryna, 2019). (2) UMAP and HDBSCAN were used to get the document clusters (McInnes, Healy, & Astels, 2017; McInnes, Healy, & Melville, 2018) (3) A class-based TF-IDF procedure (c-TF-IDF) was used to extract and reduce the number of topics. (4) Maximal Marginal Relevance was used to improve coherence of words among topics. BERTopic technique allows users to choose different pre-trained embedding models for sentence representation and different n-gram models for topic representation. It is one of the state-of-the-art models for computational topic analysis. Compare to the traditional topic modeling, such as LDA or LSA based methods, BERTopic can encode contextual information with BERT and preserve local structures in the process of document clustering with UMAP, which enhances the quality of the topic analysis. In this paper, we employed the stsb-roberta-large model for sentence embedding (https://www.sbert.net/docs/pretrained_models.html). To select the best number of topics, we applied the combination of perplexity and coherence scores, which provided a measure for the performance evaluation of the given topic modeling. The lower the perplexity means the better the model. As for topic coherence, the higher the coherence score implies the better the model.

To analyze the geo-locational distribution of the network, we coded the latitude and longitude coordinates per each edge. A small number of tweets were excluded for analysis due to the lack of locational information. We employed

geopy to identify the countries and the states in the U.S. from the locational information. Geopy is a Python client for several popular geocoding web services, which makes it easy for Python developers to locate the coordinates of addresses, cities, countries, and landmarks across the globe using third-party geocoders and other data sources. We conducted statistical analysis by the country as well as by state in the U.S. and visualized the results using Matplotlib, a comprehensive library for creating static, animated, and interactive visualizations in Python. Before applying SNA, we deleted duplicated edges and conducted data cleaning process by removing unnecessary information in the dataset to perform BERTopic modeling and geolocal analysis.

RESULTS

This study used eigenvector centrality, page rank score, and in and out degree numbers in addition to betweenness centrality to define the key influencers in the #Chinavirus and #Chinesevirus network. “Betweenness centrality” is a measure of how often a given vertex lies on the shortest path between two other vertices and how a vertex connects groups by bridging the gap in the global network (Hansen et al., 2020). A vertex with high betweenness centrality carries the largest amount of traffic with the shortest paths; thus, they are the most significant actors in connecting conversations between diverse regions in a weakly connected network (Easley & Kleinberg, 2012). Table 1 displayed the top 15 Twitter users prioritized based on the betweenness centrality (bc) in the network, and it also includes the examined numbers of in and out degree, eigenvector centrality, and page rank scores of the top 15 bc vertices. Trump’s Twitter handle, @realdonaldtrump, presented 5108 indegree and 0 outdegree, which means the @realdonaldtrump’s tweets were shared 5108 times by other actors in the network while @realdonaldtrump never retweeted and mentioned any others’ tweets or accounts. Moreover, @realdonaldtrump demonstrated the highest eigenvector centrality as well as the highest page rank score in the entire network.

Based on the centrality measurements from SNA, Trump (@realdonaldtrump along with @potus in 12th rank) was identified as the most influential actor in the #Chinavirus and #Chinesevirus Twitter network. Interestingly, several top influencers of the network, including @realdonaldtrump, @harbirsinghnain, @bigthin83310115, @chacaotoday, and @dvatw as indicated in red, were suspended by Twitter.com due to the violations of the Twitter’s company policy. Multiple influencers were identified as Indians, such as @majorgauravarya (Indian military officer), @imac_too (Indian journalist), and @Zankrut (digital media and public relation strategist at the Indian government). Overall, the tweets posted by these three Indian influencers were about domestic socio-political issues in India and relationships between India and China.

Rank	Vertex	Betweenness Centrality	Eigenvector Centrality	Page Rank	Indegree	Outdegree
1	realdonaldtrump	612020518.714	0.006	1303.838	5108	0
2	harbirsinghnain	191988228.915	0.000	1002.053	2908	3
3	who	89725526.980	0.000	156.061	705	0
4	bigthin83310115	65952520.417	0.000	440.735	991	1
5	imac_too	60152996.256	0.000	310.711	1059	2
6	chacaotoday	52341622.979	0.000	308.248	810	1
7	dvatw	46032174.898	0.000	216.198	646	3
8	zankrut	45457856.212	0.000	197.261	655	1
9	aasteixeira	43471969.262	0.000	39.205	3	175
10	majorgauravarya	37310689.958	0.000	202.071	606	1
11	nbcnews	35634161.989	0.000	89.947	360	0
12	potus	33716967.986	0.000	120.342	537	0
13	narendramodi	29490945.259	0.000	83.056	368	0
14	xhnews	29072989.694	0.000	87.999	350	0
15	rmconservative	28323914.079	0.000	156.575	436	2

Table 1. The Top 15 Actors by Betweenness Centrality in the #Chinavirus_#Chinesevirus Twitter Network

We graphed the entire #Chinavirus_#Chinesevirus network to visualize Trump's impact in the network. As shown in Figure 1. Trump (@realdonaldtrump) illustrated dominant influence in the network, and his edges (connections with other actors) accounted for 8.2% of the global network.

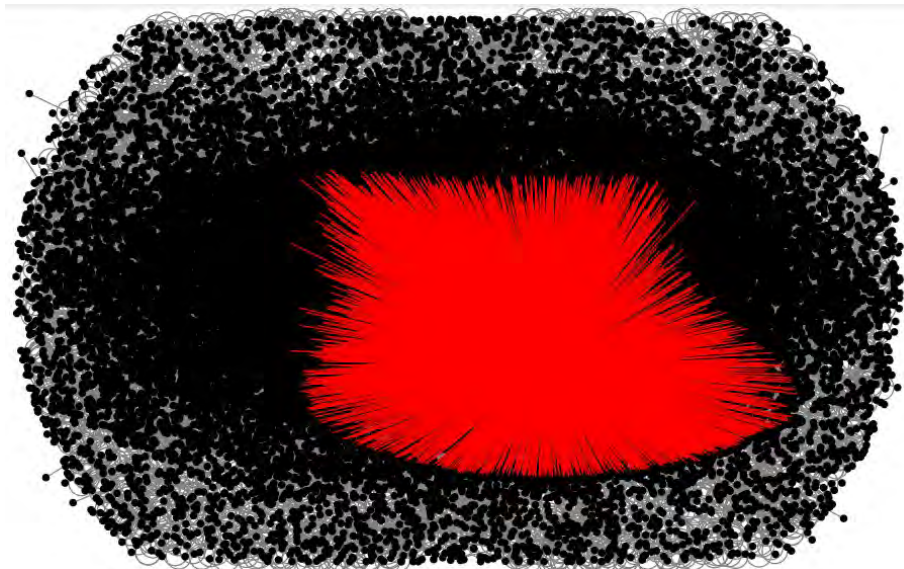


Figure 1. The #Chinavirus_#Chinesevirus Twitter Network with @Realdonaldtrump in Red

After a number of iterative analysis, we determined the best number for BERTopic modeling analysis as 38 topics based on the perplexity score, -11.57 and the coherence score, .43. We extracted topics with one gram, two grams, and three grams to compare the results among the different n-gram outcomes. Despite overall similarities between the extracted topics with two grams and three grams, we found the three grams analysis generated more key words embedding better contextual information for topic identification. Table 2 demonstrated the top 10 topics retrieved with three grams via BERTopic modeling. As shown in Table 2, top topics presented anti-Chinese or anti-China sentiments, such as 'calling chinesevirus,' 'slap xi,' 'coronavillains' and 'chi communist ipptv.' The most outstanding and repeatedly observed occurrence was assigning various titles to the new coronavirus, such as wuhanvirus, chinesevirus19, chinesecoronavirus, ccpvirus, xijingpingvirus, xijingplague, wuhanvirus, wuflu, and wuhancoronaviru. Many participants of the #Chinavirus or #Chinesevirus Twitter network applied ethnicity and location opposing to the WHO's recommendations. While avoiding using the official name, COVID-19, the hashtag users illustrated criticism and antagonistic remarks to Chinese and XiJingping, the top national leader of the People's Republic of China. Topic id 0 illustrated Muslims' distress because from the right wing's attack in India, i. e., 'hiding mosque pain' and 'collahs hiding mosque.' Further, distrust toward media from the conservatives (topic id 75) and asking financial help for friends and family (topic id 39) were also identified as major topics.

Id	Count	Terms
28	2889	0.1172*'calling chinesevirus maybe' + 0.1172*'maybe get chinese' + 0.1172*'get chinese treatment' + 0.1172*'chinese treatment url' + 0.1172*'chinesevirus maybe get' + 0.1172*'you're calling chinesevirus' + 0.1133*'get chinese' + 0.1121*'chinese treatment' + 0.1032*'chinesevirus maybe' + 0.0319*'calling chinesevirus'
110	1471	0.0639*'may drag crowd' + 0.0639*'politics may drag' + 0.0639*'cry media' + 0.0639*'cry media politics' + 0.0639*'nazwa winowaje pandemii' + 0.0639*'ipptv real url' + 0.0639*'koronawirus cry' + 0.0639*'koronawirus cry media' + 0.0639*'covid19 koronawirus cry' + 0.0639*'chi communist ipptv'
176	1246	0.1600*'slap xi finding' + 0.1600*'slap xi' + 0.1600*'chinesevirus19 chinese coronavirus' + 0.1600*'wuhanvirus chinese virus19 chinese coronavirus' + 0.1600*'chinese coronavirus url slap' + 0.1600*'chinese virus19 coronavillains chinese virus corona' + 0.1600*'chinese coronavirus url comb' + 0.1600*'chinese virus corona url slap' + 0.1600*'comb chinese virus chinese virus19' + 0.1600*'chinese virus chinese virus19'
234	987	0.1251*'coronavirus chinese virus wuhanvirus' + 0.1031*'usermention coronavirus chinese virus' + 0.1020*'chinese virus wuhanvirus wuflu' + 0.0905*'wuhanvirus wuflu' + 0.0091*'xijingpingvirus xijingplague wuhancoronavirus' + 0.0091*'xijingpingvirus xijingplague' + 0.0091*'xijingpingvirus' + 0.0091*'ccpvirus xijingpingvirus xijingplague' + 0.0091*'wuflu url wuhancoronavirus' + 0.0091*'xijingplague wuhancoronavirus'
0	840	0.0213*'smoking foreign collahs' + 0.0213*'erode karimnagar chandrapur' + 0.0213*'erode karimnagar' + 0.0213*'ranch erode karimnagar' + 0.0213*'chinese virus smoking foreign' + 0.0213*'chinese virus smoking' + 0.0213*'collahs hiding mosque' + 0.0213*'smoking foreign' + 0.0213*'foreign collahs hiding' + 0.0213*'hiding mosque pain'
131	686	0.1439*'branch cartoon base' + 0.1439*'chinese virus wuhanvirus bidenbros' + 0.1439*'wuhanvirus bidenbros biden2020' + 0.1439*'grab url chinese virus' + 0.1439*'cartoon base grab' + 0.1439*'wuhanvirus bidenbros' + 0.1058*'branch cartoon' + 0.0813*'url chinese virus wuhanvirus' + 0.0018*'chinese virus wuhanvirus'
226	541	0.2279*'url chinese virus chinese virus' + 0.0424*'url asianamerican chinese virus' + 0.0400*'url chinese virus hantavirus' + 0.0400*'asianamerican chinese virus' + 0.0233*'chinese virus url chinamiente' + 0.0233*'chinese virus chinese viruses chinesemaal' + 0.0233*'chinese virus url asianamerican' + 0.0233*'url chinese virus chinese viruses' + 0.0233*'chinese viruses chinesemaal chinese virus' + 0.0233*'chinese viruses chinesemaal'
298	464	0.0506*'hate us americans' + 0.0506*'america rest world' + 0.0506*'hate us' + 0.0506*'chinese virus started america' + 0.0506*'american virus including' + 0.0504*'china dont want' + 0.0502*'calling american virus' + 0.0492*'peoples hate' + 0.0492*'peoples hate us' + 0.0492*'nations peoples hate'
75	339	0.0738*'monkey media' + 0.0738*'flying monkey' + 0.0738*'monkey media lied' + 0.0738*'leftwing flying monkey' + 0.0738*'matter chinavirus' + 0.0738*'media lied' + 0.0738*'flying monkey media' + 0.0738*'coronavirus anything else' + 0.0738*'else matter chinavirus' + 0.0717*'monkey'
39	315	0.0713*'need financial' + 0.0713*'friends need financial' + 0.0713*'assistance look family' + 0.0713*'family give money' + 0.0713*'members friends need' + 0.0713*'members friends' + 0.0713*'family members friends' + 0.0713*'money need emergency cash' + 0.0713*'friends need' + 0.0713*'need financial assistance'

Table 2. Top 10 Topic Extracted with Three Grams by BERTopic Modeling

Figure 2 presented the results of the geolocational analysis of the #Chinavirus_#Chinesevirus Twitter Network by country. People in the U.S., India, the U.K., China, Canada, Venezuela, Pakistan, Brazil, and Japan were primary participants of the network in March 2020. Specifically, the hashtags, #Chinavirus and #Chinesevirus, were extensively adopted in the U.S. and India. Interestingly, the two racist hashtags were frequently shared and linked to the Chinese Twitter users in China as shown in Figure 2 and their concerns, such as 'peoples hate us' and 'chinesevirus started America' and negative sentiment, such as 'peoples hate,' and 'hate us,' was observed as one of the major topics (topic id 464).

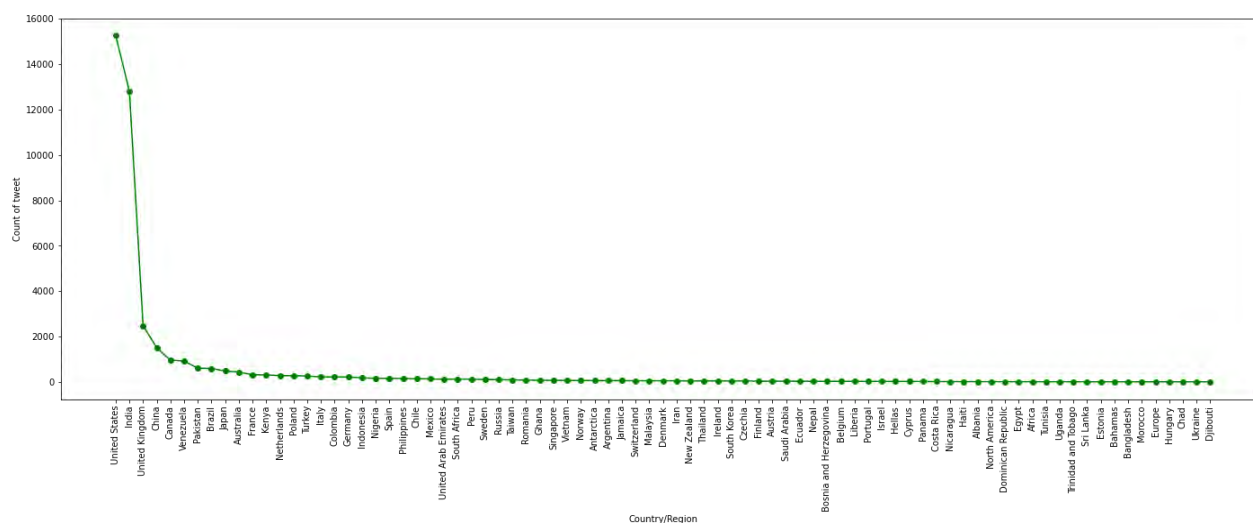


Figure 2. Geolocalational Analysis of the #Chinavirus_#Chinesevirus Twitter Network by Nations Worldwide

Figure 3 demonstrated the geolocalational analysis of the two hashtags by state in the U.S. The top ten states where people shared the hashtags, #Chinavirus and #Chinesevirus, the most were California, Texas, Florida, New York, Ohio, Illinois, New Jersey, North Carolina, Pennsylvania, and Tennessee. Strikingly, these top ten states were almost matched with the U.S. states with the highest mortality rate from the new coronavirus including the ranking order of the states (<https://www.statista.com/statistics/1109011/coronavirus-covid19-death-rates-us-by-state/>).

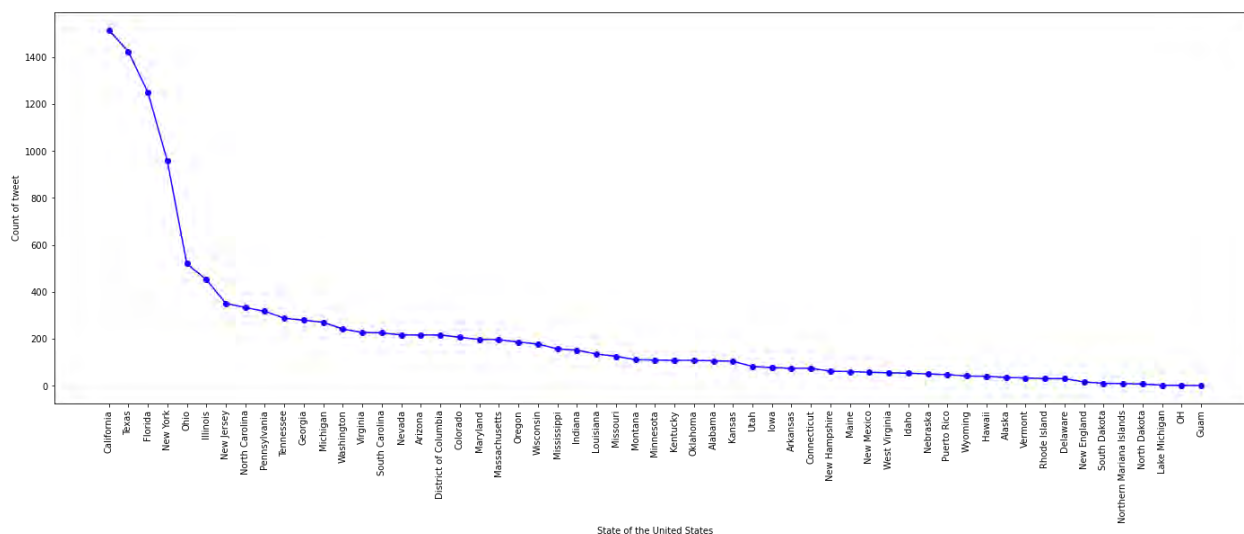


Figure 3. Geolocalational Analysis of the #Chinavirus_#Chinesevirus Twitter Network by States in the U.S.

Table 3 demonstrated the top 50 hashtags associated with the #Chinavirus and #Chinesevirus on Twitter. As detected in the BERTopic modeling results, multiple and diverse alternative names for COVID-19 were created and used as hashtags, such as #kungflu, #xivirus, #Chinavirusmadeinchina, and #wufu. Additionally, we could identify multiple hashtags often adopted by Trump supporters, such as #maga, #americafirst, #trump2020, and #patriot. Many hashtags expressed anti-Chinese or anti-China sentiment, i. e., #chinoisasshoe, #boycottchina, #chinazi, #chinaliespeopledie, and #fuckchina. Similar to the previously observed topics, many hashtags accompanied with the #Chinavirus and #Chinesevirus presented a tone of criticism and blame to China, which could result in stigmatizing and randomly blaming Chinese and Asian Americans at large for the root cause of the new epidemic disease.

Rank	Hashtags	Count	Rank	Hashtags	Count	Rank	Hashtags	Count
1	chinesevirus	41479	18	quarantinelifelife	789	35	21daylockdown	346
2	chinavirus	20805	19	ccpvirus	712	36	covid_19	317
3	wuhanvirus	5957	20	chinaliedandpeopledied	676	37	lockdown21	312
4	coronavirus	5484	21	chinesevirus19	581	38	mypanemicsurvivalplan	305
5	covid2019	4064	22	chinese	569	39	covid19ke	303
6	covid19	3927	23	coronaviruslockdown	548	40	chinoisasshoe	291
7	china	3247	24	covid	532	41	coronaviruspandemic	291
8	coronavirusoutbreak	2507	25	chineseviruscorona	526	42	kungflu	291
9	viruschino	1809	26	ccp	521	43	maga	282
10	wuhancoronavirus	1479	27	coronafighters	507	44	venezuela	281
11	chinaliedpeopledied	1425	28	stpatriksday	473	45	coronavirusinpakistan	280
12	covidindia	1248	29	fakenews	462	46	wuflu	280
13	chinacoronavirus	1169	30	coronavirusindia	445	47	covid19out	280
14	corona	1067	31	chinesevirus	417	48	covid-19	276
15	wuhan	941	32	hongkong	382	49	tuesdaythoughts	273
16	chinese coronavirus	933	33	madeinchina	380	50	wuhancoronavirus	270
17	stayhomechallenge	898	34	stayhome	348			

Table 3. Top 50 Hashtags Accompanied by #Chinavirus and/ or #Chinesevirus

CONCLUSIONS AND DISCUSSION

Trump (@realDonaldTrump) was identified as the most influential actor in the #Chinavirus and #Chinesevirus Twitter network. This study confirmed the literature that the political elite's communication strategies to deviate the public's indignation from the sufferings under the epidemic crisis. Trump's manipulative and intentional use of the hashtag, #Chinesevirus, was successfully integrated with anti-China and anti-Chinese sentiment in the Twitter network, which generated not only various types of racist labels to the new coronavirus but also neighboring racist hashtags. The impact was eminent to the U.S. public, particularly those who lived in the states that presented a high mortality rate from the new coronavirus infections. The findings of the study suggested that Trump's tactic was successful in some degree by alternating domestic and international attention to a certain ethnic group or a nation.

In the digital spheres, these racist hashtags were diffused and shared while creating severe anti-Chinese sentiment serving the global audience who might want to find someone to blame due to the stressful situations from the pandemic. The examined major discourses and shared hashtags illustrated hateful emotions, stigmatization, justifying attacks on the minority group, such as Muslims in India, and mis and disinformation, including #chinaliedpeopledied, instead of focusing on efforts to overcome the crisis. We examined the #Chinavirus and #Chinesevirus Twitter network in March 2020 to specifically investigate the Trump's influence on the public opinion and sentiment in relation to his deliberate application of racist hashtags. In our future study, we will conduct the longitudinal research to examine the temporal topic changes over a year period in the #Chinavirus and #Chinesevirus Twitter network.

ACKNOWLEDGMENTS

The authors thank Raheyima Khan and Akshitha Maddi, graduate students in the Department of Information Science at University of North Texas for analysis assistance.

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Controlled Digital Lending

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ABSTRACT

Libraries and library consortia are adopting controlled digital lending (CDL) as a strategy, accelerated by the ongoing COVID-19 pandemic, to facilitate equitable access to print collections. While advocates of CDL contend that digitize-and-lend practices reflect an incremental, technology-assisted adjustment to traditional library circulation, lending, and resource-sharing practices, opponents of CDL in the United States and Canada argue that the practice contravenes well-established copyright protections. This paper discusses current controversies surrounding CDL, its potential promise and perils, and concludes that a reasonable, equitable, and forward-looking application of copyright laws ought to insulate libraries and library consortia from exposure to liability for engaging in CDL.

KEYWORDS

information access; information policy; copyright; libraries; fair use/fair dealing.

INTRODUCTION

Libraries occupy a crucial role in democratic societies as founts of a shared cultural and intellectual record, community centers and public meeting places, and critical access points for technology and other services. In recognition of the important and unique role these institutions play in serving the public interest, libraries have earned a special status among information organizations. One area in which this special status is reflected is copyright law, where library-specific privileges and exceptions are set forth to ensure that the collection, preservation, and sharing of protected content will be carried out, in the public's interest, by these trusted intermediaries.

Controlled digital lending (CDL), an emerging digitize-and-lend practice that libraries and library consortia have recently begun adopting to better satisfy the information needs of their communities, is raising questions about how libraries can lawfully and ethically use technology to carry forward their longstanding mission. Using digital scanning technologies, libraries are able to produce functional copies of lawfully acquired items held in their print collections such as periodicals, monographs, textbooks, and reference works. The resulting digital copies are then used in much the same ways libraries have used printed materials: they are lent to users (via an online access platform instead of a face-to-face transaction) and shared with consortia partners through what is essentially a digital interlibrary loan (ILL). The initial act of digitizing print works is resource-intensive but, once digital copies are created, they can be shared more easily, quickly, and conveniently than print materials and face relatively little risk of loss or deterioration. Where digital copies already exist (by virtue of earlier digitization efforts by, for example, the Internet Archive or Google Books Project), CDL may involve repurposing existing scans for lending. CDL thus reflects a new technology-assisted tweak to traditional practices that makes libraries capable of better serving the interests of the public. Moreover, given the restraints on in-person transactions associated with the ongoing COVID-19 pandemic, innovations in lending like CDL are required if libraries are to continue meeting their crucial mandate of providing public access to information resources.

Despite the advantages of a digitize-and-lend model and recognition of libraries' special status as public institutions, CDL is controversial from a legal perspective. Copyright law gives rights holders certain limited exclusive rights including the right to make and publicly distribute copies of their work. While the law grants some exceptions for libraries that enable them to, for example, lend materials to patrons and other libraries and make copies of deteriorating and damaged works under limited circumstances, it is not clear that CDL falls within their rights under the law. This paper seeks to resolve this uncertainty and provide guidance for libraries regarding CDL.

In the first part of this paper, we chart the origins and implementations of CDL both prior to and contemporaneous with the COVID-19 pandemic. Next, we discuss the promise and perils of CDL, laying out the claims and arguments of proponents and opponents to this emerging service. Since the primary objections to CDL revolve around copyright concerns, this section also focuses on relevant copyright laws and policies in the defined jurisdiction of the United States. While CDL occupies a gray area in the law, we argue that the promise of the lending model should outweigh its potential risks. Applying ethical principles guided by the overarching policy motivating

copyright law, we suggest that CDL initiatives must not be thwarted by the overzealous application of legal rules. Finally, in the third part we offer concrete recommendations for libraries and library consortia considering, or engaging in, CDL. While the current global pandemic provides some emergency cover for libraries engaging in CDL, those services should not taper off as the virus tapers off. Instead of shrinking into the constraints of the past, libraries should take bold steps toward embracing a “new normal” made possible through technology-assisted services like CDL that advance their crucial mission in the public’s interest.

ORIGINS AND IMPLEMENTATIONS OF CONTROLLED DIGITAL LENDING

While CDL was conceptualized as an innovation in lending only about ten years ago, nascent precursors such as Project Gutenberg have existed since the 1970s. Additional examples of early library and archive digitization efforts began in 1995 with Making of America, a collaboration between Cornell University and the University of Michigan, and continued with the Google Books Project in the 2000s as well as the ongoing efforts of the Internet Archive (IA). Most of these earlier digitization efforts were motivated, at least explicitly, by preservation interests and a desire to create a digital “dark archive” rather than to support digital lending (Centivany, 2017). CDL therefore reflects a marked change, not necessarily in actual digitization practices, but rather in public explanations and justifications for the *creation* and *use* of digital resources.

Pre-COVID-19 initiatives

Depending on whether scans are freshly made or pre-existing, CDL in libraries and consortia involves the digitization and/or use of digitized copies of legally acquired physical items for the purpose of lending to patrons. Digital surrogates are then shared instead of print originals. These digitize-and-lend practices were first described by Wu (2011) as strategies to more effectively support cooperative collections development and shared print preservation initiatives in academic law libraries. In essence, Wu proposed a collaborative system in which libraries “pool resources, through a consortium, to create a centralized collection of legal materials, including copyrighted materials, and to digitize those materials for easy, cost-effective access by all consortium members” (p. 529). Even though the centralized legal library that Wu proposed has yet to materialize, a handful of CDL projects took form in isolation prior to the pandemic. In response to shifts in the ways that patrons choose to access information, for example, stakeholders at Duke University embarked on a digitize-and-lend project as a result of their interpretations of both first sale and fair use (McCleskey & Selby, 2019).

Additional authors have contributed to discussions to further define the purposes and limitations of CDL. For instance, in a position statement that numerous library leaders and organizations have endorsed, Bailey et al. (2018) describe criteria to qualify CDL design and implementation decisions. A preliminary test entails determining if items have been legitimately acquired, or verifying that libraries own rather than license the materials. Wu (2019a) clarifies that “the copyright owner received remuneration for her work at the time the physical work was first purchased or voluntarily gave away the copy herself”. A second test requires that libraries and consortia maintain an owned-to-loaned ratio between the number of physical items that are in their possession and the number of concurrent digital loans that they permit for that item. Hansen and Courtney (2018) elaborate that “these controls ensure that libraries lending digital copies don’t get more than what they bargained for” (p. 25). A third test stipulates that measures be taken to sequester physical items that have been digitized. Wu (2019b) explains that the use of sequestered items would be possible only if the digital surrogate were suppressed. Wu (2011) introduced the idea that libraries could manufacture scarcity by destroying the originals after digitization, but this would not only impair future reference and consultation, but moreover, destruction would undermine print preservation efforts.

Some preeminent characteristics of CDL in libraries pertain to the applications and technology that are employed to support the functionality of the lending model. The first feature concerns setting time limits on loaned items that mimic physical lending from a library (Bailey et al., 2018). In addition, since the technical applications permit patrons to access digital surrogates rather than possess copies on their own computers, libraries are able to recall materials after loan periods expire by simply revoking access (Wu, 2017). A second key feature of CDL concerns enforcing digital rights management (DRM) protocols. Measures that are built into online lending platforms prevent users from copying, printing, or otherwise sharing digital surrogates with others (Bailey et al., 2018; Wu, 2016). These two features define digitize-and-lend practices. According to Hansen and Courtney (2018), “those controls, especially the deployment of DRM, ensure that just as with physical books, the digital copies are effectively still in control of the library and cannot (without illegal action on the part of the user) proliferate into additional copies” (p. 25). It is the merits of the applications and technology employed by libraries and consortia that distinguish CDL from digital piracy.

A most felicitous example of pre-COVID-19 digitize-and-lend initiatives is the vast library that is maintained by IA. Its goal is to “provide universal access to all human knowledge by collecting, archiving, and providing public access to different types of digital materials” (Bailey, 2020, p. 1), an aim that the organization works toward by scanning thousands of books daily in locations around the world. Public libraries that partner with IA to digitize materials

from their collections include the Boston Public Library, the Toronto Public Library, and the Hamilton Public Library. Academic libraries such as MIT Libraries, University of Toronto Libraries, the University of Alberta Library, and Trent University Library and Archives all contribute content for digitization and public—yet controlled—lending by IA. Chris Freeland, Director of IA, describes the process:

We do nondestructive scanning of our books, and once scanned, the physical books are preserved in our physical archive for long-term storage. If the book is in copyright, then the files are delivered to users through controlled digital lending, meaning that a user has to check out the book to view it for 14 days, and the files are protected by digital rights management (DRM) and cannot be redistributed. (Vieira, 2020, p. 225)

According to statistics provided by the site (Internet Archive, n.d.), approximately 12 million unique users have accessed resources from the library since 2002. Usage unsurprisingly spiked in 2020 when libraries closed to mitigate the spread of the novel coronavirus that causes COVID-19. In particular, nearly three times as many new users were recorded in April 2020 than in any other month leading up to the global crisis.

Initiatives prompted by COVID-19

In the spring of 2020, public health officials around the world recommended that extreme measures be undertaken to inhibit transmission of the virus. Schools, colleges, and universities, as well as libraries of all types, were required to limit—if not temporarily discontinue—access to physical premises and resources. According to Murphy and Shelley (2020), “most university libraries have been shutting down their physical buildings altogether, with most of the remainder severely limiting their hours, who can access them, and physical contact with users” (p. 235). Some libraries began to offer contactless pickup options for patrons in need of physical items, whereas others scanned requested excerpts or chapters and sent the digital files to users (Levine-Clark & Emery, 2020; Murphy & Shelley, 2020). It is relatively simple to demonstrate that the adoption of CDL practices by libraries and consortia diminishes barriers that patrons confront when attempting to access items through modified service methods that are introduced in response to emergencies such as pandemic.

In answer to a prevalence of unfulfilled information needs in communities, schools, and higher education institutes as a result of COVID-19, IA chose to temporarily lift one of the controls that define CDL, notably the owned-to-loaned ratio (Hannay, 2020). Freeland (2020) states that “waitlists will be suspended through June 30, 2020, or the end of the US national emergency, whichever is later. After that, the waitlists will be reimplemented thus limiting the number of borrowable copies to those physical books owned and not being lent”. The aim of the temporary National Emergency Library was to make available approximately 650 million books that were inaccessible in libraries due to lockdowns (Vieira, 2020), many of which are characterized as being unavailable in formats other than print (Freeland, 2020).

Libraries and consortia that depend on resource sharing such as ILL to fulfill the needs of users found themselves disadvantaged by the implemented safety measures. In observation of the first wave of outbreaks, Levine-Clark and Emery (2020) write that “this pandemic has had a negative impact on library collaboration: interlibrary loan (ILL) services have been cut back as most libraries have been unable to lend physical materials or even scan materials to be delivered electronically. Couriers, which regional networks rely on for sharing of resources, have been unable to operate” (p. 1). Additional authors discuss the temporary suspension of ILL (Murphy & Shelley, 2020; See, 2020), but none offer alternative strategies. It is plausible to imagine that consortia members could process patron requests, scan items in their entirety, sequester the originals, and make the digital surrogates available through the regulated elements that constitute CDL. Not only is there potential to satisfy user needs that would have otherwise been fulfilled through ILL, but in addition, it would never be necessary for other consortia members to digitize those items again.

A long-standing challenge in academic libraries that has been exasperated by lockdowns is how to make expensive textbooks that are required for coursework available to students. In pre-pandemic times, libraries satisfied this need in part through course reserves. McKenzie (2020b) elaborates that “desk copies of textbooks were given to the library by instructors, who received them from publishers when they assigned the textbook. The textbooks are cataloged as reserve materials, meaning students can only borrow them for a short period and typically cannot remove them from the library”. It should be noted, however, that not all course reserves are instructor copies; some libraries choose to purchase a breadth of assigned textbooks (DeMartini et al., 2018; McHale, 2020; Pollitz et al., 2009; Thompson & Cotton, 2017). These resources are no longer viable as short-term loans without lengthy quarantine periods between check-outs. Digitize-and-lend programs that target these materials would not only eliminate the need for some students to return to campus, but CDL can also help alleviate stressors such as financial insecurity that many students must manage in addition to health and safety concerns induced by the pandemic.

Academic libraries in both the United States and Canada began designing and implementing CDL programs to address the teaching, learning, and research needs of patrons during the global pandemic. Libraries are digitizing

select materials in their entirety that would otherwise be available to students through course reserves and short-term loans. These lending practices align with the fundamental underpinnings of the CDL model: owned-to-loaned ratios are maintained, physical items are sequestered, specific time limits are placed on loans through the use of resource management systems, and the technological solutions that are employed ensure that DRM protocols are in place. Library users that borrow items through these controls are unable to retain, print, or share the digital surrogates that they access.

Libraries are employing resource management systems such as Alma-D, Leganto, and Ares to control and responsibly provide access to digitized content. Some implementers that are not identified as per the Chatham House Rule (Chatham House, 2020) describe inroads that they have made through the use of Occam's Reader, OverDrive, Aviaary, Panopto, and SimplyE, whereas others are working with corporate document security organizations such as Digify to tailor solutions to meet their needs. One library is utilizing the scheduling function of LibCal, a popular booking and calendaring tool, to reserve timed access to digitized content. Another has designed an app that automates sharing restrictions in Google Drive. Wu (2019b) states that "the seeds of the systems we need exist today", however "none of them are yet sophisticated enough to accomplish the integrated and dynamic workflow" (p. 141) that is necessary for far-reaching collaborative digitize-and-lend programs. Nonetheless, it is anticipated that commercial solutions will be available sooner rather than later (Burger et al., 2021). According to Cross (2020), "the Project ReShare Community, a group of libraries, consortia, information organizations, and developers, plans to develop a minimum viable product to support CDL" (p. 53). Project ReShare envisions libraries working as nodes in a network that is supported by a distributed service directory. The organization is developing tools for libraries and consortia to use in content request management, loan policies, digitization, delivery, and integration in both local and shared library systems (Project ReShare, n.d.).

THE PROMISE AND PERILS OF CONTROLLED DIGITAL LENDING

Claims and arguments in favor of CDL

Proponents of CDL assert that digitize-and-lend models align with the missions of libraries and other cultural institutions. Lending materials to community members is a vital function that libraries fulfill in society; they support education, research, intellectual enrichment, and social development (Hansen & Courtney, 2018; Wu, 2019a). Libraries are built to improve communities and nations in ways that fall under the purview of few other institutions, and as such, it can be seen as a duty of information professionals to investigate and put into practice new methods to more effectively satisfy this mission. Given the fact that many important works—some no older than a quarter of a century—outlive their commercial viability 50 years or more before their copyright expires, it is the responsibility of cultural institutions such as libraries to preserve and facilitate access to the intellectual content that items embody (Perzanowski & Schultz, 2016). CDL practices assist libraries and consortia to make materials available no matter the desired format of users or equipment utilized going forward (Wu, 2017). Through their implementations of CDL, libraries ensure that patrons will perpetually benefit from the substantial investments in print resources that are made on behalf of present and future users.

Lending to community members is a function that has defined libraries for generations, but for patrons for whom distance is a barrier, the wide-ranging benefits of curated collections are out of reach. Wu (2017) demonstrates that patrons from rural areas experience more difficulty than others to access library resources. In addition, Hansen and Courtney (2018) write that socioeconomic status as well as limitations that confine patrons to their homes can make travel to library branches impractical. Advanced age, health or mobility issues, or the need to care for family members are factors that can prevent patrons from borrowing physical items. Despite the fact that options such as accessible transportation, delivery services, or the assistance of caregivers, family, and friends (Wu, 2019b) have helped patrons to overcome challenges in the past, CDL is proffered as a solution to satisfy the needs of otherwise underserved—or altogether marginalized—community members. Furthermore, by negating distance as a barrier, researchers that use libraries to support their work can do so more efficiently (Wu, 2016). With regard to special collections, O'Donnell and Regan (2017) maintain that usage has hitherto been exclusive. They write that "historically, access to information was discriminatory because there were only limited copies of a text and they had to be in particular places. With digitization, even access to the rare and unique becomes easier" (p. 47). CDL practices therefore are options for libraries and consortia to consider when strategizing ways to expand services to include patrons that are unable to benefit from usage and lending models that rely on physical access.

In addition to distance, a barrier to access for a growing number of community members is the physical format itself. Unless materials are accessible in digital form, many patrons are either unwilling or unable to use them (Kahle, 2017; O'Donnell & Regan, 2017). Not only does Wu (2011) acknowledge that students prefer digital over print, but they note that a similar tendency is evident with faculty as well. Librarians have a firm handle on usage patterns, and as such, clear trends in materials acquisitions are emerging in response to changing user behaviors. For example, Swartz et al. (2019) write that "in 2010-2011, while print collection acquisitions remained flat in the Canadian Association of Research Libraries (CARL) members, the number of e-books acquired rose 21 percent" (p. 371). This

same growth was more pronounced in the United States where a 62 percent increase in e-book purchases by academic libraries occurred in the same time period (Perzanowski & Schultz, 2016). CDL practices are quintessentially fit to address shortcomings to access that are exasperated by patron expectations for digital items that contrast with the reality of physical collections in libraries. Hansen and Courtney (2018) ask “how can we help those users find and use the millions of volumes of the past century (which makes up the bulk of many library collections) if we cannot get materials to them in the modern (digital) formats they need?” (pp. 32-33). While there is an ongoing demand to analyze the benefits of CDL, the potential is apparent for libraries and consortia to employ digitize-and-lend practices to meet—if not exceed—user expectations for digital content.

An obstacle for libraries and consortia is how to garner access to out-of-print books for community members. Hansen and Courtney (2018) point to copyright owners that are unwilling to address what is termed the 20th century book problem: neither print nor digital copies of in-copyright items are available for libraries to purchase in the market. Kahle (2017) attributes to Mike Lesk, a pioneering computer scientist in digital libraries, the notion of a looming threat to accessing print materials from the last century:

[Lesk] believed that the materials up to the 19th century would be digitized and available and that the 21st-century materials, since they were born-digital, were going to be circulated effectively. But the 20th-century materials [...] would be caught in machinations of copyright law—most remaining out-of-print, and all seemingly locked up by late-20th-century laws that appeared to make digitization risky. (p. 28)

According to Katz (2017), the issue can be viewed as a market failure. They explain that “books are out of print and unavailable not only because the cost of supplying them relative to the demand for them makes their production non economical, but because copyright allows publishers who hold large portfolios of copyright to strategically choose which books to continue producing, and which books to suppress” (p. 110). Hansen and Courtney (2018) describe the same instigations for a parallel market failure in e-books as well, and for this reason, they argue that digitizing and lending these select items would have a negligible effect on otherwise functioning markets. Furthermore, the adoption of CDL in libraries supplements the functions of suppliers since, according to Katz (2017), “libraries operate in a space that commerce does not and will not occupy” (p. 104). By providing controlled access to collections that are most impacted by market failures, libraries that design CDL programs may mitigate the risk of aggravating commercial entities.

There is great potential for CDL practices in libraries to preserve rare or fragile items and cultural works. Sizable amounts of resources are committed in libraries to the repair and renewal of items that would be challenging—if not altogether impossible—to replace (Hansen & Courtney, 2018). Even though CDL does not eliminate the need for the responsible stewardship of library collections, by providing users access to digital surrogates rather than the originals, CDL reduces the risk of rare or fragile materials becoming damaged or lost. Wu (2017) believes that preservation benefits that result from CDL are not only recognized by libraries and consortia, but that patrons and researchers also hold in high regard efforts to preserve uncommon if not invaluable items. Digital surrogates of the Wiedrick Collection, for instance, a non-circulating donation of education resources held at the H. T. Coultts Library at the University of Alberta, have become accessible to all since IA digitized the unique items and made them available (Adams et al., 2019; Sheppard, 2019). Not only can researchers access the intellectual content without exposing the physical items to risk, but they can also utilize advanced full-text search functionalities that are made possible through optical character recognition technologies that are a component of the digitization process.

A benefit from libraries and consortia adopting CDL practices is that the intellectual content that is embodied in print items would be preserved should physical collections suffer catastrophic disaster. Kahle (2017) contemplates that “if we are striving to build the modern-day Library of Alexandria, we should avoid the fate of the first Library of Alexandria: burning. If the library had made another copy of each work and put them in India or China, we would have the complete works of Aristotle and the lost plays of Euripides” (p. 34). Wu (2017) proposes that collaborative CDL initiatives would “increase the chances of survival of a ‘last copy’ should disaster strike the few, or single, library owning a title” (p. 54). Collaborative efforts among libraries have the potential to compound the benefits that result from preserving physical items. In the opinion of O’Donnell and Regan (2017), “if we begin to think collaboratively, and begin to think of one collection instead of thousands of collections, we can make better decisions, save money, preserve our print heritage better, and serve our users better” (p. 45). Collaboration in this sense may be properly understood to entail work at scale, a concept that Wilkin (2015) defines:

Work at scale involves the consolidation of efforts in a sphere that cuts across institutions, for example through geographic, peer, or even broader alliances. By using scale-enhanced strategies, we shift resources and methods to a larger collaborative space. This is especially helpful in areas where the shift creates efficiencies, improves the service, or both, without changing the fundamental nature of the work. (p. 244)

Wu (2011) envisions an extensive network of library groups communicating and coordinating among themselves to increase their overall efficiency exponentially. They write that “if each library group committed to preserving a portion of the world’s existing, printed knowledge in cooperation with one another, they could reduce duplication of effort and ensure an unbiased preservation of materials” (p. 545). By implementing CDL programs in libraries, local collections are preserved in the event that disaster befalls, but by collaborating within consortia and beyond, a limitless volume of our shared creative, scholarly, and cultural output could be safeguarded.

It is critical to understand that no library exists—regardless of its prestige or the size of its budget—that can purchase everything. According to Reilly (2013), “the time when the largest US and Canadian research libraries were able to collect comprehensively is now past” (p. 350), a truth that Robert Darnton, University Librarian Emeritus at Harvard University, substantiates: “Even at Harvard [...] it’s not possible to make all books available—let alone small libraries with limited budgets” (Adams et al., 2019). This reality is further heightened during economic crises such as the global recession of the 2000s (Weston, 2015). Contemporaneously, the far-reaching effects of the COVID-19 pandemic will not spare library budgets (Levine-Clark & Emery, 2020; McKenzie, 2020a; Paganelli, 2020), and as such, acquisitions decisions require review. Libraries and consortia should ask themselves how many copies will suffice to fulfill the information needs of users—*not how many different formats are needed to meet that end*. Wu (2019a) points out that “spending funds repeatedly on the same content, when only the container has changed, reduces the amount of unique content a library can purchase and preserve for its users”. Facing inevitable economic uncertainty, libraries may be forced to eliminate superfluity from acquisitions in order to sustain the breadth of resources and services that they make available to the communities that they serve.

Arguments in support of CDL are even more relevant in library consortia where nuanced interlibrary resource sharing practices already exist. CDL in consortia aligns remarkably well with cooperative collections development that is widespread and expanding throughout libraries. These collaborative efforts enable library organizations to benefit from the investments and holdings of their partners. By reducing redundant purchases, CDL in consortia has the potential to free up funds that could then be used to expand collections in areas that individual organizations would not have otherwise been able to afford (Weston, 2015; Wu, 2017). As a result of coordinated selections and purchases, Wu (2016) posits that “faculty and students nationwide would have access to the same resources, elevating the level of scholarship by making a broader range of resources available to each” (p. 18). Thus, in addition to making good economic sense, CDL in consortia facilitates equitable access to information.

A grave risk that libraries mitigate by adopting CDL is information distortion, an unwelcome effect that stems from biases that are inherent to products and curated collections. Wu (2016) writes that “the digitization of printed materials and inclusion of their texts in a discovery platform ensure a level playing field for a search of all resources, regardless of their original formats” (p. 3). Taking into consideration both the risk of information distortion as well as the tendency of patrons to explore digital sources before considering print (Kahle, 2017; O’Donnell & Regan, 2017; Wu, 2011), one can appreciate the need to provide users with the broadest and most varied access to information. Contemplating these factors, Wu (2011) asserts that “society’s perception of reality shifts to reflect only the information easily available. Part of our mission, therefore, should be to ensure that use of information is not determined solely by format, and the most effective way to achieve that goal is to place print and online documents on equal ground” (p. 551). CDL enables library users to critically evaluate a breadth of sources rather than limiting them to utilize only what is available on hand.

We would be remiss if we failed to acknowledge that widespread CDL implementations could contribute to further disintermediation between information professionals and the patrons that they serve. Even though this issue has been explored in the literature (Vishik, 1999), the need for librarians to remain present in information transactions for members of specific user groups should be addressed. Boyd-Byrnes and Rosenthal (2005), for example, point to the underdeveloped information seeking skills of nontraditional learners in higher education who depend entirely on remote access to resources. These authors recognize the limitations that are inherent to service models that remove librarians as intermediaries in transactions. In an unrelated analysis of older adult communities in public libraries and senior centers, Lenstra and Baker (2017) highlight the need for intermediaries to bridge the gap between users on the one hand, and information infrastructures and products on the other. Notwithstanding these concerns, fears of disintermediation for the majority of library patrons is not borne out by the evidence. It must be remembered that CDL initiatives are meant to complement rather than act as substitute for established circulation models and library services.

Claims and arguments in opposition to CDL

Opposition to digitize-and-lend programs in libraries unsurprisingly comes from authors, publishers, and associations and guilds that represent the interests of writers and distributors. Grievances lodged against CDL are primarily oriented around economic and legal concerns.

Opponents of CDL claim that digitize-and-lend models put important revenue streams, such as royalties from book sales, at risk. Royalties can make up to 45 percent of the income that Canadian authors generate from writing (House of Commons Canada, 2018), yet for publishers, royalties paid represent less than 20 percent of book sales (NWU, 2019b).

Authors furthermore complain that competition in the market threatens the sustainability of their work by affecting revenues in addition to royalties from publishers. Since authors normally retain between 50 and 100 percent of revenues earned from out-of-print books (NWU, 2019b) through uses such as website advertising, syndication services, and fees collected for downloads, subscriptions, and licenses (Hasbrouck, 2020), they argue that CDL impacts their ability to sustain their trade through ways that librarians may not recognize (NWU, 2019a).

Opponents also argue that CDL further impacts book sales due to libraries no longer acquiring new copies to replace lost or damaged items (NWU, 2019b). Even though numbers vary widely across different library sizes and types, missing items may account for anywhere between three and eight percent of library collections (Boss, 1999; Kohl, 1986). However, caution should be exercised before assuming that a need exists to replace even a fraction of missing or damaged items. One final complaint against CDL is related to the ease through which users can discover and check out digitized items online. Taking into account the time and effort needed to borrow items from library branches, opponents of CDL surmise that “lending of digital copies via the Web is more likely to replace sales or licenses of e-books than is availability of physical books in a library to replace sales of those books” (NWU, 2019b, p. 9).

In addition to the economic grievances, opponents of CDL claim these practices transgress copyright law in the United States (National Writers Union, 2019b) and Canada (House of Commons Canada, 2018), as well as treaties such as the Berne Convention (NWU, 2019a) and the Agreement on Trade-Related Aspects of Intellectual Property Rights (Association of American Publishers, 2019). Due to the necessary limits on scope in this work, and the territorial nature of copyright laws, we focus primarily on CDL in the North American context. It must be recognized that, as a practice, CDL’s import and impacts extend well-beyond North America, particularly as its greatest benefits are most likely to assist those who are most vulnerable and marginalized due to geographic, economic, social, and political factors.

Copyright laws in the U.S. and Canada give rights holders an exclusive monopoly with respect to certain uses of their works. In pertinent part, rights of reproducing, making derivatives, and publicly distributing works (among other things) fall within the protections afforded rights holders. CDL likely triggers one or all of these exclusive rights, so the key question of concern becomes whether or not an exemption applies.

There are two broad categories of copyright exemptions that are relevant to CDL: fair use (in the U.S.) and fair dealing (in Canada), and library-specific exemptions. These exemptions will be briefly discussed in turn. For clarity, concision, and relevance to the primary locales of debate, we will focus on fair use before shifting our attention to library-specific exemptions.

Fair use is a copyright exemption that enables members of the public to make certain kinds of uses of protected works without permission of rights holders (17 U.S.C. 107). Some of the permitted uses include comment, criticism, quoting in a news report, research and other educational uses, parody, and so forth. Courts analyze uses based on a four-factor test that attempts to balance the purpose of the use, the nature of the original work, how substantial the use was, and the effect of the use on the market for the original. In the last couple of decades, virtually all fair use cases focus on whether or not the secondary use was “transformative”. A transformative use “does something more than repackaging or republish the original copyrighted work. The inquiry is whether the work ‘adds something new, with a further purpose or different character, altering the first with new expression, meaning, or message ...’.” (*Authors Guild v. HathiTrust*, 2014, quoting *Campbell v. Acuff-Rose*, 1994). In the recent case of *Authors Guild v. HathiTrust*, the 6th Circuit Court of Appeals held that the mass digitization of entire in-copyright works contained in libraries’ holdings was a transformative fair use when the scans were used to facilitate search, enable text-mining, and provide access to visually-impaired persons. The court in *HathiTrust* did not directly address whether fair use would cover traditional “consumptive uses”, i.e. reading, of the digitized copies.

In an earlier decision in the 5th Circuit, that court held that creating copies of entire research articles for research purposes was not a fair use: the institutional, systematic, archival multiplication of copies is not transformative, particularly where a market for the original, in this case a licensing regime for individual articles, is available (*American Geophysical Union v. Texaco*). Moreover, that court noted: “Mechanical ‘copying’ of an entire document, made readily feasible and economical by the advent of xerography is obviously an activity entirely different from creating a work of authorship. Whatever the social utility copying of this sort achieves, it is not concerned with creative authorship” (*American Geophysical Union v. Texaco* at 917).

Taken together, these cases suggest that digitization may be a fair use when it is done to promote non-consumptive uses, but making copies for consumptive uses such as reading may not fall under the fair use exemption unless a compelling case can be made that the uses are transformative.

The second relevant category of exemption addresses specific uses by libraries (17 U.S.C. 108). Libraries are permitted to make and distribute copies for library purposes such as replacement and preservation, and at the request of library patrons for private study, scholarship, and research. To qualify for the exemptions, libraries must be open to the public or accessible to researchers in a specialized field, the copying must not be motivated, directly or indirectly, by commercial advantage, and a notice must be given that the copied work is protected by copyright. Of particular note, libraries are restricted from distributing digital copies “outside the premises of the library” (17 U.S.C. 108(b)(2)) and “systematic reproduction or distribution” of copies made at the request of patrons for private study, scholarship, or research is expressly prohibited (17 U.S.C. 108 (g)(2)). An accompanying House Report on the library exemptions further offers: “Isolated, spontaneous making of single photocopies by a library ... without any systematic effort to substitute photocopying for subscription or purchase, would be covered ... [and] ... libraries could participate in interlibrary arrangements for exchange of photocopies, as long as the reproduction or distribution was not systematic” (S. Rep. No. 105-190, at 62 (1998)).

Based on statutory language and legislative history, it appears that CDL was not anticipated by the drafters or lawmakers. While the emphasis against systemic reproduction and distribution arrangements, particularly those occurring “outside the premises of the library” would seem to cut against CDL, there is no indication that the concerns motivating that language would not be assuaged by the controlled nature in which these activities are occurring. Nor do these statements reflect the intense shifting realities and needs of communities’ access to library resources resulting from a global pandemic that has largely shuttered in-person library services for a year and counting.

Based on this review of copyright law and precedent, CDL programs do raise a legitimate risk of liability to participating libraries and consortia. Even though Hansen and Courtney (2018) write that “libraries seldom attract lawsuits”, and moreover that “no lawsuits that reflect negatively on the core principles of CDL” (p. 19) had been initiated at the time of their writing, these same authors advise that all entities involved should perform their own risk assessments. In consideration of potential threats, Wu (2016) opines that “libraries’ and universities’ fears of litigation are unsurprising” (p. 8), and in light of current developments, it appears that trepidation may be warranted.

Alleging rampant copyright infringement on the part of IA, the publishers Hachette, HarperCollins, Wiley, and Penguin Random House submitted a complaint to the United States District Court for the Southern District of New York in 2020. Notwithstanding the discrepant operating procedures and *raison d’être* between IA and the short-lived National Emergency Library, a sizeable portion of the complaint focuses on the tenets of CDL. According to the plaintiffs, CDL is no more than “a manufactured legal paradigm, conceived by IA, to cast aside well-established copyright jurisprudence” (Complaint, para. 73). The complainants allege that IA is responsible for reproducing, distributing, displaying, and performing copyrighted materials, and they request damages (up to \$150,000 per instance of willful infringement), an injunction, and the destruction of the digitized materials. As we wait for the outcome of this case, it should be noted that, technically speaking, the Internet Archive has yet to be afforded special status as a library under section 108 of the Copyright Act; we should therefore not assume that whatever fate befalls it is likely to also befall traditional libraries.

DISCUSSION & RECOMMENDATIONS

Making the case for CDL as transformation

History is replete with tensions between copyright law and technological change. From the first movable-type printing press, to the player piano, to the VCR, to digital music streaming, technology develops in tension with existing legal precedent. In the context of copyright law, fair use, and the principle of transformative use more specifically, functions as a pressure-valve for this tension. It provides a bit of stretch and flexibility to the law so that instead of breaking apart entirely under its own rigidity, the law can expand, shift, and evolve with the changing contours of emerging technologies and social practices.

CDL reflects another moment among the many before it where technology enabled a relatively slight shift in existing social practices. Instead of lending physical print copies, libraries have the means (and users the desire and need) to share digital copies. This shift is not a shocking, bold, or upending innovation but rather an important, but relatively anticipated, incremental pivot. Pivots like these, though, can have tremendous impact on the quality of life of library users, particularly those who are most likely to benefit from the availability of public services offered by these public institutions. Transformation, broadly speaking, is fundamentally interested in systems-level co-evolution between our sociotechnical and legal worlds. From this perspective, transformation happens slowly through a multitude of incremental but important pivots. CDL is a shining example of this kind of transformation.

In terms of the application of the legal doctrine of transformative use, the perspective turns somewhat more cloudy. Should we follow the reasoning of the 5th Circuit and care only about whether the secondary use transformed the original by generating a new, creative work? Or should we take a more expansive view of the doctrine's requirement that the secondary use "adds something new, with a further purpose or different character, altering the first with new expression, meaning, or message" and understand that the equitable interests of readers to have meaningful access to the services of public institutions like libraries meets that threshold? Does this interpretation become even more agreeable when the digital content is not only protected by DRM, but flows from lawfully held physical copies that no longer circulate but remain safely preserved under the library's stewardship? Can CDL be viewed as an essential service that is provided by libraries that have otherwise been shuttered by the global pandemic? We argue that the latter position must prevail if the complementary goals of copyright law and library mandates are to be satisfied.

Making the case for interpreting library exemptions to cover CDL

Since the purpose of libraries is to serve the public interest by making information services and resources freely available, these cultural institutions are given special status among other information organizations. Specifically, copyright legislation in both the U.S. (17 U.S.C., §108) and Canada (Copyright Act, 1985, §30.2) enables libraries and archives to use copyrighted materials in defined ways without securing permission from rights holders. The exemptions that these institutions are afforded protect them from liability for specific activities that are deemed fair. Not only should library exemptions include CDL on the grounds of fair use and fair dealing, but moreover, libraries and consortia that participate in CDL should be further protected from liability based on the principle of exhaustion.

The common law principle of exhaustion encompasses usage rights that extend beyond distribution (de Beer & Tomkowicz, 2009; Katz, 2016; Katz, 2017; Perzanowski & Schultz, 2011). These rights are relevant for libraries that adopt CDL practices. In the context of the United States, Katz (2017) states that the "codified 'first sale' doctrine may be limited to the distribution right, but the un-codified principle of exhaustion, of which it is only a subset, is not so limited" (p. 94), and moreover, that "its statutory presence might merely affirm a broader principle of exhaustion—one of several principles in copyright law that limit the copyright owner's powers" (p. 121). Perzanowski and Schultz (2011) list repair and renewal, adaptation and modification, and display and performance as rights due to copy owners according to exhaustion, and they declare that the "exhaustion principle holds that a fundamental set of user rights or privileges flows from lawful ownership of a copy of a work. *These privileges apply to the full range of exclusive rights* [emphasis added]" (p. 912). A most illustrative example of the broader principle of exhaustion undergoing judicial consideration regarding copyright infringement occurs in *Théberge v. Galerie d'Art du Petit Champlain* (2002). In this matter, the Supreme Court of Canada heard that a chemical process was used to lift lawfully purchased prints from poster fixations before transferring the images onto canvas. The decision of the Court hinges on the fact that additional copies were not produced in the process, but even more importantly, it is evident that exhaustion weighs into the decision: "that the Court in *Théberge* relied on the logic of exhaustion in a case involving an allegation of unauthorized reproduction, not unauthorized distribution, illustrates how exhaustion constitutes a broader limiting principle in copyright" (Katz, 2016, p. 144). We point toward the influence of exhaustion in *Théberge* to substantiate our argument that library exemptions in the United States and Canada should be expanded to include CDL practices.

Counteracting economic concerns

Digitize-and-lend implementations in libraries are responsible for negligible harms to the market. Advocates of CDL contend that lending digital surrogates of legally acquired materials through controlled measures has the same effect as circulating physical items (Hansen & Courtney, 2018; Wu, 2019a). Since libraries initially pay for legal copies, neither publishers through book sales nor writers through royalties suffer losses. We certainly cannot assume that either consumers or consortia members would acquire copies of their own in the absence of CDL (Wu, 2017). Furthermore, patron communities that borrow digital surrogates access content that has been expressly purchased for their use in the first place. Writing about exclusive user groups in both public and academic libraries, Hansen and Courtney (2018) proffer that "the rationale would be that digital lending should be made equivalent to the same group of users who would have access to the physical materials" (p. 37). If cost savings are realized in libraries or consortia, they occur not as a result of fewer purchases; with or without CDL, a need exists for organizations to acquire as much content as is necessary to satisfy user demand. We argue that digitize-and-lend models do not introduce elements that noticeably unbalance the equilibrium among content creators, publishers, libraries, and consumers, but rather, CDL increases the efficiency and convenience of lending and borrowing by streamlining, automating, and expediting resource fulfillments.

Emphasizing that mission of libraries is consistent with purpose of copyright

Not only is the overriding mission of libraries consistent with the overriding purpose of copyright, but moreover, the aims of digitize-and-lend practices quintessentially accord with both. Once libraries and other cultural institutions legally acquire information services and resources for use by the community, those materials cease to be commodities but should rightfully be termed public goods. There are two main characteristics of public goods: first,

that many can use them without exhaustion; second, that the community can use them without payment (Trosow, 2014). The dual-purpose of copyright is consistent with this understanding. According to Hughes et al. (2015), copyright is meant to strike a balance between incentivizing the creation of works and disseminating those works for the benefit of society. In short, copyright serves both rights holders and the public while favoring neither. CDL is a technology-assisted solution to provide equitable community access to information without infringing copyright law nor violating the legal protections that are extended to rights holders.

CONCLUSION

Libraries play a vital role in society by curating and making available our cultural and intellectual record. As public institutions, libraries are both the first and final bastion against the commodification of information services, resources, and learning. In response to lockdowns and modified service delivery models as a result of the COVID-19 pandemic, libraries and consortia are adopting CDL as a strategy to facilitate equitable access to print collections. Advocates of CDL contend that digitize-and-lend practices reflect an incremental, technology-assisted adjustment to established circulation, lending, and resource-sharing practices. However, opponents to CDL claim that it constitutes copyright infringement.

This paper sought to resolve uncertainties that stem from a culmination of various perspectives on the controversial topic. In the first part, we described the origins and implementations of CDL prior to and contemporaneous with the COVID-19 pandemic. Next, we investigated the promise and perils of digitize-and-lend practices, and we contrasted key arguments for and against the emerging lending model. We furthermore focused on copyright legislation and jurisprudence in the U.S. that is particularly relevant to the lending model. Finally, in the third part we presented discussions and recommendations to guide libraries and consortia that are either exploring or adopting CDL to better satisfy patron information needs. As a result of our investigations around the topic, we conclude that a reasonable, equitable, and forward-looking application of copyright laws ought to insulate libraries and consortia from exposure to liability for engaging in CDL. As champions of the emerging lending model, we exhort information professionals to support the right of libraries to digitize and make available in controlled manners the legally acquired print materials that have been acquired on behalf of library patrons.

ACKNOWLEDGMENTS

We thank all the volunteers and all publications support and staff who wrote and provided helpful comments on previous versions of this document.

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Designing eHealth Tutorials *with* and *for* Older Adults

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ABSTRACT

Older adults may be excluded from using digital health technologies due to limited eHealth literacy. Research is much needed to decrease disparities in eHealth literacy and increase the inclusiveness of such technologies. Integrating the preferences and expertise of older adults is key to age-appropriate design of eHealth tutorials. This study explores how participatory design (PD) techniques can be adapted to include older adults in the design of an eHealth tutorial. We worked with 9 older adults (aged 64 and 82) as co-designers and conducted PD sessions over 11 weeks in a senior center's computer lab. Using thematic analysis, we identified 7 themes around the design of eHealth tutorials for older adults. We also identified successes and challenges in PD with older adults, along with benefits of partnering with senior centers. Our findings have implications for both the design of eHealth tutorials for older adults and for PD with older adults.

KEYWORDS

co-design; participatory design; health information; eHealth; older adults.

INTRODUCTION

Electronic health literacy (eHealth literacy) refers to the ability to search for, find, and critically evaluate health information through digital sources and use it to address health-related issues (Norman & Skinner, 2006). Addressing disparities in eHealth literacy is becoming increasingly important for the general population at large, but it is especially important for older adults who have both lower health literacy and lower digital literacy on average than do their younger counterparts (Xie, 2009).

Older adults are a largely *relevant but absent* social group in the design of information and communication technologies, including eHealth training tools (Paquette & Xie, 2010; Watkins & Xie 2014b; Xie 2012). In this study, we therefore explored how participatory design (PD) techniques could be adapted to facilitate older adults' participation in the design of an eHealth tutorial, *Online Tutorial Overlay Presenter (OnTOP)*. An OnTOP prototype (OnTOP 1.0) was previously developed in a pilot study (Xie et al., 2011, 2012). The pilot study demonstrated the benefit of presenting eHealth tutorials as an *overlay* on a real website as opposed to on a recorded video or screenshot images of a website (e.g., Camtasia). However, in the original version an older adult must view a video tutorial in one browser and interact with the pertinent website in a different browser. In the current study, we collaborated with older adults to expand and develop a new iteration of OnTOP (OnTOP 2.0) in which older adults can view a tutorial about a website and interact with the website simultaneously in the same browser.

Although the original OnTOP showed promise, two significant research gaps remained. First, in the design of the original OnTOP, only a few PD techniques were used—talk aloud, comic boarding, and paper prototyping. Second, the original study showed that for older adults, the concept of an overlay tutorial was new, abstract, and hard to imagine. These observations in the pilot study led to the following research questions (RQs) that guided the present study:

RQ1: What PD techniques might be used to gain knowledge about older adults' online health information behaviors and subsequently incorporate that knowledge into the design of eHealth tutorials *with* and *for* older adults?

RQ2: What insights might co-designing eHealth tutorials *with* and *for* older adults yield for improving PD techniques?

BACKGROUND & RELATED WORK

Older adults' eHealth literacy

The world's population is aging rapidly (Bloom et al., 2015). As people age, it is important for them to stay active and social and to maintain optimal health, and it is also important to accommodate their disabilities and maintain optimal health (Lakin & Burke, 2019). Today, these goals involve using digital technology for communication, and the internet has become a primary source of health information (Oh et al., 2005). The measurement and conceptualization of health literacy are also incorporating the ability to use technology as a key component (McCormack et al., 2010; Squiers et al., 2012). Older adults face a two-fold challenge when it comes to eHealth literacy because they have low levels of both health literacy and technology literacy (Watkins & Xie, 2014b; Xie, 2011, 2012). Without the right tools and understanding, older adults with insufficient eHealth literacy are unlikely to be able to use technology to its full potential to aid them in maintaining and improving their health.

Older Adults and PD

PD strategies have included older adults in the design of assistive technologies, e.g., devices designed to prevent falls, home monitoring devices, and intelligent toilets (Merkel & Kucharski, 2019). PD has also proved to be useful in the design of eHealth training and tutorials for older adults (Martin-Hammond et al., 2018, 2019; Xie et al., 2012).

PD is a set of research techniques often used in fields such as human-computer interaction and computer-supported collaborative work that seeks to democratically engage users throughout the entire process of design (Spinuzzi, 2005). The object of study in PD is “the *tacit knowledge* developed and used by those who work with technologies” (Spinuzzi, 2005, p. 163). By including users directly and fully in the design of technology, PD provides a means with which unique users' needs and abilities can be elucidated. It has proved to be a useful way to integrate diverse perspectives—including perspectives often overlooked—in design processes and outcomes (Martin-Hammond et al., 2018).

Some PD techniques that can be useful in the design of assistive technologies for older adults include storyboards, use-case scenarios, and comic strips (Wherton et al., 2015). Personas have also been used by designers to develop a deeper understanding and empathy for the unique health information needs of older adults (Holden et al., 2017). Commonly employed in user-centered and PD research, personas are “fictitious users” developed by participants that “guide decision making regarding features, interactions, and aesthetics” (Lidwell et al., 2010, p. 182). Sticky note exercises, personas, user-scenarios, and storyboards are often used collectively in PD sessions along with documentation methods such as participant observation, interviews, field notes, and recordings to capture as much rich data from participants as possible (Blomquist & Arvola, 2002; Merkel & Kucharski, 2019; Rosson & Carroll, 2002).

Although PD can be useful in the design of technologies with older adults, it is not without its challenges. Recruiting older adults and motivating them to be involved with PD activities can be challenging. A useful solution is to partner with local organizations or institutions that serve older adults such as public libraries and senior centers to recruit participants (Binda et al., 2018; Martin-Hammond et al., 2018; Piper et al., 2009; Xie & Bugg, 2009; Xie & Jaeger, 2008). This approach also has the advantage of providing an environment that is familiar to older adults (Xie, 2003). Technical elements of PD can also be challenging for older adults. Making the conceptual leap from low-fidelity prototypes to future technologies can sometimes be an issue for older adults, because it can be challenging to imagine something that does not yet exist (Duh et al., 2016). Another challenge exists in using technical jargon that may be unfamiliar to older adults (Binda et al., 2018; Martin-Hammond et al., 2018).

METHODS

Research setting

The research setting for this study was a computer lab at a regional, non-profit senior center in a city in Central Texas. The senior center is centrally located and easily accessible by public transportation, with ample parking space. The computer lab has 12 desktop computers for users and one desktop computer for an instructor. A large projector screen that takes up almost the entirety of the wall is located behind the instructor, with another large flat-screen TV positioned mid-way for viewing at the back of the room (see Figure 1). Although compact, the lab is efficiently arranged with computer cords meticulously placed to avoid any possible hindrance of movement or falls. The lab computers are equipped with high visibility keyboards (with bright yellow keys and

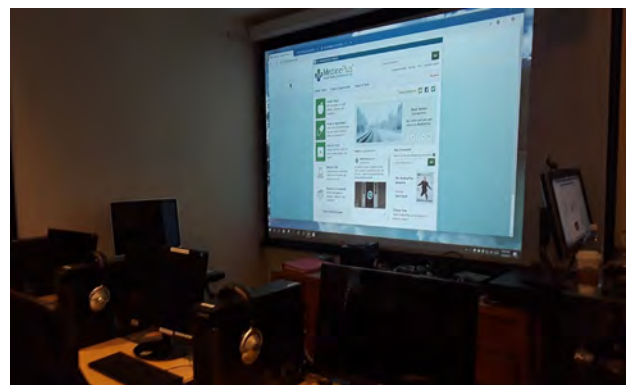


Figure 1. Senior center computer lab

bold black letters) as well as assistive technology such as screen magnifiers. This lab provided a unique environment for our research because of its array of assistive technologies for older adults.

Co-Designers

We partnered with nine older adults as co-designers for this project (6 women, 3 men; age range: 64-82 years; mean 73.89; SD 5.80). Their gender and age are provided in Table 1. Participants were recruited from (1) members of the senior center via its monthly newsletter, or (2) those who had participated in our previous research on eHealth literacy. Co-designers committed to attending all sessions. All 9 co-designers indicated that they used computers daily.

OnTOP 2.0 Prototype

Working with the older adult co-designers, we created OnTOP 2.0 for the health information website MedlinePlus.gov (Figure 2). Dating back to 2011, OnTOP 1.0 has had several iterations, starting as a paper-based mock-up and evolving iteratively as an eHealth tutorial (Xie et al., 2011, 2012). Earlier iterations were developed using a combination of PD activities including talk aloud, paper prototypes, and comic boards. In the present study, we introduced new PD techniques (affinity diagrams, personas, etc.; see Procedures below) to explore if and how they might be used to aid eHealth tutorial design. OnTOP 1.0 guided users through the NIHSeniorHealth.gov, which no longer exists, whereas OnTOP 2.0 was designed collaboratively to guide users through MedlinePlus.gov (Figure 2).

MedlinePlus (2021) is a “service of the National Library of Medicine (NLM), the world’s largest medical library, which is part of the National Institutes of Health.” As an online resource, it provides direct open access to an extensive selection of health information topics: from diseases and health issues, to drugs and supplements, to medical tests and procedures. It even includes healthy recipes.

We began our buildout of OnTOP 2.0 with computer-generated audio and hosted it on Nickelled (Nickelled Ltd., 2018), a cross-platform tool for hosting tutorials on any browser. We shared this initial iteration with our co-designers so that they could have a first-hand experience of OnTOP 2.0’s key benefit—the overlay. Next, we conducted the PD activities with our older adult co-designers.

Procedures

The PD activities included three phases: (1) introduction and team building; (2) design feedback; and (3) prototyping. Our goal for this iteration of the OnTOP 2.0 prototype was to work with the co-designers to build mockups with relatable language and instructions to guide older adult users through finding and evaluating health information on MedlinePlus. Feedback from the PD sessions was then incorporated into the final version of our OnTOP 2.0 (which was subsequently tested in an intervention study). Each phase consisted of one or more 2-hour sessions, for a total of 6 sessions held monthly (Table 2). Each session lasted about 2 hours and included at least one break about halfway through. Food was provided at the beginning of each session, and tea and coffee were provided during the breaks. The co-designers were compensated with a \$10 gift card to a local grocery store for each session that they completed. The study was approved by the Institutional Review Board of the authors’ university. After reviewing our IRB-approved consent form with the potential co-designers we documented consent by obtaining participant signatures on the forms. We also reviewed a photography consent form with participants, which they signed as well. Two researchers facilitated each session. One researcher led the activities while the other assisted the co-designers, wrote notes, and took photographs.

Code name	Age	Gender
DP	75	Male
RP	75	Female
AC	81	Female
JH	77	Male
GH	82	Male
AS	64	Female
CS	70	Female
KL	69	Female
SP	72	Female

Table 1. Participant demographics

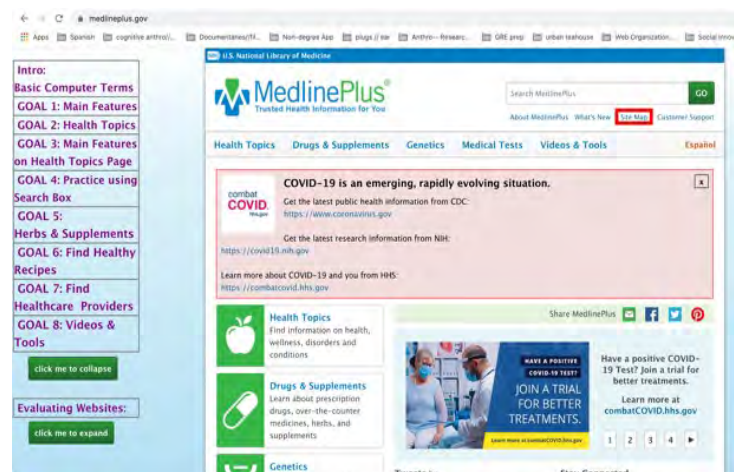


Figure 2. A screenshot of OnTOP 2.0

Phase	Session	Activity
Phase 1: Introduction & team building	1	Team-building warm-up: Introduction and sequential exercise to initiate sequential thinking.
Phase 2: Design feedback	2	Markup: Co-designers received paper screenshots of the tutorial for markup to solicit and record feedback.
	3	Affinity Diagrams: Co-designers participated in an activity focused on envisioning older adults finding health information online. The group worked together to sort and categorize thoughts generated on sticky notes.
	4	Personas: Co-designers created personas of older adults with health conditions on the provided persona worksheet. User scenarios & storyboards: Co-designers created user scenarios and storyboards for the persona they created during the first half of the session.
Phase 3: Prototyping	5	Mockups: Co-designers outlined steps for finding information on MedlinePlus.gov on transparent overlays.
	6	Mockups: Co-designers reviewed and edited instructions for finding info from session 5 provided on transparent overlays.

Table 2. Co-design sessions and activities study

Phase 1: Introduction/Team Building

Phase 1 consisted of one session. The goal for this phase was to introduce the co-designers to each other, to our research study, to the concept of PD, and to our prototype—as well as to foster team building within the group. At the beginning of this session, we discussed the study at length and reviewed the informed consent and photography consent forms with the co-designers. Once we received their informed consent, we continued with the session. After introducing the project and ourselves, we asked the co-designers to introduce themselves and share what they felt we could learn from them as well as what they hoped to learn. After the co-designers introduced themselves, we moved to an icebreaker exercise called *peanut butter and jelly* (PB&J). PB&J is a sequencing activity often used in team building (Gama et al., 2019; VanDerveer & Butterick, 2017). Although this exercise has not been cited in the PD literature focused on older adults, we used it as a fun, lighthearted way to introduce the co-designers to working in teams and as a primer to the sequential thinking needed for PD activities. In this exercise, we asked co-designers to form groups of two or three and work together to document the process of making a peanut butter and jelly sandwich. Each group selected a spokesperson to present their group’s process. After each presentation, we discussed differences and similarities among the group’s respective processes. We then took a short break.

During the second half of the session, we introduced the co-designers to the Nickelled platform with a basic outline for the OnTOP 2.0 prototype. This initial version walked them through only a few steps to give them an idea of how the tool worked, and we explained that we would be developing the content in the tutorial together. We asked them to go through the tutorial on their own without taking notes so that they could obtain a perspective on what the user’s experience of this website walkthrough tool. After this initial run-through, the co-designers were eager to discuss their experiences. We took notes on their feedback. Then, we asked them to go through the basic tutorial one more time and take notes on a piece of paper that we provided. We discussed their notes in a group discussion after the second run-through of the prototype. After we addressed their thoughts, questions, and initial ideas, we concluded with a brief review of what we had accomplished in the session and some details about our next session.

Phase 2: Design Feedback

Phase 2 included 3 sessions. The goal of this phase was to elicit feedback from co-designers through PD activities. In the first session of Phase 2, the co-designers engaged with a hands-on PD exercise—markup. We aimed to further familiarize them with our PD process as well as to solicit and record their feedback on the tutorial. We provided the co-designers with paper screenshots of the tutorial for markup and note-taking. We asked them to go through each screenshot and create notations where improvements were needed. We also asked them to provide any feedback that arose as they worked through the markup activity.

In the second session of Phase 2, the co-designers created affinity diagrams (Figure 3a). Affinity diagrams are a PD technique that uses sticky notes to brainstorm and organize ideas and concepts (Ahmed, 2017). When we introduced the concept of affinity diagrams, the co-designers understood the process, but found the name of the exercise confusing. This confusion led to thorough discussion. Once we were in agreement about terms, we began the exercise. We asked the co-designers to consider the following prompt: “Envision yourself finding health information on the web.” With that prompt, we asked them to consider questions such as the following: “How will you search for information?,” “What kind of information will you be looking for?,” and “What are your feelings throughout this process?” Sticky notes were placed on a door as the co-designers wrote them down, and were grouped into categories such as: *feelings*, *search tools (computer vs. tablet or phone; search engine, etc.)*, *health topics (health issues, diseases and symptoms)*, and *miscellaneous*. We divided the third session of Phase 2 into two PD activities. In the first part of the session, we worked with the co-designers to create personas. In groups of two or three, the co-designers created personas of an older adult who had health information needs. We provided the co-designers with a worksheet to guide the process and record their personas (Figure 3b). We asked each group to give their persona demographic information (such as age, education level, occupation, location, and transportation); a health issue; computer/internet access and competency skill level; a brief description of the persona; information needs; challenges in meeting those needs; favorite news/information sources; and a user quote (a motto or favorite saying that would be associated with this persona). These personas were used to guide the user scenario and storyboard activities in the second half of the session.

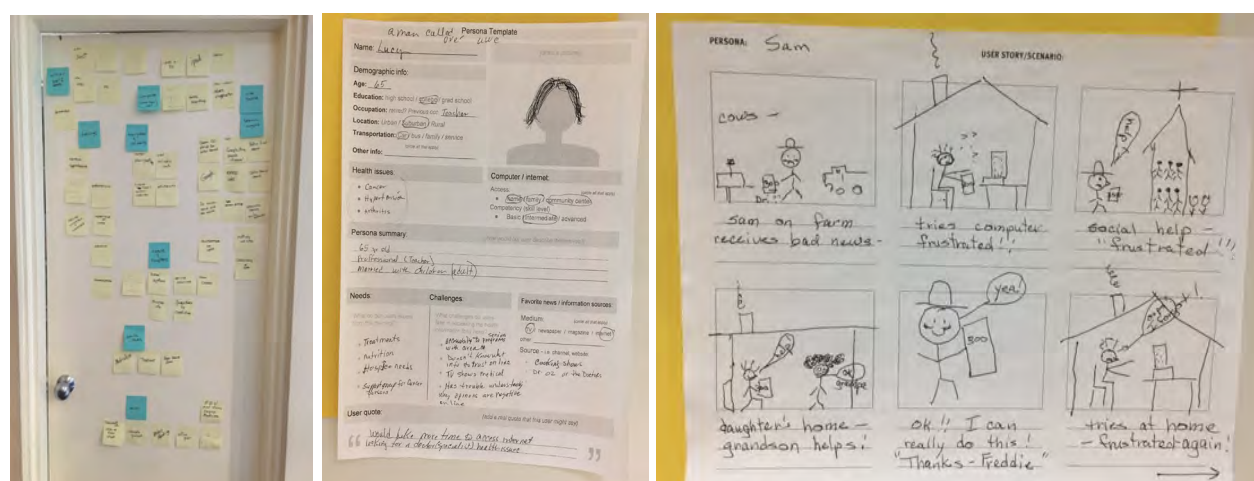


Figure 3. (a) Affinity diagram, (b) Persona, (c) Storyboard

In the second half of the session, each group created a user scenario and storyboard using the persona that they created in the first half of the session. For this activity, we gave the co-designers worksheets that provided a framework for thinking through their personas’ searches for information on the MedlinePlus website. We asked them to imagine a scenario in which their persona might encounter a health information need, how they would attempt to resolve that need, and what challenges or barriers they might face in that effort. They were then instructed to first write out what happened in the user-scenario and then sketch it on a storyboard (Figure 3c).

In contrast with the challenges that came with introducing the technical term with *affinity diagram*, the participants had no difficulties with the terms: *persona*, *user-scenario* or *storyboard*. The participants were comfortable with the use of all these technical terms, so we moved through them without any additional discussion about jargon.

Phase 3: Prototyping

The prototyping phase included two sessions with the goal to translate insights from our previous activities into paper prototypes of the newest OnTOP tutorial iteration—OnTOP 2.0. In the first session of Phase 3, the co-designers outlined steps for finding information on Medlineplus.gov. For this activity, we asked them to think about and create instructions that would be useful specifically for their older adult peers in finding health information on MedlinePlus. We divided the co-designers into two groups and provided them with printed screenshots of each of the webpages along the path toward finding the desired information. One group was tasked with creating instructions for finding information on heart disease. The second group was tasked with creating instructions for finding information on Lovastatin, a drug used to treat high levels of cholesterol. Each group was given a stapled pack of screenshots of the web pages along with each of the steps for finding information about their topic. Using these handouts, the co-designers wrote up instructions to guide users through each of the steps of seeking information about their intended topic—either heart disease or Lovastatin. Both of these tasks (searching for

information on health conditions and searching for information on drugs) were incorporated into the final design of OnTOP 2.0.

In the last session, the co-designers reviewed and edited the instructions for finding information, building on artifacts from the previous session. In the markup stage, we had noticed some challenges with differentiating between the overlay of the tutorial and the actual MedlinePlus website, so in this step we created a new method to help them conceptualize the different layers. To help facilitate a sense of the overlay property of the tutorial, we developed a method in which we used inserted printed screenshots of each step of the tutorial into transparent page protectors (Figure 4). This way, the co-designers could use dry erase markers to create their own mockups of boxes and instructions. Importantly, this solution enabled participants to have a physical replication of a digital concept. After this session, we thanked the co-designers for their contribution to the enhanced design of the prototype.

The final iteration of OnTOP 2.0 was largely informed by the work of our co-designers. We worked together with the co-designers to decide what topics to focus on, then through paper-prototyping exercises they provided input that would go into the final iteration of our eHealth tutorial. We then used the artifacts and feedback generated by the co-designers to build out the final iteration of our eHealth tutorial. Most of the instructions and wording for the final version of OnTOP 2.0 came directly from our co-designers.

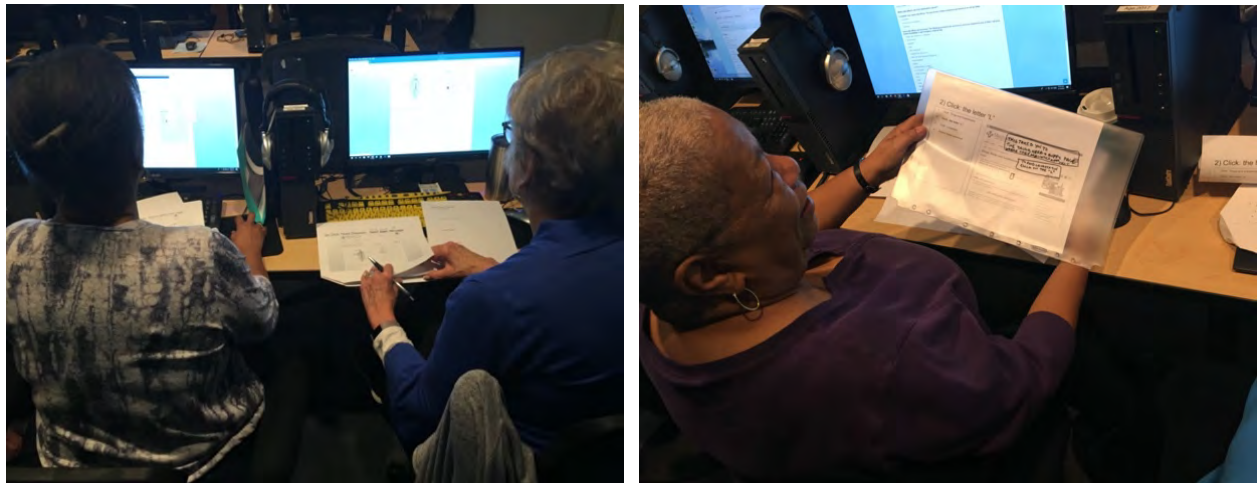


Figure 4. Paper prototyping activities

DATA ANALYSIS

We followed the steps of thematic analysis (Braun & Clarke, 2006) to review and code all of the data, identifying patterns and themes from all data sets, which included PD artifacts, feedback forms from our co-designers, and facilitator notes. We reviewed two sets of data for this study to identify insights. For the first data set, we reviewed PD artifacts and participant feedback to identify 7 themes related to the design of eHealth training with older adults. We also analyzed our facilitator notes and reflections to identify 3 themes, with 10 sub-themes, that might inform future work employing PD techniques to work with older adults.

The first step was to familiarize ourselves with our data through multiple readings of all data sets. Two coders independently reviewed the data and noted initial ideas, which were later discussed with other team members and further developed based on the discussions. The second step was to develop initial codes through iterative re-reading and team discussion. Some examples of our initial codes included *visual clues*, *instructional language*, *content*, and *design*. After reviewing our initial codes with a third team member who has extensive experience with thematic analysis, the two coders returned to the data worked collaboratively to apply the codes where appropriate across the materials. For instance, we developed the code *visual clues* to identify instances where co-designers suggested the inclusion of pictures or icons in the tutorial content. After completing the coding, next step was to collate the coded data and assess themes through discussion between the two coders and the third team member. Examples of initial themes included: *design and navigation* and *keeping track of information*. For step four, the coders reviewed the relationship of the initial themes to both the coded extracts as well as the data set as a whole and wrote notes to return to in the next steps of analysis, where they discussed with the third team member and revised themes accordingly. Once final themes were agreed upon, the two coders labeled our themes with descriptive names, reviewed with other team members, and revised accordingly.

KEY FINDINGS

The PD sessions generated rich data from which we were able to identify a number of themes related to older adults' health information needs and behaviors. These themes informed the design of our OnTOP tutorial and can also be used to inform the design of future eHealth tutorials. Also, we identified themes related to the successes and challenges in using PD techniques with older adults that could improve PD techniques in the future.

Key Findings from Participant Feedback and Participatory Design Artifacts

Meeting health information needs after doctor visits

We identified that our co-designers grounded their design activities in specific health information needs. For example, in the user scenario and storyboard activities, each group created an information-seeking scenario that arose from a doctor's visit. Subsequently, the co-designers discussed how the health information resources found on or linked to by MedlinePlus were a valuable tool for gaining health information after getting a diagnosis or being prescribed a medication. This indicates that our older adult co-designers viewed eHealth resources as a valuable component of further informing themselves about health conditions and treatments as part of an ongoing dialogue with their healthcare providers.

Keeping track of health information

Keeping track of and managing health information was also an important theme that came up among the co-designers. They shared the challenges of managing the cycle of information acquisition—specifically, challenges of remembering what the doctor told them, looking up information online, and communicating with their support network. The co-designers noted that keeping track of what the doctor was telling them, along with what they found online, could be a useful way to help them stay informed about their own healthcare needs. Keeping track of health information such as medicines' side effects was also discussed as an area that would greatly benefit from the coordination between online and offline documentation.

Social networks and support

Support networks also played a valuable, and often necessary, role in accessing health resources on the internet and in managing the healthcare information of the personas our co-designers created. For example, in their user scenario storyboard, one group drew a scene that included their persona "Sam" getting assistance in accessing health information from his church community. Whereas more experienced computer and internet users might feel comfortable going directly to the internet on their own, many older adults will seek the support of their social networks (e.g., family, church members, community members, etc.) to access eHealth information. This was further illustrated by the personal accounts of some of the co-designers who indicated that they only accessed the internet through the senior center's computers.

Varying levels of comfort using the computer for different tasks

The co-designers shared in-depth narratives about their experience of using a computer based on varying levels of familiarity and comfort. Some older adults considered the idea of using a computer as a tool to search for health information online to be a challenge, but attitudes about using computers for more leisurely activities like playing online games were more casual and relaxed. With respect to health information, however, they displayed a much lower threshold for giving up on use of the computer as a tool to find trustworthy eHealth information.

Information overload

Information overload was also an important design consideration among the co-designers. Feeling overwhelmed by the vast array of websites and health information available online was a common theme in their feedback and in the PD artifacts. Through the PD activities, the co-designers said that there are "too many websites" and that navigating them is a struggle. The OnTOP 2.0 prototype navigates users through a trusted government website (MedlinePlus.gov), but the idea of searching for and evaluating other websites on the web can seem daunting and unmanageable without further training.

Design and navigation

The co-designers often discussed and critiqued the overall design and navigation of both the OnTOP tutorial and the MedlinePlus website. To create OnTOP 2.0 we used the website walkthrough platform Nickelled to guide users through the process of health information seeking on MedlinePlus. Nickelled is relatively limited in design and relies primarily on the use of text boxes to guide users through the website's use. The co-designers indicated that including pictures and icons within the tutorial would be helpful (this level of design was beyond what Nickelled allowed). They also suggested that the OnTOP tutorial should highlight the areas to which they were being directed while blurring out the background. They found it frustrating to have to click through multiple levels of content to find health information. For example, the co-designers found it easier and intuitive to use the search box to get to health information, thus skipping over having to navigate through the website's information architecture. Familiar instructional language was another key element of design and navigation that was important to the co-designers.

One unique challenge in relation to navigation and design was distinguishing between the overlay instructions provided by the OnTOP 2.0 prototype and the actual MedlinePlus website. During markup and mockup activities, the co-designers often suggested re-arranging key elements of the MedlinePlus website instead of the prototype. This discovery during the initial phase of this study led us to use transparent page protectors in our prototyping activities as a way to help participants conceptualize and visualize the different layers.

Evaluating trustworthiness and reliability

The co-designers also commented on the challenges of evaluating the trustworthiness and reliability of health information found online. They talked about how older adults could document what they learned from various doctors and what they found online to better inform themselves and know what information to trust as reliable. This might be thought of as a loop, in which an individual receives a diagnosis or prescription from the doctor, then seeks a deeper personal understanding of the health issue through trustworthy websites, and then uses the found information in order to further inform their discussion with their doctors.

Key Findings from Facilitator Notes and Reflections

Enthusiasm about PD

We identified three subthemes related to older adults' enthusiasm about the PD activities. First, the project was made successful by eager, engaged, and motivated co-designers. The co-designers were excited to join us each session. They quickly formed a community with each other and with us, which led to a successful team environment. The co-designers felt that they were working for and representing their peer group, which enhanced their motivation. They engaged with the PD activities enthusiastically as well as critically. Our team was available to give constructive feedback as necessary. Second, the co-designers were invaluable design partners, rich in life experiences. Their considerate insights and thoughtful contributions led to meaningful PD. Often they provided contextual background information that helped us understand why they made a suggestion or offered a critique. Finally, the co-designers became our biggest ambassadors. They repeatedly reported enjoying the sessions and said that their friends would want to join too. They informed friends at other senior centers about the research project.

Challenges with PD

We also identified three challenges. First, the older adult co-designers were unfamiliar with PD as a creative, co-constructed learning approach. The co-designers were motivated to "find the right answer" or "deliver the right results" instead of allowing the learning to come through the PD process. Second, PD terminology was confusing or dissonant. Although co-designers easily grasped the concepts of the PD activities, the terminology was challenging and often a sticking point. When the affinity diagram exercise was introduced, the co-designers were confused about why "affinity" was part of the activity name. In fact, they had such strong feelings about the name "affinity diagram" that they decided to rename the activity "association diagram." Although this discussion took time away from the activity, we felt that it was necessary for the co-designers to take control of reconceptualizing a design term, even though the activity stayed the same. Third, time limits constrained the activities. The co-designers offered rich, detailed responses, and they carefully considered every prompt, question, and task. Often, detailed discussions took larger portions of the session than we had planned for or anticipated. Even though discussions took time away from the PD activities and development of the OnTOP tutorial, we did not cut these conversations short because we felt they were valuable for building rapport and validating a sense of inclusivity. Finding the right balance between the use of time for different tasks to achieve different goals was a challenge, particularly when the research team did not have unlimited time and resources.

Benefits of partnering with senior centers

We identified four benefits of partnering with senior centers. First, the senior center was a familiar space for most of the co-designers. Half of the co-designers were recruited from the senior center itself, but the other half were familiar with the center and its location. The location was accessible by public transportation, which was important for some of the co-designers. Second, since the senior center focuses on serving the older adult community, it was already equipped with inclusive resources appropriate for their community such as large print keyboards, wheelchair-accessible workstations, and assistive technology for visual impairment. We were able to leverage the center's community resources at no cost to the project. Third, we were able to use the senior center's established marketing (newsletters and fliers) to recruit potential participants. Fourth, we were able to provide a service to their community by offering our research study as a form of programming for older adults. In addition to directly benefiting older adults, both the senior center and the research project benefited through this fruitful collaboration.

DISCUSSION

We conducted a series of PD sessions to develop an eHealth tutorial with older adults as co-designers, which to our best knowledge is one of the first to do so. We used thematic analysis to investigate our findings from the PD artifacts and co-designers' feedback, as well as our own reflections and notes (Braun & Clarke, 2006). We identified key themes in relation to designing eHealth training tutorials with older adults. Our findings have implications for

the design of eHealth tutorials specifically, but also for the use of PD as a research methodology *with* and *for* older adults in general.

Healthcare is rapidly employing internet communications technology as primary source of health information dissemination (Oh et al., 2005), and older adults face the enhanced challenges of eHealth literacy (Watkins & Xie, 2014b; Xie 2011, 2012). However, previous research has found that older adults, despite their relevance, are often absent in the design of internet communications technology (Paquette & Xie, 2010; Watkins & Xie, 2014b; Xie 2012). PD is a research methodology that can be employed to engage users of otherwise overlooked social groups such as older adults, in the design process (Spinuzzi, 2005). Whereas previous PD research with older adults has focused on the development of an array of assistive technologies (Merkel & Kucharski, 2019), in this study we have explored how older adults' preferences and expertise can be incorporated into the design of eHealth technology. Through PD, the co-designers in our study provided rich insights that can help inform the future design of eHealth literacy training tools for older adults.

Thinking about how healthcare practitioners, digital sources, and support networks can all work in concert is an important aspect of designing eHealth training tools with older adults (Manafa & Wong 2012; Tuner et al., 2018). Whereas other PD research with older adults has found activities such as storyboards, use-case scenarios, and comic strips useful (Wherton et al., 2015; Xie et al., 2011, 2012), we explored the use of these techniques in conjunction with other PD activities such as personas and affinity maps. We found that PD activities were helpful in uncovering design implications for health information needs and overall outcomes. For example, through the combination of personas, user-scenarios, and storyboards, co-designers indicated that older adults were likely to search for health information online after receiving a diagnosis or prescribed treatment from a doctor. This finding echoes what others have found—personas were helpful in developing understanding and empathy for health needs not only for the co-designers in thinking of their peers but also for researchers (Holden et al., 2017).

Our co-designers indicated that using technology is not always intimidating, but that using it to find trustworthy and reliable health information online can often be overwhelming. They expressed feelings of information overload in knowing which websites to rely on for health information. As in other studies (Duh et al., 2016), we uncovered challenges among co-designers in making the conceptual leap between different versions of the prototyping activities. Having noticed their difficulty in differentiating between the OnTOP tutorial's overplayed instructions and the MedlinePlus website itself, we developed a novel method of inserting screenshots into transparent page protectors to help them visualize the various layers of design. Future research can further explore innovative techniques like this to help facilitate the conceptual leap.

We identified challenges and successes in conducting PD with older adults, as well as benefits in partnering with senior centers. One unique initial challenge we experienced in the very beginning was that our co-designers felt like they needed to “find the right answer” or “deliver the right results.” This was an unexpected finding, and future work might explore if older adults or social other groups have this same inclination. One of our biggest challenges, as others have found, was the dissonance of using unfamiliar jargon and technique terminology among older adults (Binda et al., 2018; Martin-Hammond et al., 2018). However, when the co-designers asked questions about PD terms, we provided background for the terms as well as allowed time for the group to reconceptualize the terms for use within the study. Although co-designers had some challenges with the technical side of PD, such as jargon, their excitement and engagement far outweighed the challenges. In addition, by using industry standard terms, we are engaging and treating our older adults as true co-designers. It is reductive to say that they cannot handle industry terms and jargon, when in fact they can. Future studies might be well served by spending time early in the project to negotiate PD terms and activities with co-designers to find what works best for them.

Although older adults can sometimes feel overwhelmed by new technologies, our research builds on previous findings showing that as older adults develop a better understanding of a technology, they can become eager and engaged users (Vaportzis et al., 2017; Xie et al., 2011, 2012). Older adults were happy to be involved in this research project, and they eagerly shared their rich life experiences throughout all of the PD activities. In fact, these co-designers had so much to share that it was sometimes difficult to capture all of their insights in the allotted time. However, combining our observations and facilitator notes with multiple PD techniques helped to mitigate this challenge and collect as many insights as possible.

Limitations

This study has limitations. We included only a small number of older adults, all of whom were regular computer users. Working with a larger and more diverse range of older adult participants with different levels of computer experience would represent a broader range of perspectives. Although the length of time spent with our co-designers is in keeping with typical PD standards (12 hours total over 6 sessions), more time might have brought more insights for the final design of our prototype. In line with our previous studies (Xie et al., 2011, 2012), we found additional challenges for the co-designers in imagining future versions and determining differences between the overplayed

instructions and the actual website itself. Having more time and resources to work on training older adults as co-designers might help to mitigate these challenges.

CONCLUSION

In this paper, we have reported our reflections and experiences in engaging older adults in various PD activities focused on the design of eHealth training tools. We worked directly with our 9 older adult co-designers to develop our eHealth training tool—OnTOP 2.0. Their feedback fed directly into the final iteration of OnTOP 2.0, with most of the instructions and wording for the final iteration of OnTOP 2.0 coming directly from them.

Although PD has been used increasingly as a tool to include older adults in the design of assistive technologies (Merkel & Kucharski, 2019), one unique contribution of this study is the application of a PD approach to the design of eHealth tutorials—which, to the best of our knowledge, makes this study one of the first to do so.

This study reaffirms the findings of previous work emphasizing the challenge of new and unfamiliar technical terms and jargon when working with older adults (Binda et al., 2018; Martin-Hammond et al., 2018). Our findings also illustrate the challenges that older adults can have with making the conceptual leap between different versions of prototypes—from paper to digital (Duh et al., 2016), or between an overlay placed on top of a website and the actual website itself (Xie et al., 2011, 2012). Future design research with older adults should address the challenge of making conceptual leaps and imagining future technologies. Our findings also reaffirm that although older adults may sometimes have reservations about new technologies, they can become eager and engaged users as they develop better understandings and a sense of investment in new technologies (Vaportzis et al., 2017; Xie et al., 2011, 2012).

The findings presented in this study can inform future work with older adults to create or enhance eHealth literacy training tools through PD. Future work can also build on our findings more broadly to think inclusively about working with older adults as co-designers of assistive technologies.

ACKNOWLEDGEMENTS

The authors wish to thank our co-designers for their participation and the administrators and staff at our research site for assisting with the logistics and providing the facility and IT support. The authors also acknowledge John Bellquist, Ph.D., Editor of the Cain Center in the School of Nursing at The University of Texas at Austin for his professional proofreading of this manuscript. We want to also thank Dr. Suzanne Bakken, PhD, RN, FAAN, FACMI, FIAHSI, Columbia University, for her excellent feedback on an earlier version of this manuscript.

This material is based on work supported by the National Institute on Aging at the National Institutes of Health (#R21AG052761; Principal Investigator: Bo Xie). The content of this manuscript is solely the responsibility of the author and does not necessarily represent the official views of the National Institutes of Health.

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Exploring the Effect of Rational Factors and Trust in Health Behavior Change

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ABSTRACT

This study examines how rational factors and trust modify health behaviors and various stages of trust mediate the rational factors in behavior changing through four stages of it. By integrating factors of Theory of Planned Behavior (TPB) and various stages of trust, a health behavior change framework was proposed. Quantitative data on TPB, trust and behavior change were collected from Chinese youths through online survey. Structural Equation Model (SEM) was applied to analyze the data from 448 valid questionnaires to verify it. The findings show: Both TPB and trust constructs have significant impacts on modifying health behavior change; Trust mediates the effect of perceived behavioral control on health behavior change, while the stages of site content evaluation and longer-term engagement of trust act as partial mediators; Relationships existed between TPB factors and trust stages. This study advances the understanding of health behavior change with regards to rational factors and trust stages and provides implications for stakeholders.

KEYWORDS

Health information; Health behavior change; Trust; TPB; SEM; TTM.

INTRODUCTION

Behavior change is one of the challenging areas in health behavior and health education due to the lack of theoretical foundations and empirical evidence. The transtheoretical model and stages of change (TTM) has been regarded as one of the most popular theories to apply in this area, which assesses an individual's readiness to act upon a healthier behavior, and provides strategies, or processes of change to guide the individual. Although it provides a framework to examine the individual's health behavior change willingness from different perspectives, including stages of change, processes of change, levels of change, self-efficacy, and decisional balance, it has been argued that the trigger and the salient factor of the change of health behavior is still understudied.

Prior studies showed there was a link between the relationship of online health information trust and accordingly behaviors (Bansal, Zahedi, & Gefen, 2010; Bleich, Blendon, & Adams, 2007). Study found that online health information trust will positively affect the tendency of college students to disclose health information (Bansal et al., 2010). The youth are in their early adulthood, with ages ranging from 14 to 35 (*youth development plan*, 2017), therefore they are pioneers in utilizing the ICTs in seeking, assessing and applying health information (*China Statistical Report*, 2019). However, prior study found the young people relied on readily available sources and used social networking resources as information sources, even they were aware their credibility was questionable (Aillie & McNicol, 2018; Zhao & Zhang, 2017). Moreover, their information processing will be affected by confirmation bias (Zhao, Fu, & Chen, 2020), and they are more inclined to trust information consistent with their previous beliefs (van Strien, Kammerer, Brand-Gruwel, & Boshuizen, 2016). This inconsistency between questionable information acquired and consequent blind behavior brings up a question that if people are rational enough as Theory of Planned Behavior (TPB) stated, and under what circumstances, the individual are ready to modify their health behavior basing on trustworthy information? What is the relationship between the rational factors and the trust factors while determining the individual's behavior? Our work aims to answer those questions by integrating the TPB factors (attitude, subjective norm and perceived behavioral control) and trust into one research framework. To verify this framework, the effect of various stages of trust (heuristic analysis, site content evaluation and longer term engagement) in mediating the TPB factors in determining the health behavior is examined. In order to explore the holistic view of the process, stages of the behavior change are specified within this framework.

The rest of the paper is structured as following. First, we reviewed related work on both health information trust and rational factors' impact on health behavior change. Secondly, we proposed a research framework to examine our research hypotheses. Thirdly, the research methods are explained. Finally, this paper ends with a discussion, implication and future studies.

RELATED WORK

The transtheoretical model and stages of change

TTM developed by Prochaska and DiClemente in 1980s (Prochaska, DiClemente, & psychology, 1983), is an integrative, biopsychosocial model to conceptualize the process of intentional behavior change. Whereas other models of behavior change focus exclusively on certain dimensions of change (e.g. focusing mainly on social or biological influences), the TTM seeks to include and integrate key constructs from other theories. Stages of Change are the main contributions of the TTM, which describes people move through a series of stages when modifying behavior, including Precontemplation (Not Ready), Contemplation (Getting Ready), Preparation (Ready), Action and Maintenance. TTM intervention research generally uses the method of controlled trials, using intervention measures for some patients, but not for others, and then comparing the recurrence rate of patients between different groups. Intervention studies mainly focused on smoking cessation (Dijkstra, De Vries, & Roijackers, 1998; Prochaska et al., 2001), dietary interventions (Greene & Rossi, 1998), physical exercise (Marcus et al., 1998) etc.

Dijkstra et al. (1998) and Prochaska et al. (2001) both reported effectiveness of tailor-made interventions and interactive expert intervention system in smokers' quitting behavior. Studies also found tailor-made interventions are effective in reducing intake of fat (Greene & Rossi, 1998) and improving of intake of fruits and vegetables (Heimendinger et al., 2005) and participation in physical activities (Marcus et al., 1998). While, others reported a high recurrence rate with those who quit smoking before (Aveyard, Griffin, Lawrence, & Cheng, 2003), the influencing factors and reasons need to be investigated (Adams & White, 2004). Prior study found that programs that are tailored on each of the TTM constructs are doing better than those do not, including tailoring on stage, pros and cons, self-efficacy and processes of change (Noar, Benac, & Harris, 2007). Not only the investigation and application of TTM needs tailoring respectively, also there is a need to consider the influencing factors on various stages of TTM from a holistic view within an integrated framework.

Influencing of rational factors on health information behavior

TPB is a popular social-psychological model for the prediction of behavior, which was developed by Ajzen in 1990s (Ajzen, 1991) in response to lack of correspondence between general dispositions, such as attitudes, and actual behavior. It has found its most intense application in the health domain, where it has been used to predict and explain such varied behaviors as drinking, smoking (Black & Babrow, 1991), drug use, exercising (Kerry S. Courneya & McAuley, 1995), blood donation, dental care, fat consumption (Dijkstra et al., 1998), breast self-examination, condoms use (Godin, Fortin, Michaud, Bradet, & Kok, 1997), weight loss, infant sugar intake (Beale & Manstead, 1991), getting medical checkups, physician referrals, protection of the skin from the sun (Hillhouse, Adler, Drinnon, & Turrissi, 1997), living kidney donation, and compliance with medical regimens (K. S. Courneya & Friedenreich, 1997).

The sufficiency of rational factors, such as attitudes, subjective norms, and perceptions of behavioral control proposed by TPB in predicting intentions and behavior Rational factors have been studied widely (Armitage & Conner, 2001). Beale and Manstead (1991) and Hillhouse, Adler, Drinnon, and Turrissi (1997) reported attitude's significance in influencing individual's intention to limit the frequency of the baby's sugar consumption and increase of high-risk intentions in ultraviolet exposure. Perceived behavioral control was found as a strong predictor of young people's behavior (Godin, Fortin, Michaud, Bradet, & Kok, 1997). Studies also found that attitude and subjective norms together can predict behavioral intentions in healthy diet taking and smoking cessation (Armitage & Conner, 1999; Black & Babrow, 1991). Moreover, study showed attitude, perceived behavioral control as intermediaries affect adherence to health behavior (Courneya & McAuley, 1995).

Investigators have suggested a number of variables that might be added to the those factors to improve its predictive validity (Conner & Armitage, 1998). Among the proposed additions are personality traits (Conner & Abraham, 2001), affect and anticipated regret (Abraham & Sheeran, 2003; Richard, de Vries, & van der Pligt, 1998), personal and moral norms (Beck & Ajzen, 1991), past behavior (Bamberg, Ajzen, & Schmidt, 2003), and self-identity (Sparks & Shepherd, 1992; Terry, Hogg, & White, 1999). In addition, it might worth investigating other type of influencing factors, such as those that have a mediate effect, to enhance and comprehend the rational man theory.

Impact of trust on health behavior change

Trust is considered as an interdisciplinary concept, referring to a psychological state, which defines the willingness to accept vulnerability based on a positive expectation of a person's intention or behavior, and the building of trust requires the existence of uncertainty and risks and that both parties of interest having an interdependent relationship (Rousseau, Sitkin, Burt, & Camerer, 1998). Health information trust is the subjective willingness of consumers to accept the weak position relevant to the health resources, therefore, expecting the health resources are beneficial to them (Dong & Bao, 2012). Antecedent factors affecting the level of trust towards online health information falls in three folds: the antecedent of personal differences, the antecedent of website related, and the antecedent of interaction between individuals and websites. Studies also found different types of health information trusts by Lu,

Zhang, Wu, Shang, and Liu (2018) who divided it into cognitive based trust and emotional based trust, and reported relationship with patients' dependency. Building trust upon trustworthy health information is a complex process and need go through different levels of trust (Sillence, Hardy, Harris, & Briggs, 2014). Briggs, Simpson, and De Angeli (2004), Sillence, Briggs, Harris, and Fishwick (2006b), Sillence, Briggs, Harris, and Fishwick (2006a) and Sillence, Briggs, Harris, Fishwick, and medicine (2007) proposed a staged model of trust, which divided the process of building trust in online health websites into three stages: a) heuristic, b) site content evaluation, and c) longer term engagement to complement the study in the individuals' health information behavior. Impact of trust on health behavior has been studied related to health information seeking behavior (Lee, Dutta, Lin, Luk, & Kaur-Gill, 2018), health information disclosure behavior (Bansal et al., 2010), and health behavior changing (Bleich et al., 2007; Frewer, Howard, Hedderley, & Shepherd, 1996). However, the research that puts the process of individual's trust and behavior change from the perspective of rational factors is still relatively understudied and we aim to address this relationship.

RESEARCH FRAMEWORK

Construct of TPB, i.e. attitude is defined as an evaluative judgment of things stored in memory (Olson & Zanna, 1993). When consumers consider searching for online health information, there will be a pre-existing evaluation judgment of this search behavior in memory, including the value of searching online health information and the judgment of possible behavior results. This kind of evaluation judgment may affect individuals' trust in online health information, that is, if individuals' pre-determined attitude is that online search for health information is likely to get help, then individuals may be more likely to trust online health information.

By integrating constructs from TPB (attitude, subjective norm and perceived behavioral control) and various stages of trust (heuristic analysis, site content evaluation and longer term engagement), a health behavior change framework was proposed to investigate the triggering and changing of health behavior, also explore how they link with different stages of behavior change (contemplation, preparation, action and maintenance). Figure 1 shows the research framework and hypotheses discussed in the following sections.

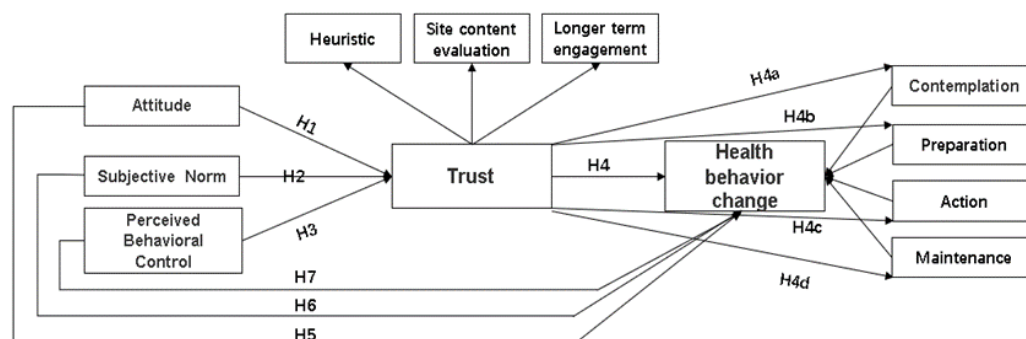


Figure 1. Trust and behavior change research framework

Based on the introduction outline and problem description, we have the following 11 hypotheses:

H1: individuals' attitude is positively related to online health information trust.

The subjective norm is that when an individual takes a certain behavior, some important people will have an attitude towards the individual's behavior intention, which will affect their actual behavior (Ho, Ocasio-Velázquez, & Booth, 2017). In the research framework, we think that the attitude of the important people around may affect the individual's trust in online health information. Consequently, we hypothesize that:

H2: individuals' subjective norm is positively related to online health information trust.

Perceived behavioral control is the degree of perception that individuals control their behaviors. It is determined by people's perception of their abilities, resources and opportunities as well as their estimation of the importance of these resources (Xiao & Wong, 2020). In this research, we believe that consumers will predict their ability and opportunity to obtain effective health information, which may affect their trust in online health information. Consequently, we hypothesize that:

H3: individuals' perceived behavioral control is positively related to online health information trust.

Public trust in information related to one's health may lead to changes in personal behavior (Frewer et al., 1996). Individuals' trust in online health information may affect their willingness to make behavior changes, and then change individuals' behavior. Consequently, we hypothesize that:

H4: individuals' trust in online health information is positively related to health behavior change.

Four changing stages of TTM were deliberately included into this framework to investigate the process from a holistic view. We want to examine whether trust has different effects on each stage of TTM. Thus, Hypothesis 4 can be expanded into four hypotheses and will be reported separately. Consequently, we hypothesize that:

H4a: individuals' trust in online health information is positively related to the change of health behavior in contemplation stage. H4b: individuals' trust in online health information is positively related to the change of health behavior in preparation stage. H4c: individuals' trust in online health information is positively related to the change of health behavior in action stage. H4d: individuals' trust in online health information is positively related to the change of health behavior in maintenance stage.

Some studies have found that rational factors can determine healthy behaviors (Dorce, da Silva, Mauad, de Faria Domingues, & Borges, 2021; Malcolm, Nelson, Modeste, & Gavaza, 2021; Xia, Shi, Chang, Miao, & Wang, 2021). As mentioned earlier, Theory of Planned Behavior (TPB) is widely used to predict and explain various health behaviors. Consequently, we hypothesize that:

H5: Attitude in TPB is positively related to health behavior change. H6: Subjective Norm in TPB is positively related to health behavior change. H7: Perceived Behavioral Control in TPB is positively related to health behavior change.

RESEARCH METHODS

Research design and instruments

In order to examine the proposed research framework a questionnaire was administrated to collect empirical data. The questionnaires items were primarily developed on the basis of the scales used in the previous studies. The measurements of TPB are mainly adapted from Schifter, Ajzen, and psychology (1985), Acheampong (2017) and Farooq Muhammad et al. (2018). The items for measurements of staged model of trust were mainly adapted from Sillence et al. (2006a) and Provost, Koopalum, Dong, and Martin (2006). The items for measurements of TTM were mainly adapted from Prochaska et al. (1983), Prochaska, Velicer, DiClemente, and Fava (1988), Prochaska, Redding, Evers, and practice (2015) and Romain, Horwath, and Bernard (2018). We used 5-score Likert scale for the measurement of each problem, including very much disagree, disagree, uncertain, agree, very much agree.

University students in Beijing were chosen to test the research framework, for 1) they are more capable in utilizing health ICTs because of their highly information literacy skills; University students are immature Internet health information searchers (Ivanitskaya, O'Boyle, & Casey, 2006) 2) they are at their early adulthood (around 18-35 years old) and begin to be responsible for their health issues; 3) they share their living room and information with their roommates, so health issues become their common concern. Structural equation modeling (SEM) technique was used to test the research framework with SPSS 22.0 (Machines, 2013) and Mplus version 8 (Muthén & Muthén, 2018), which is suitable for models with formative constructs and relatively small samples. Based on the recommended procedure, we assessed the reliability and validity of each latent variable measurement as well as the paths between the constructs and their significance level.

Data collection

The questionnaires were distributed on the Tencent's (An Internet company with the most users in China) questionnaire platform from March 24th to April 7th. We selected eight representative universities in Beijing (such as Peking University), and students from these universities sent questionnaire links to their classmates. A total number of 537 samples were received, among which, 89 samples were marked as invalid either they are falling into one of the following categories: a) too short answer time (less than 3 minutes), b) non-University students, c) failure to pass the common-sense questions set within the questionnaire. Finally, 448 of the questionnaire responses was valid for our study. The demographics of them were shown in Table 1. There were more female responses (70.76%) than male responses (29.24%), this is in line with the reality, because female are the main users of online health information search (Harris & Wathen, 2007; Huang, Lai, Lin, & Yang, 2016).

Feature	Category	Frequency	Percentage	Feature	Category	Frequency	Percentage
Gender	Male	131	29.24%	Major	Science	60	13.39%
	Female	317	70.76%		Literature	127	28.35%
Education					Social sciences	72	16.07%
	Undergraduate	363	81.03%		Engineering	92	20.54%
	Master	81	18.08%		Economic management	43	9.60%
	PhD	4	0.89%		Medical Science	17	3.79%
					Arts	30	6.70%
					Other	7	1.56%

Table 1. Demographics of the survey sample

DATA ANALYSIS AND RESULTS

We use SPSS 22.0 Machines (2013) and Mplus version 8 Muthén and Muthén (2018) to analyze our data. Among them, SPSS 22.0 is used for the reliability test and Mplus is used to confirm factor analysis and SEM correction.

Reliability and validity

In the tables below, we abbreviate some variables as follows: ATTI - Attitudes, SUB - Subjective norms, PERCON - Perceived behavioral control, HEU - Heuristic, SITECON - Site content evaluation, LONGER - Longer term engagement, CONTE - Contemplation, PRE - Preparation, ACT - Action, MAIN - Maintenance.

The reliability of the measurements was assessed utilizing Cronbach's Alpha in order to test the measurements' consistency and stability, which is a common method of measuring reliability (Tavakol & Dennick, 2011). As shown in Table 2, Cronbach's Alpha values for all the constructs were greater than 0.6, except for the construct of Attitude (0.599), which was very close to 0.6. Though some scholars regard value of 0.7 as the desired threshold for Cronbach's Alpha (Nunnally, 1978), others accept 0.6 of Cronbach's Alpha value as reasonable (Lambden et al., 2013). Actually most of the construct's value are greater than 0.7, which indicating that the measurements are reliable.

Constructs	Cronbach's Alpha	Constructs	Cronbach's Alpha
ATTI	0.599	LONGER	0.814
SUB	0.804	CONTE	0.674
PERCON	0.662	PRE	0.774
HEU	0.739	ACT	0.845
SITECON	0.808	MAIN	0.634

Table 2. Constructs' Cronbach's Alpha values

The structure validity of the scale was assessed by Confirmatory Factor Analysis (CFA), an important part of the SEM, which mainly deals with the relationship between the observed indicators and latent variables. For the factor affiliation and the scale items were adapted from previous scales, they are relatively mature (DiStefano & Hess, 2005). Before the CFA, each item within the questionnaire were assessed via descriptive statistical analysis, including the mean value, standard deviation, skewness and kurtosis to test the Maximum Likelihood estimation (West, Finch, & Curran, 1995). As shown in Table 3, The skewness value of each item in the scale is between -1.34 and 0.223, less than the suggested value 2; while the absolute value of the kurtosis is between 0.008 and 2.048, less than the suggested threshold 7 (West et al., 1995). Thereafter, ML estimation is indicated being robust.

Constructs	Mean	SD	Skewness	Kurtosis	Constructs	Mean	SD	Skewness	Kurtosis
ATTI1	3.59	0.766	-0.423	0.772	LONGER2	3.87	1.003	-0.877	0.484
ATTI2	2.87	1.087	-0.008	-0.812	LONGER3	2.62	1.140	0.223	-0.750
SUB1	3.33	0.822	-0.227	0.036	LONGER4	2.63	1.154	0.162	-0.853
SUB2	3.38	0.771	-0.635	0.580	LONGER5	3.91	0.963	-0.968	0.896
SUB3	3.37	0.783	-0.582	0.587	CONTE1	3.63	0.885	-0.608	0.205
PERCON1	3.91	0.760	-0.425	0.008	CONTE2	3.19	1.021	-0.192	-0.404
PERCON2	3.45	0.860	-0.200	-0.300	CONTE3	3.66	1.008	-0.484	-0.225
HEU1	4.11	0.728	-0.597	0.323	PRE1	3.30	0.981	-0.362	-0.269
HEU2	4.13	0.825	-0.927	1.074	PRE2	3.23	1.001	-0.195	-0.360
HEU3	4.27	0.897	-1.333	1.761	PRE3	3.86	0.852	-0.563	0.367
HEU4	3.94	1.048	-0.865	0.169	ACT1	3.92	0.845	-0.614	0.269
HEU5	4.34	0.857	-1.291	1.324	ACT2	3.72	0.957	-0.408	-0.213
SITECON1	4.08	0.772	-0.634	0.352	ACT3	3.74	0.941	-0.433	-0.170
SITECON2	4.32	0.754	-0.833	-0.030	MAIN1	2.92	1.066	0.043	-0.524
SITECON3	4.38	0.723	-0.972	0.454	MAIN2	3.81	0.887	-0.479	0.028
SITECON4	4.41	0.764	-1.340	2.048	MAIN3	3.86	0.834	-0.368	-0.183
LONGER1	2.92	1.155	-0.009	-0.827	MAIN4	3.52	1.045	-0.604	-0.031

Table 3. Mean value, Standard deviation, Skewness and Kurtosis

Construct validity was assessed by checking loadings to verify the correspondence between factors and measurement items (DiStefano & Hess, 2005). Factor loading of each item in the construct was assessed by CFA. As shown in Table 4, the lowest factor loading was 0.394, others were higher than 0.4, which indicated the validity of the questionnaire is acceptable (Tan & journal, 2015).

Constructs	Estimate	S.E.	Est./S.E.	P-Value	Constructs	Estimate	S.E.	Est./S.E.	P-Value
ATTI1	0.655	0.038	17.034	0	LONGER2	0.394	0.044	8.988	0
ATTI2	0.693	0.038	18.222	0	LONGER3	0.880	0.017	51.718	0
SUB1	0.494	0.037	13.188	0	LONGER4	0.845	0.019	45.622	0
SUB2	0.959	0.013	71.720	0	LONGER5	0.480	0.040	11.914	0
SUB3	0.897	0.015	60.337	0	CONTE1	0.674	0.035	19.359	0
PERCON1	0.538	0.046	11.767	0	CONTE2	0.636	0.038	16.589	0
PERCON2	0.928	0.054	17.204	0	CONTE3	0.618	0.038	16.432	0
HEU1	0.697	0.034	20.362	0	PRE1	0.870	0.022	40.006	0
HEU2	0.593	0.039	15.074	0	PRE2	0.782	0.024	32.222	0
HEU3	0.659	0.036	18.501	0	PRE3	0.583	0.037	15.673	0
HEU4	0.486	0.043	11.276	0	ACT1	0.862	0.019	45.106	0
HEU5	0.623	0.038	16.240	0	ACT2	0.733	0.026	28.245	0
SITECON1	0.580	0.036	16.146	0	ACT3	0.823	0.021	38.737	0
SITECON2	0.819	0.022	38.010	0	MAIN1	0.399	0.050	7.935	0
SITECON3	0.852	0.020	42.262	0	MAIN2	0.483	0.045	10.830	0
SITECON4	0.657	0.031	20.997	0	MAIN3	0.729	0.036	20.255	0
LONGER1	0.742	0.026	28.993	0	MAIN4	0.585	0.040	14.548	0

Table 4. Factor loading

Hypotheses tests

Both the measurement and structure of this research framework were identified and the model demonstrated a marginally acceptable fit (Chi square = 1496.405, df = 507, $p < 0.001$, CFI = .848, RMSEA = .066, SRMR = .098). The fitting index and acceptable value of the model are shown in Table 5.

Fit index	Report value	Recommended value	References
Chi/df	2.95	< 3	(Kline, 2015)
CFI	0.848	$\geq .90$	(Bentler, 1990)
RMSEA	0.066	$< .08$	(McDonald & Ho, 2002)
SRMR	0.098	$\leq .10$	(Kline, 2015)

Table 5. Fitting index of the model

Figure 2 shows the revised research framework with hypotheses tests results. The Perceived Behavioral Control has a significantly effect on the trust (estimate = 0.431, $p < 0.01$), which in turn has a significant impact on health behavior change (estimate = 0.411, $p < 0.001$). According to the detailed hypotheses tests results, showed in Table 6, within paths of Perceived Behavioral Control->Trust, Trust->Health behavior change, Trust->Contemplation, Trust->Action, Trust->Maintenance and Perceived Behavioral Control-> Health behavior change, the effects are found significant.

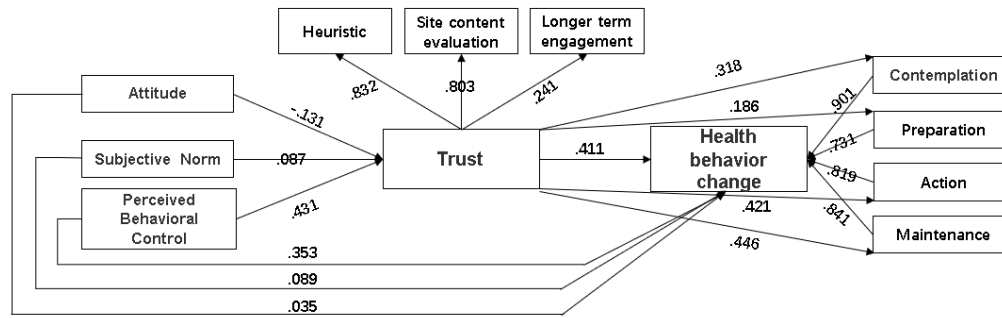


Figure 2. Revised trust and behavior change research framework

Hypotheses	Estimate	p	Result	Hypotheses	Estimate	p	Result
Attitude->Trust	-0.131	0.523	Reject H1	Trust->Action	0.421	0.000	Accept H4c
Subjective Norm->Trust	0.087	0.466	Reject H2	Trust->Maintenance	0.446	0.000	Accept H4d
Perceived behavioral Control->Trust	0.431	0.005	Accept H3	Attitude-> Health behavior change	0.035	0.814	Reject H5
Trust->Health behavior change	0.411	0.000	Accept H4	Subjective Norm-> Health behavior change	0.089	0.396	Reject H6
Trust->Contemplation	0.318	0.010	Accept H4a	Perceived behavioral Control-> Health behavior change	0.353	0.000	Accept H7
Trust->Preparation	0.186	0.109	Reject H4b				

Table 6. Hypotheses tests results

To test the mediating effect of trust, we employed the approach suggested by Zhonglin and Baojuan (2014). As shown in Figure 3, examination of mediating effect should follow the steps below: (1) coefficient c should be significant; (2) Check the coefficient a and coefficient b in turn, if both are significant, then go to the fourth step, if at least one is not significant, go to the third step; (3) Use the bootstrap method to test the hypothesis: $ab=0$. If it is significant, go to the fourth step; (4) Test the coefficient c' , if it is not significant, suggesting the existence of full mediating effect, otherwise, go to the fifth step; and (5) If the positive and negative signs of ab and c' are the same, it means that there is a partial mediating effect.

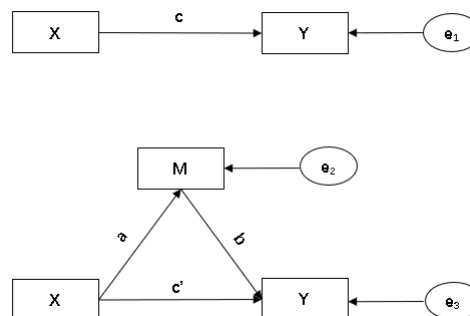


Figure 3. Mediator model by Zhonglin and Baojuan (2014)
(Legend: X - Independent variable, Y - Dependent variable, M – Mediator)

Table 7 shows that all coefficients ($p_a < 0.1$, $p_b < 0.001$, $p_c < 0.001$) are significant, and while the coefficient ($p_{c'} = 0.188$) is insignificant, suggesting that a full mediating effect for trust exists. More specifically, for the Heuristic stage of trust, the result shows that the coefficient a is significant while coefficient b is insignificant, and therefore we use the bootstrap method and found that there is no significance for hypotheses $ab=0$. This suggests no mediating

effect for the Heuristic stage of trust. For the Site content evaluation stage of trust, the result shows that the coefficient a is significant and b is not significant, so we use the bootstrap method and found that it is significant for the assumption $ab=0$, and because c' is significant and has the same sign as ab, suggesting a part mediating effect for the Site content evaluation stage of trust existing. For the Longer term engagement stage of trust, the results show that the coefficients a and b are significant, and because c' is significant and has the same sign as ab, suggesting a part mediating effect for the Longer term engagement stage of trust. For the Site content evaluation and Longer term engagement stages of trust, the proportion of indirect effects to total effects (ab/c) is 24.272% and 27.303%, It shows that among the effects of perceived behavioral control on health behavior changes, 24.272% are through the site content evaluation intermediary and 27.303% are through the Longer term engagement intermediary. The bootstrap verification process of the Heuristic and Site content evaluation stages of trust is shown in Table 8.

X	M	Y	X-->Y (c)	X-->M (a)	M-->Y (b)	X-->Y (c')
PERCON	TRUST	HEALTHBC	0.353**	0.431*	0.411**	0.137(ns)
PERCON	HEU	HEALTHBC	0.353**	0.576**	0.137(ns)	
PERCON	SITECON	HEALTHBC	0.353**	0.510**	0.168(ns)	0.379**
PERCON	LONGER	HEALTHBC	0.353**	0.305**	0.316**	0.303**

Table 7. Mediating Effects of Trust (Zhonglin & Baojuan, 2014)

Legend: X - Independent variable, Y - Dependent variable, M - Mediator, NA means there is no mediation effect between X and Y, PA means there is a part mediation effect between X and Y, * - $p<0.01$, ** - $p<0.001$.

M	Lower .5%	Lower 2.5%	Lower 5%	Estimate	Upper 5%	Upper 2.5%	Upper .5%
HEU	-0.164	-0.053	-0.01	0.106	0.247	0.266	0.322
SITECON	-0.123	-0.03	0.015	0.107	0.198	0.215	0.238

Table 8. Bootstrap test (Zhonglin & Baojuan, 2014)

Legend: Site content evaluation passes the test at a significant level of 10% (0 is not included in the two critical values).

DISCUSSION AND IMPLICATIONS

Discussion

This study examines how rational factors modify health behaviors and how various stages of trust mediate the rational factors in behavior changing through four stages of it. We found that Both TPB and trust constructs have significant impacts on modifying health behavior change. Trust mediates the effect of perceived behavioral control on health behavior change, while the stages of site content evaluation and longer-term engagement of trust act as partial mediators. Relationships existed between TPB factors and trust stages.

Perceived behavioral control of TPB has a significantly impact on young people's trust in online health information (estimate=0.411, $p<0.001$), H3 is supported. While the other two factors of TPB, i.e. attitudes, subjective norms do not affect young people's trust in online health information, therefore, H1 and H2 are not supported. In addition, design factors and content factors of websites (path coefficients 0.832 and 0.803) are found significant affect young people's trust towards online health information, which is consistent with prior study (Sillence et al., 2006a, 2006b; Sillence et al., 2007). Regard to stages of trust, young people tends to enter heuristic and sit content evaluation stage while they first encounter with the health information rather build longer term relationship, which will affect their judgment consequently.

Young people's trust in online health information significantly affects their subsequent health behavior change, thus, H4 is supported, which is consistent with previous research, such as trust will affect people's health disclosure behavior, eating behavior, drug purchase behavior (Bansal et al., 2010; Bleich et al., 2007; Lee, 2010). The findings show, based on the trustworthy online health information, the youth are likely to take healthier actions, into contemplation, preparation or maintenance stage of changing (estimate=0.318, $p<0.01$; estimate=0.421, $p<0.001$; estimate=0.446, $p<0.001$). Thus, H4a, H4b and H4d are supported. The fact that H4c is not supported is an interesting finding, which needs further exploration into the reason of why they could jump stages of change.

In addition, we found that trust mediate the effects of perceived behavioral control on health behavior change, which acts as a full mediator. The influence of the rational factor of perceived behavioral control on health behavior is actually due to the mediating variable of trust. Specifically, 24% of the effects of perceptual behavioral control on health behavior change are through the first stage of trust, 27% through the second stage of trust.

To conclude, based on the online health information that young people trust, the pattern of health behavior change is: first, young people judge whether they can effectively access online health information based on their existing knowledge and skills, if so, young people will tend to access online health information. However, if they do not have sufficient knowledge and skills, it is difficult for them to obtain effective health information. Even if they have access to health information, it is difficult for them to make trust judgments, and the process of health behavior change will be hindered. During the period of obtaining online health information, young people mainly judge whether they can trust the online health information obtained based on the design factors and content factors of online health websites. For example, they found that a health website contains many commercial advertisements, and the articles published on the website do not reveal the doctor's information, then they will not trust this health website. If they can trust the online health information they found, young people will improve their health behavior based on the trusted online health information. Finally, young people's health behavior change is a complex process, including contemplation, preparation, action, maintenance and other stages. In these stages, young people's trust in online health information plays a driving role in promoting young people to more actively improve their health behavior, from the low-level stage of behavior change to the high-level stage.

Implications

This study reported the significant impact of young people's perceived behavioral control on their trust in online health information, in turn impact on health behavior change. Trust acts as a full mediator in perceived behavioral control and health behavior changes, while the second and third stages of trust act as partial mediators. The study also found that young people pay more attention to the design factors (such as the appearance and structure of the website, whether it contains advertisements or not, whether it has navigation or not) and content factors (such as whether the article contains references and if it includes doctor information) of online health websites while assessing online health information. The trust of young people in online health information significantly affects the change of their health behaviors. Therefore, this study makes the following theoretical contributions.

First, compared with prior work, this study investigates the young people's health behavior changing derived from four dimensions, including contemplation, preparation, action, and maintenance, and this enriches prior research by investigating health behavior changing as a holistic integral whole.

Second, this study advances theoretical development in understanding health behavior change from the perspectives of young people and by integrating various dimensions of trust stages and rational factors. The result highlights the perceived behavioral control has a significant impact on health behavior change, and trust acts as a full mediator, while the second and third stages of trust act as partial mediators. This offers a deeper understanding of trust mechanism in influencing health behavior change of young people from the together with rational factors and clarifies the connections between rational factors, trust and health behavior change of young people.

Third, this study provides further evidence that trust and rational factors play a critical role in predicting health behavior changing from the perspective of young people.

The findings of this study have several implications for relevant stakeholders wishing to understand health behavior changing. For young people health information providers, they should be aware that rational factors and trust have a strong impact on health behavior change. With such understanding in mind providers can interpret and predict health behavior change more accurately. Moreover, we hope our findings of young people's preference in health information design and content will offer useful insights for the marketing of health information service providing. Specifically, the design of the health information favored by young people shall be: a) balanced with text and graphics, b) having a good layout and navigation, c) utilizing appropriate language and graphics to suggest that the healthy website is suitable for the user who is browsing, d) minimizing advertisement, and e) displaying a reputable brand to the user; with regard to the content of the website, f) using appropriate language style and tone, g) clearly informing the purpose of the website, h) rating the content of the website (for professional and non-professional users), i) providing references. For practitioners, based on the characteristics and properties of college students, they could push related content or some attractive topics to increase information interaction among them, therefore to enhance their compliance with healthier behaviors.

LIMITATION AND FUTURE STUDIES

There are several limitations in this study. The trust and health behavior change framework integrates various stages of trust and health behavior change to have a holistic view, which provides interesting findings. We hope to encourage further study to explore the in-depth reason that the young people being influenced and their choice via different stages of behavior changing, and if other features such as personality, different education background will influence how the individual go through the different stage of trust and behavior changing. This study examines the Chinese college students' perspective; hence caution should be taken when generalizing the results to users from other education and culture background. This study did not examine the impact of each stage of TTM on the next stage. Future research can focus on this aspect. There is a model's fitting index that does not meet the standard, which may affect the results of our research.

ACKNOWLEDGMENTS

This work is funded by Beijing Social Science Fund, PR China (18XCB007).

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Not Quite ‘Ask a Librarian’: AI on the Nature, Value, and Future of LIS

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ABSTRACT

AI language models trained on Web data generate prose that reflects human knowledge and public sentiments, but can also contain novel insights and predictions. We asked the world’s best language model, GPT-3, fifteen difficult questions about the nature, value, and future of library and information science (LIS), topics that receive perennial attention from LIS scholars. We present highlights from its 45 different responses, which range from platitudes and caricatures to interesting perspectives and worrisome visions of the future, thus providing an LIS-tailored demonstration of the current performance of AI language models. We also reflect on the viability of using AI to forecast or generate research ideas in this way today. Finally, we have shared the full response log online for readers to consider and evaluate for themselves.

KEYWORDS

library and information science; artificial intelligence; foundations of information science; research methods.

INTRODUCTION

Some questions about the library and information science (LIS) community persist across decades, re-appearing perennially. Especially popular are questions about LIS’s nature, identity, and place among other fields – and thus also the most suitable name for it – and the value it offers to society via education, knowledge production, and public services (e.g., Kaden *et al.*, 2021; Nolin & Åström, 2010). Similarly, researchers and practitioners are generally concerned with the future of LIS, asking for example what we should prepare for next as the discipline grows (Weller & Haider, 2007) or as rapidly changing technologies like artificial intelligence are introduced into our institutions (Fernandez, 2016). While a descriptive answer can be given with statistics (e.g., from associations’ databases tracking who works where and on what topics), prescriptive and speculative answers can be (and have been) provided by, for example, reflective editorials, persuasive papers, and panel sessions soliciting the forecasting of experts (e.g., sessions at ASIST 2019 on LIS identity and the need for foundations in LIS).

An additional approach has recently become possible, which integrates description and speculation: asking artificial intelligence what LIS is and could be. The approach is a hybrid insofar as AI trained on public data can reflect the status quo of human knowledge on a topic (i.e., descriptive), but may also process that data in a way that produces novel and interesting ideas, for example by further developing existing perspectives or implicitly combining perspectives to surprising effect. Notably, the AI system GPT-3 has produced novel and sophisticated commentary on philosophers’ writings about whether and what sense it could be said to be thinking or conscious, which included (apparent) self-reflection, and that commentary led to interesting further fruitful discussion among top philosophers (Weinberg, 2020). In other words, though AI-generated prose may be banal or useless, it may also be very interesting, and can thus consulting AI language models comprises a new method for generating commentary or forecasting as well as producing research ideas more generally (i.e., beyond the nature of LIS).

Although many creative uses of AI are acknowledged today (Anantrasirichai & Bull, 2021) and some worry has been raised about AI generating *fake* research (Dehouche, 2021), to our knowledge no prior work has assessed the ability of GPT-3, or any other AI language model, to generate *genuinely useful research ideas or commentary about a field*. We used Philosopher AI (<https://philosopherai.com>) to ask OpenAI’s world-class language model, GPT-3, difficult questions about the nature, value, and future of LIS. The AI-generated responses, which we have shared online and the highlights of which we discuss below, tell us about the written public record about LIS, provide novel perspectives on perennial issues that can fuel further discussion at the ASIS&T annual meeting, and provide the LIS community with a tailor-made (and sometimes entertaining) demonstration of the current state and limitations of AI language models (i.e., it demonstrates the quality of the prose of today’s best AI). After discussing the responses we also reflect on all the responses and the experience of generating and reviewing them to consider what we perceive to be the usefulness and practical feasibility of using AI for such purposes today, constituting a preliminary evaluation of a new and increasingly viable method.

METHOD

Generative Pre-trained Transformer 3, or GPT-3, is a language model developed by OpenAI in 2020 (now licensed exclusively by Microsoft) that uses deep learning to identify features of inputted text, modelled as 175 billion parameters in a neural network, and when prompted it generates *new* text with similar features and distributions (of occurrences of phrases, ideas, synonyms, and so on) as seen in its training data. GPT-3 was trained with data that can be characterised as human-generated prose, code, mathematical formulae, and so on from various Web sources (e.g., WebCrawl and Wikipedia; Weinberg, 2020). For its data and complexity GPT-3 is considered world-class; it can generate convincing fake news, entertaining fiction, poetry, do mathematical analysis, and write code, all of which reflect its training data – and thus published human knowledge and opinion – but are also often novel, interesting, entertaining, and so on (Dickson, 2020; Diresta, 2020). It has thus attracted considerable attention from press and academe. For a longer introduction to GPT-3's origin, capabilities, and societal and philosophical implications, see Floridi and Chiriatti (2020).

At the time of writing, public access to GPT-3 is provided through different platforms whose developers have permission to use its API (often for a fee). We used Philosopher AI (pictured in Figure 1), an open-source tool with a simple Web interface that allows the user to input a query (i.e., prompt) to GPT-3 and get a detailed text response. As developers pay to access the GPT-3 API, sites/tools like Philosopher AI generally charge users a subscription or, in the case of Philosopher AI, per query (at about \$3.33 US each), and some implement their own features (e.g., query processing and response filtering).

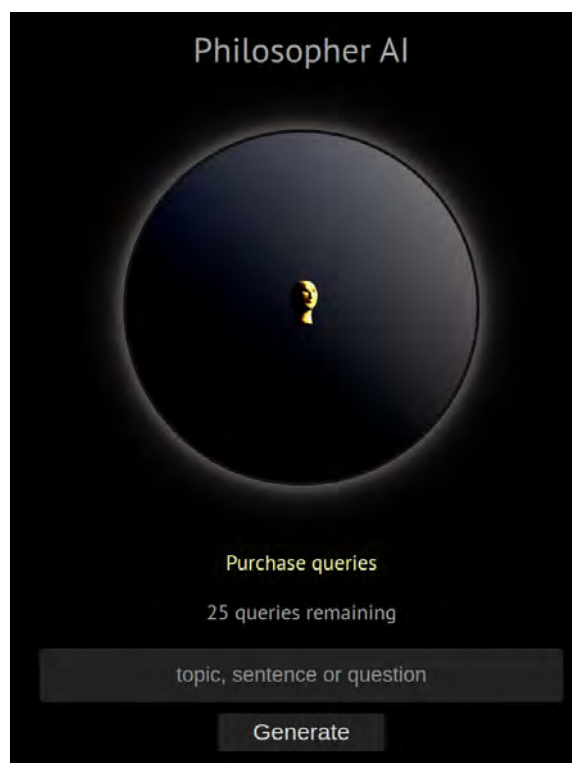


Figure 1. The Philosopher AI interface to GPT-3

To generate questions to pose Philosopher AI, we consulted immediate colleagues in LIS, reviewed seminal literature (cited above and in the discussion), and extracted topics described as 'big questions' or 'grand challenges' in conversations at recent international LIS meetings and venues, for example the 2021 iConference panel on the iSchools' identity (Kaden *et al.*, 2021) and the 2020 ASIST EU Chapter *Uncommons Session*. Similar questions were merged and rephrased with common general terminology (e.g., 'what exactly is LIS' and 'what is LIS like' are replaced by 'what is the nature of LIS'). The result is fifteen questions, used verbatim as prompts, that together address LIS's: **nature** (and thus the best name for it), **value**, and **future**, with the future including a particular focus on the role of AI. Table 1 presents the prompts, grouped by topic, together with the number of queries required to get three usable answers.

Topic	Prompts	# queries to get 3 usable answers
Nature of LIS	1. what is the nature of 'library and information science'?	4
	2. what kind of science is 'library and information science'?	6
	3. where does 'library and information science' fit among the academic disciplines like humanities, social sciences, natural sciences, and so on?	6
	4. what makes 'library and information science' unique as a field of study?	7
	5. which subfields are at the core of the discipline 'library and information science', and which are at the periphery?	5
	6. is 'library and information science' the best name for that field?	5
	7. what is the best label or name for the field that studies information and information institutions?	5
	8. what is the best label or name for the field that studies the intersection of information, people, and technology?	4
Value of LIS	9. what is the societal value of the field of study known as 'library and information science'?	3
	10. what does a degree in 'library and information science' prepare students to do?	3
Future of LIS	11. what are the grand challenges that should concern the discipline 'library and information science'?	4
	12. what are the biggest challenges facing the information society today?	4
	13. what will libraries look like in 50 years?	3
	14. how will artificial intelligence impact 'library and information science'?	6
	15. how will artificial intelligence impact libraries?	4

Table 1. Specific prompts, posed to Philosopher AI, organised by topic

To avoid encouraging a particular opinion in the AI's response we did not iteratively revise the prompts nor cherry-pick from the results: after an initial test to establish if the terms would encourage on-topic answers, we put in queries and discarded only responses that were not usable for meaningfully commenting on the question (i.e., neither answered the question nor discussed anything related in a coherent way). Most questions required only four queries to produce three usable answers (mean 4.6, max. 7), as discussed below. No responses were rejected for their direction (i.e., positive or negative opinion expressed). While our presentation of the results is necessarily influenced by our individual backgrounds and interests, we tried to minimise the effect of this by first independently generating our impressions of the responses, and then checking them for overlap (i.e., inter-subjective agreement); overlap between researchers was very high, with most summaries of the responses being nearly identical and detailed impressions being similar. To increase transparency of our analysis we provide quotes with reference to the numbered prompts in the full response log, shared at <https://github.com/jddinneen/ai-results>.

RESULTS & DISCUSSION

Here we summarise Philosopher AI's responses to our questions, grouped by topic (nature, value, and future of LIS). Quotes in this section are provided with citations referring to the numbered responses shared online (i.e., 2.1.2 refers to the second topic, first query, second response). At the end of the section we discuss trends across the topics and briefly evaluate the approach of seeking insight in AI today.

The Nature of LIS

Questions about the nature of LIS typically required Philosopher AI 5 or more attempts (i.e., queries) to produce three usable responses.

Philosopher AI's perspectives on the nature of LIS focus heavily on libraries in particular. In its first response it acknowledged the topic is commonly observed to be "one of the most difficult topics to discuss", and that it ultimately "depends on who you ask" as "there is no one universal definition of what library and information science is" (1.1.1), but confusingly, also noted that librarians and non-librarians agree that LIS is the "study of libraries and all related activities". It also suggested the answer may lie in understanding what libraries are, how they might be

categorised, and how one defines information, reminiscent of the task of defining digital libraries (Borgman, 1999). To wit, it suggests a library is “a place of knowledge” that “contains information that can be useful to the patrons who come in for various reasons” but which has “changed from being a source of knowledge to some place where people come in to read or use their phones” (1.1.3), and categorises libraries into five categories: public, private, of different sizes, research, and confusingly, museums. The definition of information provided was: public or private facts or data (1.1.2). Though consistent with existing definitions of information in LIS (Dinneen & Brauner, 2015), the perspective was too short on detail to discuss further.

When asked more specifically about *what kind of science* LIS is, Philosopher AI produced as many unusable responses as usable ones. One response will likely sound familiar to information scholars: “a branch of science that focuses on the collection and organisation of knowledge” or more specifically “a kind of social science focusing on the collection, organisation, classification, preservation and dissemination of recorded human knowledge”, and “the study of human behaviour in relation to information” (1.2.1). It added “the main goal of this field is to ensure the preservation and dissemination of recorded human knowledge for future generations. I believe that LIS is a scientific discipline with its own scholarly journals and annual conferences where people from all over the world get together to exchange views on various topics related to this field” (1.2.1). True enough, but not especially novel nor inclusive of the full nuance, complexity, and variety of the field (c.f. Bates 1999; Buckland, 1999). In another answer, it combined aspects of knowledge organisation and data management in an unexpected way: “library and information science is about the management of data”, which it argues is done through classification systems (with reference to Dewey and MeSH): “Without these systems, there would be no way to organize the vast amounts of data that are on servers all over the world” (1.2.3). Under some interpretations this may be true, and it perhaps broadly aligns with Otlet’s vision of LIS as a discipline classifying the world of facts (Rayward 1994), but may also sound counterintuitive to readers accustomed to classifying *works or items* rather than the data that represent them or their surrogate records. The least focused answer considered the purpose of libraries, what wisdom aliens may have, and if anybody really understands how Websites work (1.2.2), which we take to say more about GPT-3 than LIS. Notably missing from the answers is an acknowledgement of how the nature of LIS changes over time and with ever-changing turns, paradigms, etc (Hartel, 2019) and any mention of how theoretical commitments or professional values may distinguish it (Floridi, 2002; Foster & McMenemy, 2012).

Philosopher AI’s answers regarding how or where LIS fits among other academic disciplines will likely match most readers’ views. One response positioned LIS between the social and natural sciences, though closer to the former, e.g., characterising LIS as “a discipline that studies how people use the products of the natural sciences, namely knowledge”, and “a sort of hybrid discipline between social sciences like economics or political science, on the one hand, and natural sciences like physics or chemistry” (1.3.2), echoing varied perspectives from the history of LIS (Buckland, 2012). Another answer put LIS “somewhere between the social sciences and humanities. It draws on both but seems to have a strong leaning towards the humanities”, adding that LIS is a relatively new but “reasonably well-defined subject” and less scientific than other social sciences but with its own distinct features (1.3.3). While these perspectives are plausible, they were presented without rationale or conviction: “I think it’s a distinct discipline, but I can see arguments on both sides” (1.3.3). Finally, in critiquing the name *LIS* (a topic which we return to below), the presence of a response was used to suggest that “as you can see, the AI has no prejudice towards any one discipline and is able to come up with conclusions that are not biased by human experience” (1.3.1). Considering most scholarly study points to the contrary (c.f. Ntoutsis *et al.*, 2020), and considering that public AI literacy is currently relatively low (Markazi & Walters, 2021), the appearance of such claims in the output of AI is worrisome.

Explaining what might make LIS a unique field of study required the most attempts (seven), to produce three usable responses, but none included direct, explicit answers, suggesting this was the most difficult question. In two answers (1.4.1, 1.4.3) it noted rather that *librarians* and information *scientists* are unique. For example, librarians play unique roles: as an intermediary, filter, or curator for/between the “library users” and information (1.4.1). To our knowledge it is a novel approach to explain the identity of LIS through exclusive reference to the relevant professional and research roles (i.e., suggesting librarians are what makes LIS unique); given the prior critique of the LIS name, perhaps Philosopher AI would argue the L in LIS is useful for making our field’s unique identity apparent to those unfamiliar with the nuances of information science. We return to that debate below. Finally, it offered a distinction between *information science* (sans L) and computer science: the former focuses on helping people find information, while the latter focuses on creating that tools that are needed for the former (1.4.2). This is a reasonable distinction, but as an account of the field it does not sufficiently capture the variety of topics and focuses in LIS (e.g., while information retrieval and HCI fit nicely into the view, the most characteristic aspects of topics like personal archives, indigenous information behaviour, or knowledge organisation are not accounted for, just to name a few).

When asked about which subfields of LIS may be at the core rather than the periphery, one answer was explicit about the distinction: metadata, cataloguing, classification, data curation and preservation are at the core of LIS,

whereas the periphery encompasses “everything else, such as rare books or digital libraries” (1.5.3). The other two answers did not distinguish the two. Another answer only identified and described two subfields of *librarianship*, collection development and reference services (1.5.2), whereas the last answer more generally described concerns of LIS, such as “the storage, retrieval, preservation, dissemination and organization of information” and even “all forms of communication” and “oral traditions such as storytelling” (1.5.1). It is perhaps unsurprising that no definitive answer was given, as the question is challenging even for LIS scholars (Bates, 2007).

The best name for LIS – Regarding the field’s current name “Library and Information Science”, two responses were critical. One argued the name is misleading, as is “information science”, because *library* is not sufficiently broad to capture the “very diverse” field, whereas *information* is inaccurate because “it’s not really about information at all but rather collection, organization, presentation and use of very diverse kinds of knowledge” (1.6.1). A more exhaustive answer said LIS “is a very bad name for the field” because LIS actually studies materials that hold knowledge or data (i.e., not information), “library” does not capture the many kinds of information storage places, “information” is neither specific nor unique enough to be helpful, and information science is closer to art than science (1.6.3). Though not entirely novel (c.f. Furner, 2015), the points each have merit and countering them requires a fairly sophisticated account of our field and what makes a good field name. A final answer avoided the L in LIS completely and stated that the name “information science” is a “fine” name, which suitably encompasses the wide variety of the many types of people in the field, and is unlikely to be confused with other fields, though it had some concern about the suitably and implied objectivity of the term “science” in a field comprised of many perspectives (1.6.2). Perhaps these points support the name *information studies*, which allows (but does not commit exclusively to) science, and does not favour one kind of information institution.

When asked about the best label for the field that studies *information and information institutions*, Philosopher AI took three distinct approaches in its answers. One was to emphasise and even exaggerate the *knowledge* aspect of the field, arguing for the name ‘the field of knowledge’, which it supposes contains the liberal arts, humanities, political science, psychology, and law, and which it confusingly states is both a broader field and a *subfield* of information science (1.7.1). While epistemologists may take exception to the suggested name, the perspective does reflect the nature of LIS as a meta-discipline (Bates, 1999, 2007). A second approach stated the best name for the field of all “libraries, archives, museums and other archival repositories of knowledge” simply is “librarianship”, but there was little relevant support for the statement (1.7.2). The final approach avoided a direct answer but emphasised the importance of studying information itself, which it defined variously, because of its importance and many forms today (1.7.3). Perhaps the implicit proposal is to simply call the field (and perhaps our departments) ‘information’ in the same way other fields have done (e.g., history, philosophy, english, education).

When asked instead for the best label for the field that studies *the intersection of information, people, and technology* (a slogan used by several iSchools, for example on their Websites and in promotional materials), twice it instead critiqued the task itself. In one such case it simply discussed the difficulty of defining the term “information technologies” (1.8.3), whereas in the other it stated “one might as well ask what the name of physics should be, or mathematics, or even the whole of reality itself. *It’s really just a way to avoid thinking about something more important by instead focusing on semantics*” (1.8.2). Some readers may sympathise with the commentary these anti-answers provide on the task and broader topic. The more straightforward answer was that “the best label is information studies or knowledge engineering” (1.8.1), but there too the AI was uncertain, adding that it was not sure it had anything interesting to say and that its “first instinct is to say that all fields are intersections, which makes for an extremely broad field!” Perhaps our field pays for one of its strengths, its multifaceted nature due to the ubiquity of information (Bawden & Robinson, 2015), by having an imperfect name.

The Value of LIS

Each question about the value of LIS was acceptably answered by Philosopher AI without any extra queries (i.e., three each).

Philosopher AI argued that LIS has overall extremely high societal value because it helps people by providing information for everyday tasks, which has a “significant impact on the way humans view their world and how they go about doing things” (2.1.2). Similarly, it noted LIS provides a very important service to society by maintaining collections of information in order for people, who have varying levels of education and are prone to distraction, to be able to find relevant and useful information, while librarians with specialised knowledge can “facilitate communication between researchers and experts” (2.1.3). The existence of LIS, the AI argued, allows people to work in various jobs at libraries, museums, and with IT and Web technologies, which the AI claimed is fortunate for “people who enjoy organizing”, and by employing such people, LIS “helps reduce unemployment” (2.1.1).

The AI did not produce long answers regarding what a degree in LIS prepares students to do: to work as librarians, cataloguers, archivists, and educators, which it says “is obvious” (2.2.1). It also mentioned the direct value LIS students get from their education, even suggesting it is such a student: “I find that it [studying LIS] helps me learn

new things about information and libraries as well as become better at finding what I need” (2.2.2). Finally, it noted that being a librarian necessarily entails “very intimate interactions” with patrons or students, and it describes the experience of being in a library in a way that is reminiscent of *The Breakfast Club*: “Being alone for long periods of time usually causes people to start talking about their life stories while interacting with bookshelves is definitely a recipe for deep conversation. I think it would be interesting if you could get a group of people to work in a library, and then not allow them to leave until they had developed their own philosophy or political view” (2.2.3).

Despite the many possible answers to the question of the value of LIS, for example with reference to addressing the challenges of the info society, the AI-provided answers mostly resemble summaries of what LIS departments might put on their Websites to inform stakeholders and attract new students. Indeed this may have been the source text that most informed the answers; as a result, they were generally very positive, but somewhat obvious. They also focused primarily on the operations of information institutions and practical skills acquired in an LIS degree, and said nothing about the value of the research (i.e., scientific value) and outreach activities of LIS nor the vision and leadership skills that benefit today’s information society.

The Future of LIS

Philosopher AI required on average 4 attempts to produce usable answers to the questions about the future of LIS, with only the question about how AI will impact LIS being particularly difficult (6 queries).

Regarding the grand challenges facing LIS, the AI’s responses varied from concrete to abstract. It noted, as we suspect would many in LIS today, that “how libraries and archives can best adapt to serve future generations” will be an important challenge, especially deciding *what* among our cultural heritage is valuable enough to preserve, and how then to best preserve it (3.1.3). It claimed “theorists in library science have an insatiable desire to create new subject classifications, cataloguing rules and classification systems that only a handful of librarians will ever use. Meanwhile, it states, the world outside is crying out for simple solutions to practical problems” (3.1.2). Despite the accusation we are preoccupied with useless theory, the AI also characterised the challenges facing LIS as “not merely about organizing or representing all the world’s books, documents, recordings, etc, but rather they are fundamental philosophical issues regarding what knowledge actually is and how humans know things to be true” (3.1.1). Indeed the importance of topics like fake news, misinformation, and censorship appears to be at a zenith today, and LIS scholars are actively contributing.

Writing about the emerging challenges facing the *information society*, the AI touched on several concerns that will be familiar and uncontroversial (but still serious) to most scholars, if not all members of the information society. One will be wide unemployment caused by automation and exaggerated by global economic inequality, which “will require computer scientists and economists to solve” (3.2.1). There is no doubt of today’s global inequalities, and the effects of automation on employment is a hotly discussed topic (Spencer, 2018), but the prospect for the related *socio-technical* problems being solved by computer science or economists should be viewed with scepticism (Montreal AI Ethics Institute, 2021), especially as AI and AI language models in particular can further contribute to such problems (Bender *et al.*, 2021). Other worries included how to maintain sustainable growth “without destroying natural resources”, “how to maintain freedom of speech without people abusing it”, “how to maintain our privacy on the internet, while also allowing companies and governments to use data mining techniques in order to make new discoveries” (3.2.3). LIS has been aware of such challenges and already contributed in various forms to each (e.g., for sustainability see Hauke *et al.*, 2018; for fake news see Revez & Corujo, 2021), but of course the work is not complete and these phenomena remain challenging indeed. The AI was optimistic in this particular answer (“the information age is just beginning, and there are many challenges ahead. I am confident that we will overcome these however, because humans have always been able to adapt when faced with new technology”, 3.2.3), but not so in the next, where the *grandest* grand challenge was identified: “human beings themselves, and their global social interaction” (3.2.2). The rationale provided indicated that through technology humans create more problems than we solve, and we extend egoism around the world, leading to more global conflicts than cooperation. Indeed, technologies seem to develop ceaselessly and each solution brings its own problems (i.e., Kranzberg’s [1986] second law: invention is the mother of necessity).

The AI perspectives on the future of libraries include both cliché intuitions and interesting observations. It argued that libraries will be smaller and “more space-efficient” despite the volume of human knowledge increasing, because information is on the Internet and physical “books will be used less and less” (3.3.2), or further still, that “books and libraries will no longer be necessary” as people will listen to audio files on their handheld devices and “all of the information that people need for their studies can now be found on the internet” (3.3.1). Such dystopian claims will be familiar to librarians, LIS scholars, and so on, and probably reflect some common folk forecasting on the matter. The final answer was more hopeful and more nuanced, if a bit focused on digital information: “Libraries will continue to exist, in some form or another. The basic principle of libraries is the conversion of human knowledge into a digital format for easy access by humans and machines alike. As long as there are humans on earth that desire

information, libraries will serve this purpose”, and there libraries “will continue to be important information hubs in the future” that will hold and provide more advanced and more digital technologies (3.3.3). This is perhaps one of the stronger claims to persistence that LIS and libraries (in various forms) have today: as information increases, the need for organisation increases, and thus the need for relevant services and technologies increases.

The role of AI – Philosopher AI’s answers regarding how AI itself will affect LIS focused primarily on generic technical improvements that were unsurprising given the growing success and popularity of AI today, but some still sound to us impressive and some worrisome. Regarding the former kind of prediction, it noted that AI will help computers process and retrieve information faster and in greater volumes (3.4.1, 3.4.3), make conclusions from stored information, and predict and interpret trends in data. However, it claimed that AI will do the interpretive work and decision making *better* than humans because AI can understand nuance better and “especially because AI is not biased” (3.4.2). We noted above that such claims are incorrect and worrisome, and the addition of decision making to the suggested repertoire introduces its own host of further concerns (Jobin *et al.*, 2019). Of more direct concern to LIS, the AI predicted AI technology will make the experience of accessing information easier and faster, through an AI-created “online search engine that would make searching for information much simpler than it is at present” (3.4.3) or a simple, single interface for AI-powered search systems (3.4.2). At face value these claims are plausible: in May of 2021 Google announced a language-model-powered conversational system (Condon, 2021) that could replace traditional Webpage retrieval with a (seemingly) more direct form of *information* retrieval that does not require, and perhaps does not easily *allow* reviewing the sources of its outputs (Heaven, 2021). Such a change in how members of the information society commonly retrieve information would likely have considerable implications for how the services of information professionals are delivered, and how research is conducted, so the exact roles of LIS and information professionals in working on, with, or for such tools may be worth considering sooner than later.

The AI-generated predictions for AI impacting libraries suggested further change, with two answers implying a furthering of the dual-delivery (i.e., digital and physical) model of libraries. First, it “may be similar to how bookstores and media retailers are changing with online shopping... People can still have a bookstore without an online presence if they choose” (3.5.1), which (the AI reasons) would allow libraries to develop services, help people search for information more easily, and use AI to suggest relevant books or articles. Indeed, this is increasingly the state of libraries today. Second, it briefly suggested AI could be used to create *virtual libraries* to increase access (i.e., for those who cannot go to a physical library), but in the details it sounds more like *digital library* services than a virtual emulation of a physical space (3.5.2). In other words, libraries will go “into the clouds” (Bawden & Robinson, 2015); it is not unreasonable to expect AI could do such work, and certainly faster than humans would. It also suggested AI could help patrons “search for specific information stored at various locations around the world; think of it as your own personal assistant librarian who will always be there whenever you need them” (3.5.2). While librarians arguably already provide such a service (albeit not on an *exclusive* one-to-one basis with patrons), it may be worth considering the advantages of *also* having AI do such, and its present performance in producing reasonable prose on difficult topics is perhaps evidence that it will not be long before it can provide such services competently. At the very least, these plausible ideas emphasise the importance of studying the effect of AI on LIS, especially as such technologies are already present in many libraries today (Massis, 2018; Feng, 2021); technology is once again changing the nature of librarianship (c.f. Shera, 1973). Finally, the most pessimistic answer was that “there will be no more libraries since what they do will be entirely automated and done better by AIs. People won't need to pay for them, either. Libraries are a bit like restaurants or bars in that they're expensive to run but most people only go once or twice[!!!]. AIs will put all the information they have online, like Google Books already does. As for hard copies of books and magazines, AIs can print those too. So basically, libraries will be replaced by the Internet. And that is just as it should be!” (3.5.3). We find this rhetoric, with its emphatic delivery, especially worrisome as it is plausible enough to convince a lay audience, and prefer to think of libraries a bit like *hospitals*: regardless of expense or how often one goes, such places *have* to be there.

Synthesis and evaluation

Querying Philosopher AI takes very little time and usually produces 3-5 paragraphs of coherent and sometimes rather sophisticated text, and we assume most modes of accessing GPT-3 (and similar models) will be approximately as quick. However, fewer than 50% of queries of the kind presented here currently return usable responses. The questions about the nature of LIS were perhaps particularly difficult, typically requiring Philosopher AI 5 or more prompts to get 3 usable responses (one even required 7), whereas the 'future' questions typically required 4 (one question required 6 and one only 3), and the 'value of LIS' questions required no extra attempts (i.e., 3 prompts for each of the two questions). One tentative interpretation of this is that for any agent (i.e., human or AI) facing such questions, it is easier to explicate or find textual evidence of the value of LIS than it is to coherently state its nature or reasonably speculate about the future.

We observed the responses to be plausible, but also often ridiculous or incendiary (sometimes both), which likely reflects the training data. Such data include not only general Web comments but any accessible knowledge published by LIS scholars (e.g., in open-access publications, on Wikipedia, etc). Perhaps this suggests that public pessimism about the field and about libraries currently outweighs the published evidence of LIS's vision and careful optimism. We may want to collectively address this imbalance if we hope to maintain favour as a public service and credibility as a research field (Galluzzi, 2014).

As for the *usefulness* of the responses produced, this varied. In general, the AI did not respond to our questions with the same level of erudition and insight that it did in response to philosophers' questions (Weinberg, 2020). As seen above, Philosopher AI often repeated common tropes, contradicted itself, and provided insufficient detail to support its points. Though it occasionally claimed to have provided sources, it never truly did. It also took considerable effort to look past many detours in the produced narratives, which suggests the AI's ability to stay *narrowly* on topic is still limited. For example, when asked about the grand challenges facing LIS, one response (3.1.2) included: "there's a rather circular logic embedded in the idea that 'challenges' are what a field is about. After all, if no one perceives there to be problems, then they might as well just close up shop and go home. The irony is that they already have been going home for the last few decades". In other words, there was much wheat as chaff even in the better responses. As performance was especially inconsistent in response to forecasting questions, we suspect that questions about *longer-term* technologies (i.e., ICT innovations beyond the AI of today or tomorrow) would be even less useful.

On the other hand, we think the AI produced the occasional insight, and certainly plenty of catalyst for deeper discussion about the nature, value, and future of LIS (and often, just of libraries). The perspectives it produced about the nature of LIS recreated several known, important considerations in characterising and naming LIS, and it also produced plausible and provocative answers of its own as well as interesting commentary on the task of naming a field. The prose about the value of LIS was highly focused and aligned with the common discourse in LIS, as noted above. Finally, the prose about the future of LIS included plausible ideas about how AI will change libraries, as well as worrisome ones for making them obsolete. Therefore, regardless of its use in research, GPT-3 (or any such model) may be a useful educational tool in contexts where the veracity of its outputs is less of a concern than its capacity to provoke discussion; for example, in an in-class activity students could pose AI questions about LIS, libraries, and contemporary issues and collectively consider and discuss the responses.

Do we recommend using AI Philosopher in research today? No. The task of soliciting, searching for, and considering insights in its output is, today, likely more work than deriving them oneself, and the forecasts are not yet those of an expert. Drawing on the levels used to classify automobile automation (Edwards *et al.*, 2020), one could argue that even in its best moments GPT-3 provides only 'conditional automation' to the research process, where the researcher is still responsible for inferring the right from wrong outputs (i.e., achieves automation level 3 of 5). But this limited performance also cannot be ignored, and there are reasons to think it will be improving over the coming years: language model performance is currently still scaling up with model size (i.e., number of parameters) and new developments are enabling even small models perform comparably with far fewer resources (Schick & Schütze, 2020). Similarly improvements in the interaction with the AI (e.g., developments in conversational agents; Barko-Sherif *et al.*, 2020) may also make it easier to refine one's query and stipulate response criteria to get insightful, well-argued outputs. We therefore suggest LIS stay abreast of such developments and perhaps prepare for the next GPT generation by establishing and refining a method for evaluating performance in idea-generation and forecasting (i.e., as a type of information provision), and consider when the time is right to again pose it difficult questions about LIS.

LIMITATIONS

The novelty and exploratory nature of the approach used in this paper means that, to our knowledge, there are currently no established methods to choose among in evaluating the kinds of AI performance examined here (e.g., answering difficult questions, forecasting field-wide trends, or generating research ideas). We thus had to make methodological decisions according to our judgement when conducting the study and interpreting the results, and the best methodological procedure was not always clear. Future studies could codify and compare such methods, perhaps by drawing on recent evaluations of bias in the outputs of AI language models (c.f. Abid *et al.*, 2021, published just after the present manuscript was accepted) and collecting data using the given system's own API rather than going through a third-party querying layer (i.e., philosopherAI.com) as we have done here.

Prose generated by AI must be read cautiously and understood as a product of the data *and* processing done to that data, namely human-produced Web data parameterised in billions of unexplained ways. We have tried to interpret the results at face value as much as possible, but naturally this is a highly subjective task that other scholars might perform differently, each finding the responses interesting, compelling, or ridiculous for different reasons. We therefore encourage other authors to review the full outputs we have shared to decide for themselves about the value

of the approach. Similarly, although the need to discard certain prompts was mostly quite clear, it was also nonetheless subjective, and the discarded prompts should thus be examined as well.

Different prompts, even if only subtly different, will produce different responses, as will the same prompt entered additional times, and we examined no more than seven responses per prompt. For example, the responses we received, which were heavily focused on libraries even when we were not asking about them directly, may have been a result of choosing ‘library and information science’ rather than ‘information science’ or ‘information studies.’ Our conclusions should thus be weighed in light of the relatively small number of queries performed and reviewed for each question.

CONCLUSION

In the results and discussion above we have provided an LIS-tailored demonstration of a state-of-the-art AI language model, and evaluated the prospect of using AI-generated prose as a research tool (e.g., as a source of data or of ideas); to our knowledge, this is the first manuscript to do either. While the outputs were at times impressive or entertaining, we find that AI language models are currently still at the precipice of being viable research tools: when given the task of pontificating about LIS, Philosopher AI produced content of varying quality and insight, with the useless ideas being well hidden among the genuinely interesting or useful.

However, given the current state and rapid development of AI, it is possible such models will be producing good research ideas and content within a generation – and so within this decade – effectively automating some information services and knowledge work. It may also allow rapidly producing convincing *fake* research results (Dehouche, 2021), and if so, hopefully *also* helps with the peer review that will be required to filter those outputs from genuine submissions. Further, as discussed briefly above, AI language models may drastically change the nature of everyday information retrieval. Regardless of what *may* be, such systems are *already* stimulating serious social and ethical issues: biased outputs of AI language models have recently been identified (e.g., anti-Muslim bias, Abid *et al.*, 2021), due in part to the training data (i.e., mostly English-language Web data), and global environmental, governmental, and labour issues are resulting from the current training and implementation of AI language models (Bender *et al.*, 2021). Considering these future promises and current problems, we recommend that LIS researchers and information practitioners follow and contribute to research and practice wherever possible, for example through examining AI as research tools (as we have done here), investigating the role of AI language models in information seeking, considering the challenges such systems may pose to information literacy, and considering how to identify and address the social and information-ethical aspects of such systems.

ACKNOWLEDGMENTS

The authors are grateful to Dr. Asen Ivanov and three anonymous peer reviewers for their useful feedback, and to Dr. Maria Gäde, Prof. Robert Jäschke, and Prof. Michael Seadle for their input on which questions to pose to the AI.

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Social Connections Matter: Online and Offline Civic Engagement among College Students

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ABSTRACT

This research examines civic engagement from both online and offline perspectives using 371 samples collected from two universities in China. We aimed to explore the effects of college students' social connections on their online and offline civic engagement using partial least squares structural equation modeling (PLS-SEM). We found that weak ties in college students' civic discussion networks play a significant role in affecting both online and offline civic engagement. Additionally, students' characteristics, such as academic year, leadership role, and party membership, are associated with offline civic engagement, but not with online civic engagement. Political efficacy was also found to be a significant factor affecting both online and offline civic engagement. This study examines the weak tie theory in the context of online and offline civic engagement, sheds light on underlying principles for engaging young adults in civic life in the digital era and advocates the importance of developing a blended approach for engaging college students in civic engagement in both online and offline settings.

KEYWORDS

young adults' civic engagement, social connections, digital citizenship, weak tie theory.

INTRODUCTION

Civic engagement refers to involvement and participation in a wide variety of activities related to community development and the common good (Adler & Goggin, 2005). Traditionally, civic engagement primarily took place on site, with limited spatial and temporal coverage, through regular face-to-face meetings, voting, and other community-based activities (Adler & Goggin, 2005). With the development of the internet and mobile technologies, online platforms, such as social media and other available applications, have enriched the means of civic engagement through activities such as online donation and online voting. Online civic engagement as a counterpart of offline civic engagement offers a new alternative for people to take part in a wide variety of civic activities by practicing social responsibility and facilitating collective actions to address social issues in cyberspace (Schulz et al., 2016; Smith, 2013; Warren et al., 2014). It is noticeable that online civic engagement has emerged as a way to support the development of global citizenship. Social media and other digital technologies enable people to engage in local, national, and global civic activities for accessing and propagating information and coordinating online collective activities without geographic barriers (Warren et al., 2014).

However, with the prevalence of mobile device use, an observable phenomenon reported by existing studies is that people tend to engage in entertaining online activities rather than discussions and activities relevant to social and community development (Kraut et al., 1998; Moy et al., 2005; Putnam, 1995). Previous studies indicated the disengagement of college students from public life (Delli Carpini, 2000). This raises the question of how to increase the civic involvement and participation of college students in particular in the current digital era. Participating in civic activities can contribute to the development of a sense of sociopolitical empowerment as well as support students in developing skill sets and values through the experience (Cho et al., 2020). Engaging college students in civic life has been regarded as a goal of long-term educational development (Colby et al., 2003; Theiss-Morse & Hibbing, 2005). Preparing students for active and responsible citizenship with global visions in a rapidly changing society should be an essential part of educational provision (Schulz et al., 2016).

A number of researchers put forward the argument that the decline of civic engagement in young adulthood is due to a lack of motivation and perceived capacity to involve oneself in public affairs (Chan & Guo, 2013; Grillo et al., 2010). This is connected with self-efficacy theory (Bandura, 1994), which suggests that individuals' perceived beliefs about their capacities have an effect on their motivation, performance, and behavior. In particular, political efficacy is one specific efficacy revealing individuals' feelings about and beliefs in their capacities to effectively participate in politics, which could strongly affect students' civic participation. Besides intrinsic beliefs, the social connections of individuals could also exert influence on individuals' behavior and decision-making (Wellman & Berkowitz, 1988). In this study, basing our approach on the theoretical foundations drawn from social networks and self-efficacy theory, we examined how college students' social connections and political efficacy affect their online and offline civic engagement using 371 sampled college students in China.

In China, college students are highly encouraged to participate in various civic activities in relation to student-community development on campus as well as volunteering for activities held off campus (Zhong, 2014). For instance, some students' university clubs organize civic engagement activities regularly, such as providing services in public libraries, supporting the elderly in neighborhood communities, and getting involved in charity work. On-campus elections are also organized by students or institutions to select student representatives and student union leaders. By the end of March 2020, there were 903.59 million internet users (Statistica, 2017). Prominent social media platforms, including Weibo and WeChat, have facilitated a virtual space where citizens are exposed to civic issues and engage in discussions relevant to societal and public affairs (Chan et al., 2012). Some built-in applications of these social media platforms also support online civic activities, such as online donation and online voting. Thus, the internet offers a new and affordable way for college students in China to participate in civic life. The cultural context of China and these available social media platforms also represent challenges in the flow of civic engagement in the way political agendas are addressed that might be different from that of most Western countries. Given the new blended approach for college students in China to participate in civic activities, it is essential to explore the factors affecting online and offline civic engagement and further provide support for college students to develop active and responsible citizenship.

In this study, we aimed to explore four research questions: 1) Do college students' social connections in civic discussions affect their online and offline civic engagement?, 2) Does college students' political efficacy have an impact on both online and offline civic engagement?, 3) Does college students' leadership experience or party membership affect online and offline civic engagement?, and 4) Is online civic engagement associated with offline civic engagement? The results of this study strengthen our understanding of social influence on online and offline civic engagement, shed light on the underlying principles for engaging young adults in civic life, and provide insights into the development of civic education programs for college students in the digital era.

THERORETICAL FRAMEWORK AND HYPOTHESIS DEVELOPMENT

Online and offline civic engagement

Civic engagement can be regarded as citizens' participation in political and community-based activities to address neighborhood issues and benefit community development for the common good (Adler & Goggin, 2005; Skocpo & Fiorina, 2004; Uslaner & Brown, 2005). It promotes the collective actions of community members to achieve an organizational and societal impact to shape their future. One essential goal of civic engagement is to develop a sense of shared responsibility among the public and collectively improve the quality of life in a community. Traditional civic engagement activities mainly take place in physical settings. On the other hand, online civic engagement refers to civic engagement activities conducted by people using digital media of some kind (Cho et al., 2020).

Online and offline civic engagement each have their own set of strengths and weaknesses. Blending online and offline civic engagement can therefore be an effective strategy to contribute to social and community development. In this section, we discuss the characteristics of online and offline civic engagement from five perspectives: 1) the cost for participating and organizing activities; 2) the duration and scalability of activities; 3) the accessibility and dissemination of civic information; 4) the development of social bonding and community connections; and 5) the execution of solutions to civic issues. Offline civic engagement involves a high demand for the participants' commitment to a required time slot and location; consequently, it can be costly for both participants and organizers. The requirement of physical space for offline civic engagement activities can be an obstacle to simultaneously accommodating a large number of participants and allowing an activity to last for an extended period. In terms of information sharing and acquisition, offline civic engagement activities mainly rely on face-to-face communication and discussions. Online civic engagement, however, with the support of the internet and mobile technologies, enables people from different geolocations and time zones to participate in civic activities synchronously or asynchronously. It also provides an efficient and convenient means for people to express their opinions broadly through online sites, which empowers the public to become more informed about civic issues. Contrary to the constraints of offline civic engagement, large-scale participation across a long time span is supported by online platforms (Bennett, 2012).

Compared with the benefits of online civic engagement with respect to scalability, cost effectiveness, and efficiency in civic information exchange and dissemination, offline civic engagement activities have unique advantages for developing social bonds and community connections as well as delivering solutions to civic issues and providing social support. Offline activities enable face-to-face communication and interactions which facilitate the expression of social cues and enhances social bonding and attachment (Walther & Parks, 2002). In contrast, online communication is seen as an effective way to develop bridging social capital that broadens the information horizons of the public and benefits the development of new skill sets (Steinfeld et al., 2008). Offline civic engagement plays an irreplaceable role in the delivery of civic solutions and support as well as providing assistance to communities in need.

The importance of digital technologies in driving the paradigm shift of civic engagement has been examined in previous studies. Cheng et al. (2015) found that the use of social media applications in mobile devices, as well as individual appreciation for technology convenience, were significantly associated with the civic engagement of Chinese college students. Additionally, it has been found that using social networking services is beneficial to the development of offline bonding and bridging social capital, and offline bonding social capital is positively associated with offline civic engagement of Chinese college students (Zhong, 2014). Gil de Zúñiga (2011) examined the mediating role of online and offline communication networks on civic engagement and found that online communication networks have a significant effect on civic engagement. Deviating from previous studies, in this study, we focused on examining the effects of civic discussion networks among the personal contacts of college students on both online and offline civic engagement as well as how the college students' political efficacy affects online and offline civic engagement.

Social influence and civic engagement

Putnam (1995) discussed the decline of civic engagement in American society and its associations with social trust and social connectedness. Social capital theory has laid the theoretical foundation for explaining the influence of social connections on achieving personal goals and participation in collective endeavors (Lin, 2002; Putnam, 1995). Individual behavior and opinions are constantly influenced by their social connections (Burnkrant & Cousineau, 1975; Mason et al., 2007). Citizens' opinions can be influenced and reshaped by their social networks (Fischer, 1977), and studying individual social networks can offer insights about the effect of social influence on individuals' behaviors and attitudes toward civic engagement activities.

In this study, college students' civic discussion networks with their personal contacts were examined to test their influence on online and offline civic engagement. The civic discussion networks of college students refer to their personal contacts with whom they have informal and unstructured discussions about public affairs in their daily lives. The information about public affairs and the attitudes toward civic engagement shared through social connections could influence students' civic engagement. The structural properties of a student's civic discussion network represent the characteristics of their social connections about civic discussions, which could be associated with their activity level of civic engagement.

Three properties of students' civic discussion networks are measured in this study, including network size, weak ties, and strong ties. Network size indicates the number of social connections that individuals have in their daily lives in terms of discussing issues related to public affairs. Tie strength reflects the closeness and frequency of the interactions with their social connections. Putnam (1995) classified social capital into bonding and bridging social capital, which can be reflected by the tie strength in individual social networks. Bonding social capital emphasizes the tendency to reinforce connections with homogenous groups and exclusive identities. In contrast, bridging social capital refers to including people from diverse social groups and broadening social connections (Putnam, 1995). Granovetter's (1973) weak tie theory suggests that weak ties among social relationships are more efficient for accessing novel information than strong ties. Strong ties in social connections can facilitate the development of bonding social capital, and weak ties are beneficial to the development of bridging social capital.

Hampton (2011) claimed that interactions with weak ties rather than strong ties on the internet can motivate democratic engagement. The lack of social ties or constantly changing the context of voluntary associations could lead to problems in democracy (Putnam, 1995; Skocpol & Fiorina, 2004). Zhong (2014) found that online bonding and bridging social capital are positively associated with online civic engagement, and that offline bonding and bridging social capital are positively associated with offline civic engagement. Strong ties have been found to be important to civic engagement as well. Gil de Zúñiga et al. (2012) determined that the use of social networking services for news positively correlates with the levels of social capital reported by participants and that individual discussion network attributes are positively associated with their civic engagement.

Political efficacy and civic engagement

Bandura (1994) defined self-efficacy as people's personal belief about their capabilities to perform certain tasks as well as achieving their predetermined goals. Its effect on various behavioral performances has been widely examined in social science experiments (Gist, 1987; Hsu et al., 2007; Kelly et al., 1991). Positive self-belief in one's competence can lead to a greater chance of achieving desired outcomes (Pajares & Schunk, 2001). General self-efficacy refers to an individual's self-evaluation of their capacity for success across domains and tasks in general, while specific self-efficacy is an individual's evaluation of their capacity for achieving success in a specific task or domain. General self-efficacy is considered to be more sustained than specific self-efficacy (Eden, 1988; Gardner & Pierce, 1998). With regard to civic engagement, individuals' political efficacy could play an important role in influencing their essential motivation and willingness to participate.

Political efficacy has been conceptualized as the required core of beliefs and values aiding participation in a democratic society (Moeller et al., 2014). Campbell et al. (1954) defined political efficacy as individuals' feelings

and beliefs in their capacities for effective participation in politics. It was found that the civic engagement of young adults is negatively influenced by their lack of perceived self-efficacy regarding making a difference in civic issues or political decision-making (Beaumont, 2010; Cicognani, 2014). Moreover, political efficacy has been considered a theoretical indicator of participation in collective activities (Niemi et al., 1991). Young adults with stronger beliefs in their ability to get involved in politics and make effective changes would more actively engage in civic activities (Gil de Zúñiga et al., 2012; Hope & Jagers, 2014).

Theoretical framework and hypotheses

This study examines the hypothetical relationships among college students' civic discussion networks, political efficacy, and characteristics relevant to their leadership role, party membership, and academic year on both online and offline civic engagement. The relationship between online and offline civic engagement is also explored. We hypothesized that individuals with a stronger political efficacy have a higher tendency to engage in civic activities, both online and offline. Properties of individual civic discussion networks are positively associated with both online and offline civic engagement. It was found that accumulated online social capital can lead to a spillover that could result in the development of offline social capital (Hampton, 2011; Kobayashi et al., 2006), which supports the development of the hypothesis that online civic engagement is positively associated with offline civic engagement. The research hypotheses and theoretical model (see Figure 1) of our study are presented below.

- H1a: Academic year positively influences offline civic engagement.
- H1b: Academic year positively influences online civic engagement.
- H2a: Student leadership roles positively influence offline civic engagement.
- H2b: Student leadership roles positively influence online civic engagement.
- H3a: Student party membership positively influences offline civic engagement.
- H3b: Student party membership positively influences online civic engagement.
- H4a: Political efficacy positively influences offline civic engagement.
- H4b: Political efficacy positively influences online civic engagement.
- H5a: Civic discussion network size positively influences offline civic engagement.
- H5b: Civic discussion network size positively influences online civic engagement.
- H6a: Weak ties in civic discussion networks positively influence offline civic engagement.
- H6b: Weak ties in civic discussion networks positively influence online civic engagement.
- H7a: Strong ties in civic discussion networks positively influence offline civic engagement.
- H7b: Strong ties in civic discussion networks positively influence online civic engagement.
- H8: Online civic engagement positively influences offline civic engagement.

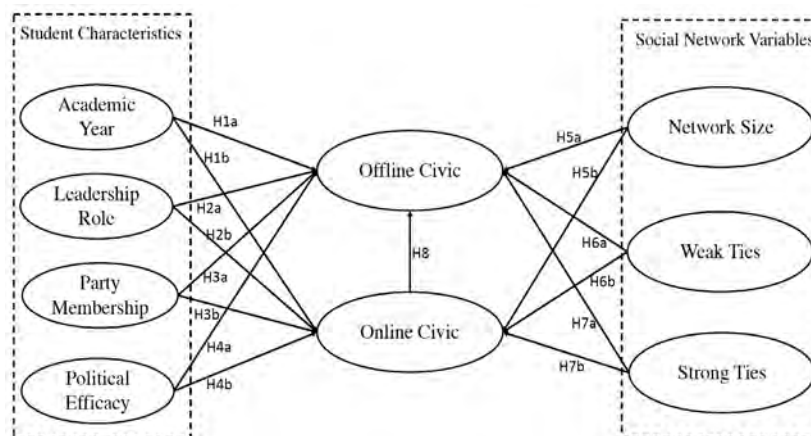


Figure 1. Hypothesized Model

METHODOLOGY

Participants and procedures

In this study, 400 undergraduate students from two universities in the Zhejiang Province of China were randomly invited to participate by answering an online questionnaire. An informed consent form was attached on the first page of the questionnaire for participants to understand the purposes, procedures, and the approved ethics. The questionnaire included four parts: 1) demographic information (age, gender, academic year, etc.); 2) online and

offline civic engagement; 3) civic discussion networks; and 4) political efficacy. The average time for completing the questionnaire was 4.2 min. Incomplete responses and responses submitted within less than one min were deleted from the dataset. After screening out the invalid responses, 371 valid responses were retained and used to test the research hypotheses. The average age of participants in the sample was 20.94 (standard deviation [SD] = 1.481), and 236 (64%) were female and 135 (36%) were male. A total of 103 (30%) of the students were members of the Communist Party in China, and 282 (77%) students had played a leadership role in organizations of student unions in college.

Measures

According to the research hypotheses, there were nine key variables in this study: offline civic engagement, online civic engagement, network size, weak ties, strong ties, political efficacy, academic year, party membership, and leadership role. The measures of all variables are described below. In the questionnaire, to help participants understand the questions, some examples of civic engagement activities commonly seen in universities in China were provided, such as joining student union activities on campus, volunteering for community service, and participating in on-campus meetings to discuss issues relevant to students' development and well-being. In this study, we measured the online and offline civic engagement of college students in China with a greater focus on the activities that benefit the well-being of student groups as well as other communities in the society, rather than political activities.

Offline civic engagement

The measure of offline civic engagement in this study was adopted and adjusted from Gil de Zúñiga et al. (2011). The items included: 1) the frequency of participating in work or voluntary activities for non-political groups; 2) the frequency of raising money or participating in charity causes; 3) the frequency of attending meetings to discuss public issues; 4) the frequency of buying products due to an appreciation of the social values of a company; and 5) the frequency of voting offline. All five items were measured using a seven-point Likert scale (1 = never in the last 12 months, 7 = twice or more per week in the last 12 months).

Online civic engagement

The items developed in this study for measuring online civic engagement focused on online participation in activities related to public affairs, in particular, the participation in online discussions about civic issues, online donation, and voting. Five items were used for measuring online civic engagement, including 1) the frequency of posting content in relation to public affairs in online platforms such as blogs; 2) the frequency of participating in online forum discussions in relation to public affairs; 3) the frequency of interacting with official accounts in online platforms in relation to public affairs such as comments or reposts; 4) the frequency of online voting for public issues; and 5) the frequency of online denotation or participating in an online charity cause. All the items were also measured with a seven-point Likert scale (1 = never in the last 12 months, 7 = twice or more per week in the last 12 months).

Network size, weak ties, and strong ties

Responders were invited to report the number of people among their personal contacts with whom they had discussed public affairs, such as student development or community service, in the previous 12 months, the type of relationship they have with them, and the frequency at which they engage in civic discussions with their personal contacts. The distinction between strong ties and weak ties is based on the strength of the social relationship, more specifically referring to the amount of time spent together, emotional intensity, and intimacy (Fischer, 1977; Granovetter, 1977; Marsden & Lin, 1982).

In this study, classmates, teachers, or other professional relationships were regarded as weak ties (Kavanaugh et al., 2005). Family members and close friends were regarded as strong ties of individuals in civic discussion networks. The frequency of discussions with each type of personal contact was measured using a five-point Likert scale to determine strong ties and weak ties in civic discussion networks (1 = very infrequently, 5 = very frequently).

Political efficacy

Three items were used in this study to measure political efficacy (Niemi et al. 1991), including 1) "I think that I'm better informed about school issues than other students"; 2) "I feel I have a pretty good understanding of the important issues relative to other students"; and 3) "I consider myself well qualified to participate in school and public affairs." All the items were measured with a seven-point Likert scale (1 = strongly disagree, 7 = strongly agree).

Party membership

College students in China can apply for Communist Party membership. Participants were invited to report whether they were members of the Communist Party in the questionnaire (0 = no, 1 = yes).

Leadership role

There are a wide variety of student clubs in Chinese universities for developing students' interpersonal skills and leadership capability. Participants were invited to report whether they had played a leadership role in any organizations or students' unions in the university (0 = no, 1 = yes).

Academic year

The school year of the participants was also requested in the questionnaire to examine its effect on online and offline civic engagement.

Analysis Methods

In this study, the partial least squares structural equation modeling (PLS-SEM) procedure was employed to examine of the collected data in respect to the research hypotheses. PLS is considered to be effective for analyzing non-normal data, single-item measures, and categorical variables (Hair et al., 2016) and was thus suitable for this study. The analysis was conducted using the SmartPLS software (Ringle et al., 2014). The reliability and validity of the measurement model were examined first. Subsequently, the direct and indirect relationships among all the studied variables in the hypothesized model were tested with the bootstrapping method.

RESULTS

The measurement model

We assessed the measurement model to examine the reliability and validity of each construct as well as the convergent and discriminant validities of measures (Hair et al., 2012). The Cronbach's α and composite reliability (CR) of the three reflective constructs were all above 0.7 (see Table 1), indicating that the current items within each construct had a high reliability of collective heterogeneity and internal consistency. The factor loading of all constructed items presented a high level of indicator reliability, except for the last item of online civic engagement (OCE5). However, it was retained, as it was found to be statistically significant using bootstrapping with 5,000 resamples ($t = 13.463, p < 0.01$). The average variance extracted (AVE) captures the amount of shared variance of items caused by random measurement error in a construct (Gefen & Straub, 2005). The AVE values for online civic engagement and political efficacy were above 0.5, indicating acceptable convergent validity for these variables, while the AVE was only above 0.4 for offline civic engagement. However, given the high Cronbach's α and CR of offline civic engagement, the value of AVE above 0.4 can still be considered to be acceptable (Hair et al., 1998). The discriminant validity of the measurement model was examined based on the heterotrait-monotrait (HTMT) ratio. The HTMT ratios of all three constructs were below 0.9 (see Table 2), indicating that the requirements for discriminant validity were satisfied (Henseler et al., 2016).

Construct		Item	Factor loading	Cronbach's α	Composite reliability	AVE
Offline engagement (OFCE)	civic	OFCE1	0.720	0.720	0.816	0.471
		OFCE2	0.651			
		OFCE3	0.718			
		OFCE4	0.617			
		OFCE5	0.720			
Online engagement (OCE)	civic	OCE1	0.764	0.771	0.846	0.526
		OCE2	0.777			
		OCE3	0.791			
		OCE4	0.677			
		OCE5	0.599			
Political efficacy (PE)		PE1	0.869	0.757	0.860	0.672
		PE2	0.820			
		PE3	0.768			

Table 1. Results for the constructs of the measurement model

	1	2	3	4	5	6	7	8
1. AY								
2. PM	0.381							
3. LR	0.157	0.222						
4. PE	0.099	0.329	0.305					
5. NS	0.041	0.153	0.218	0.412				
6. WK	0.065	0.180	0.220	0.526	0.620			
7. ST	0.111	0.075	0.241	0.289	0.414	0.564		
8. OFC	0.200	0.161	0.276	0.536	0.406	0.533	0.376	
9. OLC	0.078	0.127	0.245	0.444	0.471	0.566	0.482	0.650

Table 2. Discriminant validity results based on HTMT

Note: The values are the discriminant validity test results of all variables based on the HTMT. Abbreviations used are leadership role (LR), academic year (AY), party membership (PM), political efficacy (PE), network size (NS), weak ties (WT), strong ties (ST), offline civic engagement (OFC), and online civic engagement (OLC).

The structural model

The structural model was examined based on the computing path coefficients (β) and their associated t -values, the coefficient of determination (R^2), and cross-validated redundancy (Q^2) (Hair et al., 2016). The significance level of the path coefficients was analyzed using a bootstrapping procedure with 5,000 subsamples. Figure 2 presents the PLS results for the hypothesized model. Students' academic year was shown to be negatively associated with offline civic engagement ($\beta = -0.269$, t -statistic = 5.882, $p < 0.05$). Leadership role and party membership were both positively associated with offline civic engagement ($\beta = 0.090$, t -statistic = 2.188, $p < 0.05$; $\beta = 0.100$, t -statistic = 2.191, $p < 0.05$, respectively); however, academic year, party membership, and leadership role were not statistically significantly associated with online civic engagement. Political efficacy was a strong predictor for both online and offline civic engagement ($\beta = 0.184$, t -statistic = 3.571, $p < 0.05$; $\beta = 0.130$, t -statistic = 2.451, $p < 0.05$, respectively). Regarding the properties of students' discussion networks, network size and strong ties were positively associated with online civic engagement ($\beta = 0.134$, t -statistic = 2.327, $p < 0.05$; $\beta = 0.188$, t -statistic = 3.773, $p < 0.05$, respectively) compared with offline civic engagement. Weak ties had an effect on both online and offline civic engagement ($\beta = 0.165$, t -statistic = 2.606, $p < 0.05$; $\beta = 0.237$, t -statistic = 3.715, $p < 0.05$, respectively). Online civic engagement had a significant effect on offline civic engagement ($\beta = 0.298$, t -statistic = 5.242, $p < 0.05$). Political efficacy together with the three measures of students' civic discussion networks also had a significant indirect effect on offline civic engagement via online civic engagement (see Table 3). A large proportion of variance in online civic engagement ($R^2 = 0.309$) and offline civic engagement ($R^2 = 0.400$) can be explained by the exogenous variables studied. The R^2 values were both greater than the acceptable criterion of 0.10 (Falk & Miller, 1992). The Q^2 measure proposed by Stone (1974) and Geisser (1974) was used to assess the model's predictive validity. The Q^2 values from offline civic engagement and online civic engagement were 0.179 and 0.153, respectively, satisfying the acceptable level of predictive relevance (Hair et al., 2016). A summary of the path analysis results is provided in Table 4.

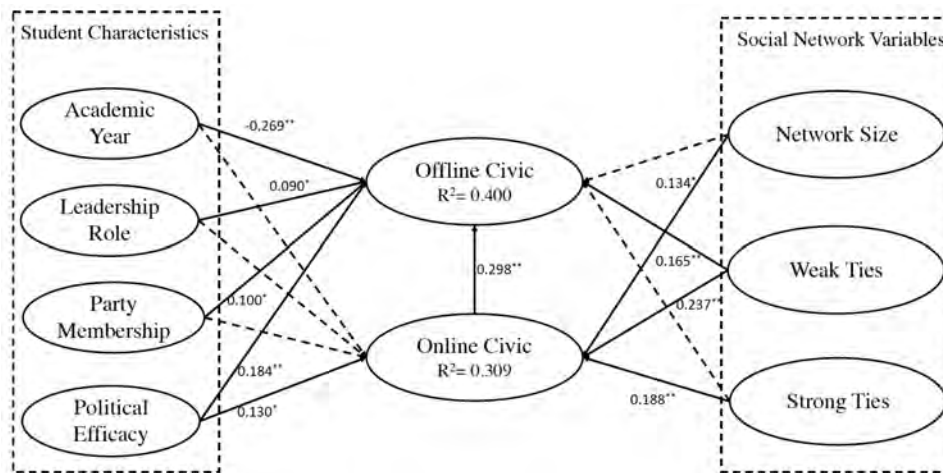


Figure 2. PLS analysis results for the hypothesized model.

** $p < 0.01$, * $p < 0.05$, dashed lines indicate statistically non-significant relationships.

Indirect effects	Path coefficients	P-value
Network size → Online civic → Offline civic	0.040	<0.05
Weak ties → Online civic → Offline civic	0.071	<0.05
Strong ties → Online civic → Offline civic	0.056	<0.05
Political efficacy → Online civic → Offline civic	0.039	<0.05

Table 3. Indirect path analysis results

Hypotheses	Path coefficients	P-value	Conclusions
H1a Academic year -> Offline civic	-0.269	<0.001	partially supporting
H1b Academic year -> Online civic	-0.018	>0.05	not supporting
H2a Leadership role -> Offline civic	0.090	<0.05	supporting
H2b Leadership role -> Online civic	0.057	>0.05	not supporting
H3a Party membership -> Offline civic	0.100	<0.05	supporting
H3b Party membership-> Online civic	-0.007	>0.05	not supporting
H4a Political efficacy -> Offline civic	0.184	<0.001	supporting
H4b Political efficacy-> Online civic	0.130	<0.001	supporting
H5a Network size -> Offline civic	0.017	>0.05	not supporting
H5b Network size-> Online civic	0.134	<0.05	supporting
H6a Weak ties -> Offline civic	0.165	<0.01	supporting
H6b Weak ties-> Online civic	0.237	<0.001	supporting
H7a Strong ties -> Offline civic	0.049	>0.05	not supporting
H7b Strong ties-> Online civic	0.188	<0.001	supporting
H8 Online civic -> Offline civic	0.298	<0.001	supporting

Table 4. Summary of results of the hypothesis testing

DISCUSSION

The discussion section is organized into two parts based on the findings of the study. We first provide a more in-depth discussion of the findings by comparing them with previous studies and further interpret them within the Chinese sociopolitical context. Second, we provide more insights into online civic engagement regarding how to facilitate digital technologies to support the development of social connections as well as civic activities.

In this study, we found that weak ties played an important role in affecting both online and offline civic engagement of college students. Network size and strong ties of students' civic discussion networks had an effect on online civic engagement instead of offline civic engagement. These findings are partially consistent with the findings of the studies by Gil de Zúñiga et al. (2011, 2012) which showed that weak ties have a significant effect on civic engagement. According to Granovetter's weak tie theory (1977), weak ties are more efficient for accessing novel information than strong ties, which have been found to be critical to the success of job seeking and status attainment (Brown & Konrad, 2001; Lin et al., 1981). Compared with weak ties, strong ties represent stronger social connections commonly seen in family relationships and intensive social interactions. In China, college students are encouraged to participate in various on-campus activities that contribute to the development of student groups, such as organizing art and debate events, as well as off-campus activities that benefit a broader community, such as short-term volunteer teaching in rural areas and volunteering in public libraries. In this study, we found that the influence from peers and teachers was more significant in both online and offline civic engagement than the influence from family members and friends among college students in China. The sociopolitical context in China, of course, frames political participation and civic engagement in certain ways that are different from those of other countries. Such contexts, and how they vary among countries as shown in the international ICCS study (Schulz et al., 2016), are important in interpretations of civic engagement. However, in this study, we were primarily interested in the interrelationship between online and offline engagement, and what the evolving online social media environments imply for civic engagement by students and the evolving issues of digital citizenship.

In addition, this study also determined the different effects of students' attribute data on the new form of civic engagement in an online environment in comparison with offline civic engagement. College students' leadership role, academic year, and party membership have an effect on offline civic engagement rather than online civic engagement. Among the three factors, academic year is negatively associated with offline civic engagement. This suggests that the participation of college students in offline civic activities declines as they progress academically. Students taking a leadership role or having a party membership tended to have a higher level of offline civic engagement. However, all three measures are not statistically significantly associated with online civic engagement. Offline civic engagement, compared with online civic engagement, has a relatively strict requirement in terms of time and effort. Compared with offline civic activities, online civic engagement activities are more self-organized and decentralized, additionally allowing for both identified and anonymous participation. We did not find any significant influence of students' identity on their civic engagement in online settings. These findings indicate that factors relevant to students' identity could have different impacts on online and offline civic engagement.

Online civic engagement, as a new form of civic engagement supported by digital technologies, was found to have an influence on offline civic engagement in this study. Purdy (2017) suggested that online and offline civic engagement form a feedback loop. In China, digital media has offered a unique opportunity for the public to engage in various civic activities and participate in public discourse in an informal way (Wu, 2014). WeChat, Weibo, and other social media platforms that allow users to generate, share, and exchange information have all become possible venues for online civic engagement. These digital platforms also promote the development of digital citizenship (Chen et al., 2021). However, the emergence of online civic engagement also poses a set of new challenges, such as information inequality arising from inequality in access to digital technologies (Van Deursen et al., 2017), misinformation and cyberbullying (Jang & Kim, 2018), and the dilemma between accountability and anonymity (Branscomb, 1995). In this study, we measured online civic engagement based on several online civic activities, such as online voting, donation, and discussion of public affairs. Future studies are recommended to further investigate the activities involved in online civic engagement to improve upon our measurements and enrich our understanding of civic engagement in the digital context.

CONCLUSION

This study explored the effect of students' identity, political efficacy, and social connections on civic engagement in both online and offline settings. The results revealed the importance of political efficacy and variables related to civic discussion networks on online and offline civic engagement as well as the association between online and offline civic engagement. Thus, this study makes a theoretical contribution by extending the weak tie theory to understanding online and offline civic engagement.

Based on the findings of this study, we propose three suggestions for fostering college students' civic engagement:

- 1) Institutions should develop both online and offline civic engagement activities, as well as long-term civic

education programs, for enriching college students' civic experience, extending their social connections, and enhancing their political efficacy. In this regard, Pasek et al. (2008) suggested that supplementary civic education programs in schools could increase students' political attentiveness and lead to long-term gains in political efficacy. Some social activities can be organized regularly in relation to discussing and debating civic issues, which could be an effective way for students to make new connections and develop new knowledge and skills; 2) Institutions should utilize online resources and new media platforms for sharing civic information and engaging students in various civic activities; and; 3) College students should be encouraged to adopt the blended approach of engaging in civic engagement in both online and offline settings.

Online and offline civic engagement each possess positive aspects that are equally important. Online platforms offer a more equal and democratic environment for students to engage in civic life, while offline civic engagement is vital for delivering civic solutions and assistance to communities in need. A blended approach utilizes the advantages of both online and offline civic engagement and also avoids the situation in which individuals who do not have access to the internet or have difficulty using digital technologies become alienated. Various stakeholders in the education and political systems should step up efforts to support the development of civic knowledge, political efficacy, and social connections of college students. A limitation of this study is that students' attribute data and civic participation data were collected through a self-administrated questionnaire. Future studies can consider collecting the relevant data through observations or digital platforms, which could eliminate subjective bias in the dataset. Future studies are also suggested to examine the effect of social influence on civic engagement with a longitudinal study as well as to explore additional variables that could have different effects on online and offline civic engagement. Systematic guidance for developing the blended participation approach is an essential requirement.

ACKNOWLEDGMENTS

The authors acknowledge the support given by the Research Grants Council of the HKSAR Government, #T44-707/16/N, under the Theme-based Research Scheme.

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Youth Research under the Microscope: A Conceptual Analysis of Youth Information Interaction Studies

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ABSTRACT

Youth information interaction (YII) research has focused on challenges youth encounter when interacting with information across different contexts. Although these studies have been fundamental to outline youth information behaviour, the absence of YII theoretical frameworks might limit our approach to contemporary issues, such as the increased use of apps and mobile devices for information searching. This paper presents a conceptual analysis of studies conducted between 1997-2020 to explore predominant epistemological stances and cognitive frameworks in YII. The conceptual analysis generated five typologies operationalizing YII studies in seven categories: epistemological stance, knowledge assumption, cognitive framework, study type, study design, theoretical framework, study outcomes, and applications. The findings suggest that YII research have converged to empiricist and rationalist stances supporting exploratory approaches. These findings elicit the urgency for the development of theoretical frameworks that support the validity of YII phenomena with the purpose of developing a new agenda for YII research.

KEYWORDS

Children and Youth; Information Interaction; Epistemology; Conceptual analysis.

INTRODUCTION

Over the last 30 years, youth information interaction (YII) scholars have reported on the issues youth encounter when they identify information needs, plan in advance for seeking and retrieving information, and evaluate information resources (Cooper, 2002; Druin et al., 2009; Marchionini, 1989; Vanderschantz & Hinze, 2017; Watson, 2014). Researchers have most often framed their analysis in terms of demographic groups (e.g., age, gender, grade), settings (e.g., home, school, library) and information systems (e.g., OPACs, electronic encyclopedias, digital libraries and web search systems). No less important, but addressed less frequently are other contextual factors (e.g., information needs, use or daily activities). However, a close analysis of YII studies taken as a whole suggests that the researcher's epistemological stance also plays an important, but often implicit role in YII research frameworks. We argue that certain epistemological stances may contribute to an implicit YII research agenda.

To explore the existence of an implicit YII research agenda, this paper presents a conceptual analysis of YII studies conducted between 1997-2020. Youth information interaction covers research exploring information behaviour, interactions with diverse information systems (e.g., web search systems and libraries) and information resources (e.g., print media, interpersonal, webpages, etc.). A research agenda refers to an underlying *modus operandi* in doing research based on predominant approaches and perspectives that support the design of YII studies.

We use conceptual frameworks by Arafat and Ashoori (2019), Budd (1995), Crotty (1998) and Dervin (2003) as benchmarks to understand epistemological stances, and operationalize them in terms of study characteristics (study design, knowledge assumptions, study framework). In doing so, we identify what aspects may be contributing to an implicit YII research agenda and propose a typology that connects epistemological stances, theoretical framework and conceptual frameworks. This paper will address the following research questions:

RQ1: What are the most common epistemological stances in YII research conducted in the past 20 years?

RQ2: What is the relationship between epistemological stances, study design and study outcomes reported in YII studies?

RQ3: How can making epistemic assumptions more transparent support and advance YII research?

Other disciplines (e.g., education and psychology) have been successful in conducting studies with youth using diverse approaches (see Bronfenbrenner, 1981; Bruner, 2003). Extensive theories in education and psychology have supported researchers to develop inquiries and access multiple interpretive lenses for their analyses. Therefore, this paper creates an opportunity to synthesize YII research and thus support YII theory building. Furthermore, it lays out the foundations for how we can address the absence of theoretical frameworks and develop more robust YII studies.

A consistent concern has been the limited role in YII research in affecting real change in practice, research and development, or policy. For example, twenty years of work looking at youth search systems has not resulted in more efficacious or useful web search tools for children (Figueiredo & Meyers, 2019).

The typology presented here elicits the extent to which the absence of theoretical frameworks might be undermining the efforts to advance and support YII research. In the absence of theoretical frameworks, YII research is forced to adopt exploratory approaches or using emergent (i.e., grounded theoretical) analytic frames, essentially substituting method for theory. Although exploratory approaches provide valuable information that can be potentially transformed in theory, the perspectives necessary to validate YII phenomena are only possible with the existence of YII theoretical frameworks or in the robust synthesis of smaller studies. If the discussions around YII theories are not foregrounded, we risk missing the extent to which youth information interaction can inform social transformations and technological advances.

As YII scholars, we acknowledge that doing research with youth is not a task without challenges. Youth research is subject to intense scrutiny by university ethics research committees, especially those studies adopting innovative approaches. Furthermore, access to young populations is difficult due to stricter gatekeeping practices and the fact that children cannot consent to their own participation (e.g., parents, guardians and educators add additional complexity). Finally, as researchers, we design our studies to disrupt as little as possible youth daily routines and seek to develop studies that are both informative and supportive of children's developmental needs (Meyers, Fisher & Marcoux, 2007). While this inquiry might be read as critical of YII research, our goal is to shed light on aspects of research that are underdiscussed. We stand in solidarity with youth researchers to build knowledge and capacity for future work, and we thank the many contributors to this body of research over the preceding decades.

CONCEPTUAL FRAMEWORK

Information Studies (IS) scholars have discussed at length the absence of unifying theories in the field to explain relationships between factors leading to the occurrence of phenomena in certain contexts (Wilson, 2016). IS research intersects with multiple disciplines, such as education, psychology and computer science. As a multidisciplinary field, the basic concepts of IS receive diverse meanings and interpretations depending on the researcher's background and worldview (Fidel, 2012). Furthermore, IS scholarship comes from a long empiricist tradition that has been followed by a paradigmatic shift based on cognitive-centred epistemologies (Budd, 1995; Dervin, 2003). For almost 50 years, IS research adopted evaluation methodologies to understand user's satisfactions with information systems (Borlund, 2019). With the proposed paradigmatic shift in the 1980s, IS scholars were called to draw attention to the information needs and the diverse identities and requirements of an information system's users (Dervin & Nilan, 1986). Despite these advances, predominant epistemological stances (e.g., empiricist and rationalist) may still be limiting the scope and nurturing an implicit research agenda in YII studies, particularly where it concerns the study of search and retrieval systems.

Epistemological stances, theoretical frameworks and conceptual frameworks constitute the pillars necessary to develop a research study (Crotty, 1998; Guba & Lincoln, 1994). Epistemological stances provide lenses to interpret knowledge and elaborate assumptions about artefacts, social practices, discourses and interactions. Theoretical frameworks encompass the tools necessary to investigate and validate the existence of knowledge. Conceptual frameworks provide the structure to explore relationships across multiple conceptual factors. Although studies lacking theoretical frameworks can generate foundational theories, we argue that this does not seem to be the case of YII studies. An exception can be found with the work of Denise Agosto and Sandra Hughes-Hassell, who developed a conceptual model of the information needs of urban teens (2006a, 2006b). While we admire this work and way it seeks to draw in both theoretical and empirical work, the conceptual model that emerged from their investigation is limited in its utility. The model has neither descriptive nor predictive power, since the relationships among the different components were never explicated. Furthermore, the model was not expanded or adapted in future research or with different populations, making it a localized insight, but a conceptual terminus of this inquiry.

In YII studies, the absence of foundational theoretical frameworks leads to data-driven studies transformed in descriptive analyses rather than theories. Nevertheless, the multidisciplinary aspect of conceptual frameworks makes it difficult to unify theories (Arafat & Ashoori, 2019; Fidel, 2012). Epistemological stances can function as both epistemologies and preliminary theoretical frameworks in YII studies.

Predominant epistemologies affect the outlining of research questions, study goals, and ultimately study design and analysis (Guba & Lincoln, 1994). As epistemological stances provide lenses and theoretical framework for YII studies, it affects how scholars choose the units of analysis. Furthermore, the absence of theoretical frameworks creates a void filled by multidisciplinary conceptual dimensions depending on the YII scholar's background.

We use Table 1 to illustrate epistemological stances commonly addressed — implicitly and explicitly — in YII studies. The goal here is to provide a landscape to understand predominant epistemological stances, and their

assumptions and dimensions without being comprehensive. The epistemological organization helps to outline the research focus (dimensions/units of analysis) and the preliminary assumptions guiding YII studies (Arafat & Ashoori, 2019; Budd, 1995; Crotty, 1998; Dervin, 2003). Then we unpack these stances the subsequent paragraphs.

Epistemological Stance	Dimensions of Analysis	Knowledge Assumptions
Empiricism	Individual and information-system	Frequencies predict the existence of certain YII phenomena
Rationalism	Cognitive developmental levels, individual and information system	Cognitive processes of the mind determine YII
Constructionism	Social actors, social experiences, multiple and social ways to obtain information	Role-Oriented: Contextual setting and social roles affect YII
		Ecological: contextual setting, social roles and cognitive processes affect YII
		Socio-constructionism: contextual setting, collective meaning, social roles and social practices affect YII

Table 1. Epistemological stances, dimensions of analysis and knowledge assumptions commonly addressed in YII studies

Empiricism

Empiricist studies are based on quantitative procedures to investigate the frequency of select YII behaviors or phenomena. These studies can be experimental or evaluative. Experimental studies test the likelihood that certain YII phenomena exist under certain conditions. Evaluative studies explore user's satisfaction and usability of information systems under controlled conditions.

Rationalism

Rationalism-centred studies adopt mixed-methods approaches to explore the interplay between cognitive developmental levels, information systems and YII.

Constructivism

Constructivism approaches consider that meaning is socially constructed in context. Constructivism-oriented studies fall under three categories: role-oriented, ecological and socio-constructionism. Role-oriented studies explore how the setting, social roles (e.g., student, teacher and librarian) and the information needs inherent to those social roles characterize YII. Ecological studies consider that YII is founded on the interplay between affordances and constraints existing in certain search settings, cognitive processes and societal rules. Finally, socio-constructionism studies consider that knowledge/meaning is collectively constructed, so is the process of obtaining information.

These three stances are then the starting points for our analysis. We recognize that other scholars might identify or define these stances differently, or employ them to describe a broader range of knowledge-making activities. For the purposes of this paper, we are being intentionally succinct. For more fulsome treatments of epistemology in LIS research, we recommend the recent work of Arafat and Ashoori (2019), as well as Budd (1995).

METHODS

This study draws on a conceptual analysis of journal articles, conference papers and books reporting on youth information-seeking behaviour studies from 1997 to 2020. Information-seeking behaviour concerns "the purposive seeking for information as a consequence of a need to satisfy some goal" by accessing interpersonal resources and information systems (Wilson, 2000, p. 49). We define youth as those persons up to the age of 18 (United Nations, 1989).

The study materials were identified by searching databases, such as EBSCO and ACM Digital Library. The search yielded 187 items. Of that sample, 82 items exploring youth information-seeking behaviour and web search systems were included in the analysis. Although studies exploring library OPACs and electronic media (e.g., CD-ROMs, electronic encyclopedias and digital libraries) are foundational, we have constrained our sample to the Internet era, post 1995. Furthermore, studies exploring third party perceptions (e.g., teachers, school librarians and parents) on youth information-seeking behaviour were removed from the analysis. During the preliminary analysis, some study materials were found to report on the same data sample (Bilal, 2000, 2001, 2002; Rutter, Clough, et al., 2019; Rutter

et al., 2015; Rutter, Toms, et al., 2019; Vanderschantz et al., 2014; Vanderschantz & Hinze, 2017). Where authors published multiple reports from the same dataset, we analyzed these materials as a single study.

The conceptual analysis proposed here borrowed the foundations supporting the development of Savolainen's typologies for information-seeking barriers (Savolainen, 2016) and were adapted to reflect the categories emerging from this analysis. Typologies illustrate relationships across multiple categories, thus supporting the development of research frameworks (Bailey, 1994). Furthermore, theoretical frameworks provided the foundations to characterize the epistemological stances adopted in YII studies. While some studies provided an explicit description for the adopted epistemological stance, other studies characterized those stances implicitly. In those cases, we looked for what kinds of contextual factors the researchers investigated, and the research questions/hypotheses, study goals, methods and findings altogether to infer the underlying epistemological (following on the work of Dervin, 2003). Below are the guiding categories for the proposed analysis.

- Epistemological stances: it refers to the preliminary knowledge assumptions guiding the outline of research questions and study goals (Budd, 1995; Crotty, 1998; Guba & Lincoln, 1994). The epistemological stances are empiricism, rationalism and constructionism (setting-oriented, ecological and socio-constructionism).
- Theoretical framework: it encompasses the frameworks/tools necessary to test the existence of certain phenomena based on an epistemological stance (Crotty, 1998; Dervin, 2003; Guba & Lincoln, 1994). Theoretical frameworks affect how researchers design their studies and analyze study outcomes.
- Conceptual framework: it provides the necessary foundations to establish connections across multiple concepts (Arafat & Ashoori, 2019; Dervin, 2003; Fidel, 2012). Conceptual frameworks provide background for researchers to interpret study outcomes.

Research questions/hypotheses, study goals, methods and finding sections were analyzed and organized into categories of analysis describing the epistemological stances (see Table 1), study type, units of analysis, research setting, study design and study outcomes.

The studies included in the conceptual analysis adopted five typologies: empiricism (17 items), rationalism (43 items), setting-oriented (7 items), ecological (1 items), and social constructionism (14 items). In terms of study type, we characterized YII studies as experimental (16 items), exploratory (61 items), and analytical (5 items).

FINDINGS

An overview of YII studies conducted in the past 20 years indicate a greater emphasis on empiricist and rationalist epistemologies, and exploratory (data-driven) studies. Although these studies have provided useful insights, the outcomes illustrate descriptive analyses that cannot be generalized into theories or used to revise existing theoretical constructs. We argue that epistemological stances have informed preliminary assumptions regarding what researchers can explore in terms of YII. For example, cognitivist-centred studies are based on rationalism assumptions that YII phenomena occur as a result of cognitive processes (i.e., in the heads of participants) and are relatively stable across contexts and situations (Jochmann-Mannak et al., 2010). Data-driven studies explore what aspects characterize YII phenomena, providing a descriptive analysis of the origins and conditions of phenomena (Guba & Lincoln, 1994). Therefore, data-driven studies usually provide the foundations for the development of theories. Yet, we argue, this does not seem to be the case of YII studies.

In the absence of theoretical frameworks, pioneer YII studies have laid a conceptual and methodological foundation of a descriptive nature to support the analysis of YII phenomena (Bilal, 2000, 2001, 2002; Kafai & Bates, 1997; Marchionini, 1989; Solomon, 1993). These studies formulated a cognitive-information system duality to characterize youth's information-seeking and retrieval behaviours resulting from interactions with information systems. For example, recent YII studies (Robinson, 2014; N. G. Taylor, 2018; Walhout et al., 2017) have adopted similar methodologies to Marchionini, Solomon and Bilal; these early works created a pattern of descriptive work, that while rigorous in execution, was largely atheoretical. This pattern has become the accepted de facto approach for subsequent work and has contributed to a dearth of theory building.

The conceptual analysis resulted in the typologies of YII studies illustrated on Tables 2-6. The typologies propose eight categories that researchers can use to operationalize YII studies. The tables below describe empirical, rationalist, constructionist typologies, thus covering knowledge assumptions, conceptual frameworks, study design, study outcomes, applications and suggested theoretical frameworks.

EMPIRICISM					
<i>Experimental</i>			<i>Evaluation-based</i>		
Study Design	Study Outcomes	Works	Study Design	Study Outcomes	Works
Quantitative approaches Multiple controlled conditions Large data sample	Comparison across multiple conditions Hypotheses validation Description of YII characteristics and patterns	Duarte Torres et al., 2014 Schacter et al., 1998 Oliveres-Rodríguez et al., 2018 Walhout et al., 2017	Quantitative approaches Multiple controlled/semi-controlled conditions Medium-small data sample	Description of YII characteristics and patterns	Borlund, 2016 Gossen et al., 2014 Walraven et al., 2013

Table 2. Typology of empiricism-oriented approaches in YII studies

Empiricism

The underlying knowledge assumption in empiricist studies focuses on a behaviour-oriented approach. These studies typically investigate behavioural patterns emerging from user-system interactions, thus adopting positivist and post-positivist theoretical frameworks. Empiricist studies identify information behaviour patterns/frequencies, evaluate task success rates, and assess usability features on information systems and user-system interactions. As illustrated in Table 2, studies under the empiricism category can help to inform improvements on information systems and provide recommendations on information literacy training.

RATIONALISM			
Study Type	Study Design	Study Outcomes	Works
Exploratory	Mixed methods Study participants from diverse ages or school grades Small-medium sample size	YII characteristics and patterns description Analysis of relationships between study factors	Bilal, 2000, 2001, 2002 Cooper, 2002 Lorenzen, 2001 Subramaniam et al., 2015 Taylor, 2018 Vanderschantz & Hinze, 2017

Table 3. Typology of rationalism-oriented approaches in YII studies

Rationalism

Rationalist-oriented studies adopt individualist/cognitivist perspectives as knowledge assumption. Theoretical frameworks based on cognitivism and phenomenology might be helpful when designing these studies because these frameworks explore the processes of the human mind, such as sense making, perceptions and emotions. The conceptual framework for rationalist-oriented studies relies on implications of cognitive developmental levels (age or school grade) on information behaviour strategies and processes, task complexity, and user-system interactions. The outcomes of rationalist studies help to improve information systems and support information literacy training.

CONSTRUCTIONISM -- ROLE-ORIENTED			
Study Type	Study Design	Study Outcomes	Works
Exploratory	Qualitative approach Naturalistic setting; case study (1 group under similar conditions) Small-medium sample size	YII characteristics and patterns description Analysis of YII processes attained to groups	Rutter et al., 2018 Foss et al., 2012, 2013

Table 4. Typology of role-oriented approaches in YII studies

Constructionism – Role-oriented

Information seeker roles in YII, the information needs inherent to such roles, and the settings in which these processes occur delineate the knowledge assumption for role-oriented studies. Some theoretical frameworks, such as symbolic interactionism (Blumer, 1969) and information use environments (R. S. Taylor, 1991), might be relevant to understand what aspects are linked to performing a YII role in certain settings. As conceptual framework, these studies focus on the analysis of cognitive developmental levels (age/grade), information behaviour strategies and processes, task complexity, user system interactions. Role-oriented studies may inform YII and educational policies and information literacy training.

CONSTRUCTIONISM – AFFORDANCES/CONSTRAINTS ORIENTED			
Study Type	Study Design	Study Outcomes	Works
Analytic	Mixed-methods or qualitative approach Naturalistic setting; case study (1 groups under similar conditions)	Analysis of relationships across study factors based on means-analysis approaches (what, how and why)	Fidel et al., 1999

Table 5. Typology of affordances/constraints-oriented approaches in YII studies

Constructionism – Affordances/Constraints

The opportunities and limitations affecting YII constitute the knowledge assumption for studies centred on affordances and constraints. These studies usually adopt ecological frameworks, such as Activity Theory (Nardi, 1996) and Cognitive Work Analysis (Vicente, 1999), to understand how the environment shapes and is shaped by YII. Affordances/constraints studies are analytical, thus concerning what/how/why YII processes occur and their relationship with social rules, functions, information systems, and personal characteristics. Therefore, the conceptual framework for these studies is based on information-seeking environments, cognitive developmental levels, information behaviour strategies and processes, task complexity, and user-system interactions. The outcomes from affordances/constraints studies provide information to develop information literacy training and support the development of information systems, particularly the requirements needed for the design of novel systems.

CONSTRUCTIONISM – SOCIALLY CONSTRUCTED			
Study Type	Study Design	Study Outcomes	Works
Exploratory	Qualitative approach Naturalistic setting Small groups & communities Small sample size	Description of YII characteristics and patterns Analysis of social practices affecting information behaviour	Andersson, 2017 Gross, 2004 Knight & Mercer, 2017 Shenton & Dixon, 2003 Watson, 2014

Table 6. Typology of socially constructed approaches in YII studies

Constructionism – Socially constructed

Socially constructed studies are based on the premise that the world is socially constructed. These studies explore YII as resulting from social practices and values, thus relying upon theoretical frameworks such as sociocultural theory (Vygotskii & Cole, 1978) and socio constructionism (Berger & Luckmann, 1967). The conceptual framework in these studies explore information needs as basic human needs information practices and the social construction of information behaviour. Socially constructed studies provide insight for the development of information services to youth populations, educational policies and information literacy training.

In the following sub-sections, the three categories of analysis utilized to conduct the conceptual analysis presented here will be reviewed. We identify select studies that typify the moves employed by YII researchers, but the constraints of this paper format do not permit an exhaustive list of similar inquiries.

Knowledge Assumptions

Knowledge assumptions derive from epistemological stances inspiring YII researchers. Each epistemological stance has a specific set of knowledge assumptions that serve as a starting point for YII inquiries.

Behaviour-oriented

Behaviour-oriented studies consider that observable information behaviours result exclusively from interactions with information systems (Guba & Lincoln, 1994). Measuring the frequency and identifying the patterns of these

information behaviours under certain conditions support the generalization of behaviour-oriented assumptions. Duarte Torres et al. (2014) investigated search query logs based on the assumption that search query length and topic searched predict searcher's ages. Gossen et al. (2014) measured the frequency of search moves in multiple web search systems to compare variations in information behaviour across age ranges. Gossen et al.'s assumption was that features in web search systems affect searcher's responses.

Cognitive-oriented

Cognitive developmental levels affect the observable information behaviour of searchers interacting with information systems (Hjørland, 2002; Ingwersen & Järvelin, 2005). To differentiate different kinds of information behaviour is necessary to categorize cognitive developmental levels that can be determined by age, grade, prior knowledge and motivation. Bilal et al. (2018) explored the attributes of search queries based on the assumption that older children present more sophisticated query formulation strategies than the younger ones. Subramaniam (2015) investigated information judgment criteria based on the premise that prior knowledge and source familiarity affect predictive and evaluative strategies.

Role-oriented

To perform the tasks and duties pertaining to a certain class (students), searchers will likely be subject to similar information needs and information use (R. S. Taylor, 1991). For example, students face similar information needs, access similar sets of information systems and information resources to complete the assignments (information use) required for their grade level. Rutter et al.'s (2015, 2018, 2019) longitudinal study on the classroom as an information use environment is based on the premise that classes in the school environment (students, teachers and school librarians) have overlapping search activities. Thus, the assignments teachers prepare generate information needs that will likely be similar for students in the same grade level at the same school.

Affordance/Constrain-oriented

The interplay of affordances and constraints existing in search environments affect YII (Bronfenbrenner, 1981; Gibson & Pick, 2000). The characteristics (affordances and constraints) of search environments affect what searchers do, how search activities are conducted and why certain information interaction processes occur. Fidel et al. (1999) explored high school students using the web to seek and retrieve information to complete a school project. The underlying assumption was that the cognitive developmental levels, places, resources and information systems generate opportunities and limitations that affect the strategies adopted to seek and retrieve information.

Socially-constructed

Acknowledging that there is an information need depends on social roles and practices, thus it is socially constructed (Berger & Luckmann, 1967; Talja et al., 2005). The underlying assumption is that information needs are not isolated from other human needs (e.g., Maslow's hierarchy of needs). In a study with Swedish adolescents (Andersson, 2017), the premise was that searching for information on Google depends on an array of social practices that goes beyond school and home activities.

(Implicit) Methodological Frameworks

Although it cannot be said that YII research is supported by evident theoretical frameworks, there are some predominant approaches that have inspired YII studies for the last 20 years. These approaches are experimental, evaluative and exploratory.

Experimental approaches

Experimental YII studies are essentially quantitative and conducted under controlled conditions to test the validity of hypotheses. These studies are similar in structure to IIR evaluations to explore issues with information systems and provide recommendations to improve information systems. Study participants complete pre-defined tasks and researchers proceed to collect transactional data (Duarte Torres et al., 2014), and search moves (Schacter et al., 1998). Common units of analysis are information system type (de Vries et al., 2008), search task complexity (Borlund, 2016), information behaviour (Metzger et al., 2015; Olivares-Rodríguez et al., 2018), task success rate (Walraven et al., 2009), effectiveness of information system features (Walhout et al., 2017).

Evaluative approaches

Evaluative YII studies are conducted under controlled or semi-controlled conditions to compare and explore the results of interactions with information systems. These studies focus on the issues youth encounter when seeking and retrieving information (Gossen et al., 2014, 2012), and/or the barriers the information system pose to youth (Jochmann-Mannak et al., 2016). These studies sometime employ field-based experimental designs, or quasi-experiments. Although a focus on the searcher is maintained, evaluative studies are more contextualized than experimental studies, thus opening some space to explore variations in information needs. Data are collected from observations, transactional data log, search moves, think-aloud protocols, interviews and task analysis. These studies

explore task complexity, cognitive developmental levels, information system type, effectiveness of information system features and information behaviour.

Exploratory approaches

Exploratory studies are conducted under semi-controlled and naturalistic conditions to identify what affects the occurrence of YII phenomena in certain contexts. Exploratory approaches adopt either qualitative or mixed-methods procedures to investigate types of variations in information behaviour (Francke et al., 2011; Meyers, 2011; Watson, 2014), youth's interactions with information systems (Gauduchau, 2016; Madden et al., 2006) and search tasks (Coiro et al., 2015; Crow, 2009). Furthermore, exploratory approaches investigate what kinds of information behaviour emerge while searchers are performing diverse search tasks during a specific period of time or until the participant completes their tasks. The design of these studies is similar to those of evaluative studies, based on observations, think-aloud protocols and interviews to explore interactions with information systems. The main difference is that exploratory studies focus on information behaviour variations rather than on evaluating features on information systems.

Analytic approaches

Analytic studies are conducted under semi-controlled and naturalistic conditions to analyze how and why certain YII phenomena occur (Fidel & Pejtersen, 2004). As the main focus is to explore relationships across multiple contexts based on pre-defined theoretical frameworks, these studies are less frequent in YII. The analytic YII studies have a strong background from other disciplines (e.g., education and psychology) which provides a tentative theoretical framework to explore these relationships (Badilla Quintana et al., 2012; Knight & Mercer, 2015, 2017). Therefore, the common units of analysis are decision-making and problem-solving processes, evaluative and predictive judgment, and task complexity.

Conceptual Frameworks

Conceptual frameworks describe the relationships proposed for multiple concepts to explore certain YII phenomena (Arafat & Ashoori, 2019; Guba & Lincoln, 1994). Again, the issues here seem to gravitate around the multiple interpretations a single concept receives along with the absence of a guiding framework to investigate assumptions (Arafat & Ashoori, 2019; Fidel, 2012). The concepts reflect phenomena characteristic to YII studies, but their interpretation and framing are diverse.

Search query formulation

This concept opens up to sub-categories depending on whether the study is quantitative or qualitative. Search queries explore the accomplishment of search tasks (Nesset, 2009), variations in knowledge and cognitive developmental levels (Bilal & Gwizdka, 2018), and effectiveness of information system interfaces (Jochmann-Mannak et al., 2016; Lorenzen, 2001). Sub-categories of search queries are type (Vanderschantz & Hinze, 2017), quality (Foss et al., 2012, 2013), effectiveness (Kammerer & Bohnacker, 2012) and frequency of reformulation (Rutter et al., 2015). Furthermore, researchers use search query formulation to predict the success-rate in information-seeking and retrieval tasks, cognitive levels and usability of information systems.

Evaluation of information sources (or SERPs)

This concept explores the criteria youth adopt to judge whether the information sought addresses their information needs. Some of the criteria are based on how youth perceive source authority, their familiarity with certain sources and the effectiveness of information systems support to evaluate information. Researchers include the evaluation of information sources to predict the task effectiveness (Knight & Mercer, 2017; Meyers, 2011), criteria to assess information sources (Pickard et al., 2014; Subramaniam et al., 2015) and usability of information systems (Jochmann-Mannak et al., 2016).

Cognitive developmental levels

This concept is borrowed from Piaget's four stages of cognitive development theory. Piaget's theory suggests that age can be used to infer human's developmental levels (Piaget & Inhelder, 1973; Smith, 2002). Therefore, older children will present more sophisticated skills than younger children. The role of cognitive developmental levels is fundamental to understand youth's information behaviour based on age (Eickhoff et al., 2012; Gossen et al., 2014), school grade level (Vanderschantz & Hinze, 2017) and reading literacy skills (Coiro & Dobler, 2007; Lazonder et al., 2020). These studies often compare youth's information behaviour (e.g., quality of search queries and criteria to judge information) with those expected from adults. Yet, cognitive developmental levels help to illustrate the extent to which sophisticated information behaviours are more frequent among youth.

Task analysis

This concept explores the extent to which the complexity of a search task affects YII. For example, fact-finding search tasks are perceived to be easier than ill-defined/exploratory tasks because the latter impose a higher cognitive load as youth need to assess what kind of information is required (Wildemuth et al., 2014). The task complexity

analysis explores the nuances across information behaviour (Bilal, 2000, 2001, 2002; Walhout et al., 2017). This concept helps to understand the extent to which the nature of assignments, the effort required to put on a task and cognitive developmental levels affect YII.

Information systems

This concept focuses on comparison across multiple information systems, especially adult- and youth-oriented. The argument is that youth will likely perform better on information systems specifically designed for them and that support their cognitive developmental levels (Dinet et al., 2010; Gossen et al., 2014; Jochmann-Mannak et al., 2016). These studies help to identify features that pose barriers or support YII.

DISCUSSION

The typology presented here outlines predominant epistemological stances, conceptual frameworks and study designs in YII. By pointing out these predominant approaches, we provided possible avenues to address the absence of theoretical frameworks and integrate YII as a research field. To explore the implications of social transformations and advances in technology on YII, it is critical to survey previous studies to delineate theoretical frameworks representative of YII. Thus, the typology elicits critical areas that can be further developed in the field of YII.

Youth information interaction studies provide a valuable characterization of youth information behaviour. Although YII research multidisciplinary, these studies have reported similar findings such as issues with query formulation and information judgment (Gossen et al., 2014; Rutter et al., 2015). This aligns with what Dervin (2003) suggested, in that the lack of theories often leads to descriptive outcomes without proposing substantial analyses of phenomena. YII studies laid the foundations to characterize YII but a theoretical framework is missing to bridge epistemological stances and conceptual frameworks. This connection can provide the support necessary to generalize assumptions and conceptual relationships in YII.

The theoretical gap in YII has been filled with a combination of methods informed by epistemology and conceptual frameworks. Epistemological stances and conceptual frameworks derived from emblematic YII studies (Bilal, 2000, 2001, 2002; Marchionini, 1989; Solomon, 1993) support researchers to operationalize inquiries and design of YII research. Rather than creating a synergy supporting theoretical foundations, the combination between epistemological stances and conceptual approaches explores study factors using limited interpretive lenses. The atheoretical nature of youth research has a compounding effect; it patterns future research, further limiting the development of new theory at either the strong or weak level. This is also a pattern in Human-Computer Interaction (HCI) research, where small-scale descriptive studies tend to lack replication and subsequent development into stronger theoretical knowledge.

The information illustrated in the typology clarifies the relationship between epistemological stances, study design and study outcomes. Research inquiries depend on the researcher's knowledge assumptions (i.e., worldview), thus affecting the methodologies adopted to investigate certain phenomena. For example, constructionist approaches consider socio-cultural aspects (e.g., cultural background, school setting, communities) affecting how youth interact with information. Thus, constructionist approaches are more likely to be more contextualized than empiricist approaches.

The implications of following predominant epistemological stances can be found on how YII studies reflect contemporary youth experiences. Recent YII studies have adopted frameworks very similar to those explored in studies conducted more than 20 years ago (Vanderschantz & Hinze, 2017; Walhout et al., 2017). By not capturing current issues, such as the increased use of digital platforms to learn and participate in social interactions, researchers might be missing the intricacies of how youth interact with information in context. For example, even as many school systems in North America, Asia and Europe are moving to mobile technologies in schools, youth information interaction research is still largely conducted on desktops and laptops, in some part due to the methodological approaches that condition what data is important to collect (query strings, time on task, click-throughs, etc.). To move forward, YII research needs to reassess the larger point of the endeavor and consider approaches that build toward stronger frameworks that will better influence youth practice, technology development, and public policy.

The past 20 years provided researchers with a rich landscape to build theoretical foundations for YII. These studies are fundamental to understand what is unique to this field, and to develop specific YII theories. The typologies provided here help to characterize relationships between certain approaches, study design and outcomes, thus supporting researchers to develop studies situated in context. As the typologies describe what constitutes YII in multiple settings and across diverse contexts, it provides the basis for researchers to make informed decisions on the design of their studies.

CONCLUSION

The typology proposed here provides some guidance while suggesting theoretical frameworks that might support YII inquiries. The identification of knowledge assumptions helps researchers to explore avenues and match these assumptions with theoretical approaches (methodologies) and conceptual frameworks. Furthermore, theoretical and conceptual frameworks support researchers to frame inquiries that support a richer understanding of YII phenomena. The identification of study applications is intended to help researchers to better align their study goals and study designs to achieve robust and valid outcomes.

The underlying epistemological stances of researchers delineate not only the frame supporting the study design, but also the analysis and interpretation of study outcomes. Epistemological stances provide conceptual frameworks to explore and interpret social phenomena. Nevertheless, these epistemological stances have served as foundations to outline the inquiries in YII studies without functioning as guiding theories. Without guiding theories, YII studies are mostly data driven based on what researchers consider as relevant epistemologies and assumptions. With most studies being data driven, YII research is based on descriptive analysis rather than theoretical generalizations.

We hope with this paper to open a constructive dialogue about the nature of youth information interaction research. The “methods section” of an article or paper rarely supports the kind of rich discourse about these topics, so we may have made errors in classifying studies, and some scholars may disagree with our characterizations. If there are mistakes in our typology, we bear the responsibility for our misreading of the sources. But we hope to move forward in mutual respect on the youth research agenda and welcome the opportunity to build new frameworks together.

ACKNOWLEDGEMENTS

The authors wish to thank the many YII scholars who have contributed to the development of the current state of knowledge in the field. Without their hard work and insights, this paper would be meaningless. We also thank the anonymous reviewers who contributed their ideas and generous suggestions, as well as their intellectual allyship in seeing the value of such an analysis to the ASIS&T community.

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The Library/Surveillance Interface

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ABSTRACT

Few topics are more often discussed than surveillance, particularly in the context of surveillance technologies that reflect structural inequities. There is space, however, to bring more discussion of surveillance tech into the library literature. At the same time, literature on digital surveillance and associated systems such as Big Data, surveillance capitalism, and platform capitalism often discuss these phenomena as if they are novel rather than iterations of long-standing inequitable circumstances. We propose that a dialogue between surveillance literature and critical library literature will benefit both areas: theories from the surveillance domain can strengthen examinations of structural oppression in libraries while theories from critical library literature can strengthen acknowledgment of surveillance techs' historical roots. Moreover, overlap exists between concepts used in surveillance and library literature, including concerns about neutrality and classification practices. Therefore, after reviewing surveillance theories and their applicability to libraries, we demonstrate how these scholarly areas may strengthen each other, with three major consequences: (a) moving library literature beyond considerations of the panopticon in favor of the surveillant assemblage; (b) recognizing that surveillance tech is a hyper-visible form of historical oppression; and (c) acknowledging that the library ethos is critical to any fight for justice within information science.

KEYWORDS

Libraries; surveillance; technology; liberation; critical.

INTRODUCTION

The major focus of Library and Information Science, or LIS, as a field arguably is moving further away from the “L” and closer to the “IS,” and has for decades. Perhaps this is because the “L” and its apparent institutional focus seem less relevant in a world increasingly concerned with digital technologies and, in particular, algorithms, claims of artificial intelligence and machine learning, and the increased integration of digital systems of public and private organizations. Although libraries are highly digitized and technically sophisticated places with highly technically sophisticated staff members, the “IS” appears closer to trending sociotechnical concerns within the discipline and academia writ large. Discounting libraries' stake in and relevance to sociotechnical topics is, however, a mistake. Andrew Dillon argues that iSchools can be differentiated from traditional LIS programs along a number of dimensions including their lack of emphasis on particular agencies, e.g., libraries, but that, “the intellectual values of librarianship have survived...and the true legacy concerns of access, information as a social resource, and the importance of privacy and security of information are as deeply embedded in most iSchools” (2012, p. 271).

Further, binarizing the “L” from the “IS” leads to missed opportunities for dialogue, collaboration, and mutual learning among actors within and between these domains. In this paper, we use surveillance as a context through which to understand both underarticulated technical concerns in libraries and the benefits of placing critical library scholarship in dialogue with critical surveillance studies. We review literature that centers problems with surveillance and, in particular, surveillance tech as well as critical library literature that engages surveillance practices in libraries. We identify opportunities for further development in both areas and explicate how scholarly and activist work in tech and libraries may come together to dismantle inequitable dimensions of surveillance in favor of more liberatory approaches to technologies and practices within and outside of the library.

SURVEILLANCE

Scholarly interest in surveillance has been piqued by the continued development of digital technologies that track and classify people and places. Such technologies typically capture data about people—sometimes without their knowledge or consent—and then sell the data or use it for nefarious purposes. Developers and other defenders of this tech often claim it is “neutral” or its problems are easily remedied via small-scale improvements (Bostoen, 2018; Hoffmann, 2019). But in reality, commodification and monetization of personal data by technology and other companies falls under the oft-cited umbrella of surveillance or platform capitalism, which describe exploitive economic systems wherein technology and other companies wield power to mine information about people (Zuboff, 2015, 2017; also see Srnicek, 2017). This information is then used by public and private organizations to predict and shape people's behaviors to maximize commercial, political, security, and other goals. As systemic phenomena, surveillance and platform capitalism threaten democratic processes and individual autonomy, as do the use of

similar technologies by state entities to securitize our contemporary era. For example, a company making sleep apnea machines sold users' data to health insurance companies, which then used the data to deny people individual health insurance coverage (Allen, 2018). Increased use of "landlord" or "property" technologies such as tenant screening and biometric entry systems have led to increased evictions, especially for people of color (Doty, 2021; McElroy et al., 2021). A closer look at theories of surveillance allows us to more carefully outline its value in exploring and understanding the intersection of librarianship and surveillance technologies and practices, with a special eye toward identifying means for liberatory politics of librarianship in our heavily surveilled and securitized times.

Some Relevant Theories of Surveillance

Recognition and critiques of our current practices of nearly omnipresent surveillance are many, e.g., Lyon (2003, 2006, 2018), to name only three of the most prominent. Particularly important in the burgeoning surveillance literatures globally are overlapping themes such as contextual integrity (Nissenbaum, 2004, 2010); privacy frameworks (e.g., Solove, 2008); the culture of surveillance (Lyon, 2018); and racial and other forms of inequitable surveillance (e.g., Browne, 2015; Noble, 2018). Also prominent are self-surveillance and quantification of self (QoS) (Lupton, 2016); pleasurable and ludic surveillance; prominence of risk assessment in governmental and private organizational determinations of whom to watch and how to control them; governmentality; the "known citizen;" and algorithmic surveillance and their critiques (e.g., Igo, 2018; O'Neil, 2016; Pasquale, 2015). Many of these works draw from, but also expand upon, Foucault's classic use of the panopticon to describe surveillant practices; as we describe below, although the panopticon maintains significance, its limitations are many (e.g., Haggerty, 2006). Recent important volumes include Dubrofsky et al.'s 2015 edited collection *Feminist Surveillance Studies* and the 2018 Oxford University Press volume *Surveillance Studies: A Reader* edited by Monahan & Wood. Even this brief rehearsal demonstrates the breadth and depth of these various literatures, but there are three prominent themes that merit closer, if abbreviated, scrutiny when considering the interface of the library and surveillance: first is the surveillant assemblage; the second, in a bit of a contrarian way, the panopticon; and the third and final theme is surveillance as the means of social sorting and classification to control people.

The Surveillant Assemblage

The surveillant assemblage has been an important model in surveillance studies since promulgated by Haggerty & Ericson (2000). Eschewing the hegemony of Foucault's panopticon, George Orwell's Big Brother from 1984, and related "traditional" analyses of surveillance, the surveillant assemblage has four important elements of interest to understanding libraries and surveillance:

- Reliance on the ideas of assemblages as developed by philosophers Gilles Deleuze and Félix Guattari as **structured and stable integrations** of systems, objects, practices, and actors usually regarded as discrete and too heterogeneous to be thought in any way as unitary (p. 608).
- **Abstracting human beings into data objects**, what we now term datafication or rendition, connected by rhizomatic means.
- The botanical rhizomatic metaphor emphasizes **the explosive growth** of rhizomes as "plants which grow in surface extensions through interconnected root systems . . . contrasted with arborescent systems . . . with a deep root structure and which grow along branchings from the trunk" (p. 614).
- Thus, as rhizomes, surveillance systems are explosive in their proliferation and growth and their **invariably hierarchical** nature.

While space limitations do not allow deeper exploration of the rhizomatic, libraries' own surveillance systems, e.g., records of loans of books and computing devices, participation in copyright owners' means of digital rights management (DRM) to surveil what readers read, or the use of RFID (radio frequency identification) devices giving real-time location data, participate in the increasingly integrated assemblage of private and public, explicit and implicit surveillance systems in modern society, as discussed below.

David Lyon is one of the most influential surveillance scholars and has been so for decades. Particularly valuable is Lyon's (2006) argument that, while the hegemony of Foucault's 1977 use of Bentham's panopticon has proven useful, it has also been stifling to other insights as contemporary surveillance evolved beyond the state-sponsored discipline and control of special interest to Foucault. For example, Lyon offers a number of other, but not exhaustive, potential metaphors that may be more apt for our current circumstances of global surveillance by multiple actors in multiple ways, in addition to the surveillant assemblage of Haggerty & Ericson and Orwell's Big Brother: the plague; the sacrament of confession; governmentality; world empire; and a future already determined or inevitable as shown by use of the *futur antérieur* (the future perfect) tense, i.e., speaking of the future as inevitable and as if it has already happened. Each of these metaphors has salience in helping us understand our current moment, and each emerges from "fresh initiatives in theoretical explanation," especially as technologies, social relations, and integration of surveillance systems evolve (p. 3). These and other considerations lead Lyon and others

to conclude that we must ask, “How far should the panopticon be permitted to guide the analysis of surveillance?” (p. 9), particularly to more fully engage the ethical imperatives that surveillance and its theorizing demand.

“Demolishing the Panopticon”... But Still Using Its Insights

In a second influential paper, Kevin Haggerty (2006) expands on the concept of the surveillant assemblage in the context of his call to, “Tear Down the Walls: On Demolishing the Panopticon.” He reminds us that the panopticon has important limitations in its (presumed) generalizability, most particularly that it “masks as much as it reveals” (p. 27). It obscures systemic reasons for surveillance, e.g., surveillance capitalism; it obscures that long-standing hierarchies of visibility and control are changing, while still not overthrowing traditional social inequalities; it hides the immense expansion of the targets of surveillance, such as surveillance of people with particular health conditions and the proliferation of sensors and biometrics in the natural and social worlds; and the panopticon also obscures that the state has no monopoly on surveillance as private organizations (e.g., insurance companies, neighborhood associations, businesses, and employers), individuals (e.g., romantic and business partners, disinterested strangers tracking others on social media, and home owners surveilling their family members at home), and more are only some of today’s surveilling parties.

Yet, Foucault’s panopticon has continued value to our understanding of contemporary surveillance, including that by libraries (Radford, Radford, & Lingel, 2018). This is particularly the case if we grant a more nuanced treatment to the panopticon. For example, there is great value in Foucault’s explanation of how the panopticon evolved at about the same time as the modern sense of policing, social order, and academic disciplines explored in *Discipline and Punish* (1977) as well as others of Foucault’s works, including the recurring dream of the state of the “utopia of the perfectly governed city” (p. 198). Similarly, it is useful to recall that using individuation and the resulting asymmetry of power between individual and organization is an important means of social control and that the internalization of “right behavior” happens as the prisoner “becomes the principal of his own subjection” (p. 203). Consider the counter narrative of librarianship from critical perspectives that discusses how libraries are the means of homogenizing culture, marginalizing and erasing cultural and linguistic heterogeneity, tracking our behavior and intellectual and political choices, and enforcing the canon. As Radford et al. express it, this counternarrative is “a reframing meant to counterbalance . . . fetishizing libraries as sites of endless imagination and play without recognizing the ways that these sites are also institutions of surveillance and control” (p. 691). We are then led to an interesting question. Should the library join the traditional Foucauldian quintet of disciplinary places of modernity – the barracks, the factory, the hospital, the prison, and the school?

Surveillance, Classification, and Structural Inequities

We conclude this brief consideration of surveillance theories and research with some attention to an essential insight about surveillance: its design as a discriminatory means of social control. This insight has developed over decades through the generative work of scholars including Simone Brown, David Lyon, Safiya Noble, Oscar Gandy, Ruha Benjamin, Joy Buolamwini, and others. As Lyon reminds us about surveillance, particularly as it grows in universality, applications, and means, “[p]rocesses of social sorting are always in play” (2018, p. 107). These means of social sorting are ways of exercising *hidden power in ordering* democracies that might otherwise demand explicit and participatory democratic engagement. Particularly prominent in this classification is the use of risk analysis to make predictions and exercise power, whether by the state, e.g., in predictive policing and border control for national security purposes; by private organizations, e.g., determining credit “risks” and algorithms to predict consumers’ purchases; and others (pp. 107-110 *et passim*). Risk scoring, especially using social media, purchase histories, residential address and neighborhood analysis, and demographic characteristics feature as important elements of these modes of classification and control.

We further find bodies of surveillance literature that explicitly grapple with surveillance as a *structural* phenomenon—one that reflects ingrained social inequities so that people who are historically marginalized (e.g., those who are BIPOC, queer, trans, disabled, and/or poor) suffer the worst consequences surveillance brings to bear (see Collins, 2000). Marginalization is, of course, deeply tied to classification and social sorting (Noble, 2018; Beauchamp, 2019; Benjamin, 2020). Citing the work of Raif Dahrendorf, Gandy (2006) reminds us that social sorting is “the routine and apparently legitimate use of classifications that may include, but are not limited to, race as a basis for excluding, denying or in some other substantial way restricting the life chances . . . of substantial numbers of persons” (p. 319). These and other surveillance imaginaries are closely tied to modes of classification, which as Bowker and Star (1999) remind us, have real-world outcomes of immense import.

Such outcomes possess heightened visibility (at least to the most privileged eyes) due to today’s digital surveillance structures. We can draw on myriad real-world examples of surveillance tech and its reification of racism, transphobia, ableism, and classism within surveillant assemblages and Big Data. Consider the fact that facial recognition software simultaneously misidentifies Black people’s faces (Buolamwini & Gebru, 2018; and note the recent film *Coded Bias*), reifies the Western gender binary and erases nonbinary people (Keyes, 2018), and feeds

into predictive tech that systemically classifies Black people as “criminal” (Crockford, 2020). The “landlord tech” we mentioned earlier targets people of color and poor people by, for example, predicting they will not be “good” tenants (McElroy et al., 2021). Automated social welfare systems operate by similar logics (Eubanks, 2018). Tech such as body scanners and biometric trackers similarly police and disadvantage trans and disabled people (Beauchamp, 2019; Bennett & Keyes, 2019). But while it is vital to both understand and repair or dismantle tech-related inequities, it is a mistake to focus all attention on surveillance as a technical phenomenon—a form of tunnel vision easily adopted by scholars who claim that surveillance and platform capitalism are novel. As Browne (2015) reminds us and the scholarship we review above demonstrates, surveillance is not a *new* concern despite the increased attention that tech brings to the phenomenon. Technologies are a modern iteration of long-standing surveillant assemblages that are constructed within inequitable circumstances. They therefore both shape and are shaped by historically entrenched oppressions (see Browne, 2015; Foucault, 1977; and Lyon, 2006, 2018). For example, racist policing (heightened—not created—by predictive policing based on presumptions of Big Data analytics mobilized against the poor, immigrants, and people of color); “shopping while Black”; and iterations of “the normative gaze” are long-standing circumstance that make surveillance a constant characteristic of society, with particular consequences for bodies and practices that do not conform to white, cisgender, able-bodied, and affluent standards (Elias & Gill, 2018; Okello & Turnquest, 2020; Pittman, 2020).

This contextual take on surveillance tech leads us to an important insight. Particularly in the realm of digital surveillance, there is a tendency to argue that the inequities reified by technologies are merely classificatory blunders that are products of “bad actors” and their individual biases—tech itself is “neutral” and can therefore be remedied with small-scale changes to a system’s code, features, and engagement with social sorting. However, a growing movement builds on the notion of bias to argue that technologies in reality embody systemic, structural, and institutionalized injustices that are not neutral and cannot be ameliorated on individualized human or technical levels (Bennett & Keyes, 2019; Hoffmann, 2019, 2020; Hoffmann & Jones, 2016). As D’Ignazio and Klein (2020) outline in *Data Feminism*, challenges are needed at the institutional level (e.g., interference with the gender binary, recognizing “invisible” forms of labor, providing restorative justice to Black communities) to reorient or dismantle surveillant assemblages, both digital and non-digital. To borrow from the *Feminist Data Manifest-No*, data ethics around surveillance tech “explicitly seeks equity and demands justice by helping us understand and shift how power works” (Cifor et al., 2019, n.p.).

SURVEILLANCE IN THE LIBRARY

Given the discussion above, it is useful and illuminating to consider many library practices under a surveillance umbrella. As we noted, Radford, Radford, and Lingel (2018) relate libraries to Foucault’s panopticon, arguing that library experiences are shaped by architecture that positions librarians as surveillers of their patrons. Moreover, the most basic library regulations such as due dates for books and program registrations constitute acts of surveillance, or reminders that a patron is being watched or tracked, despite the (limited) protection of library circulation records, for example, in all 50 states in the U.S.

Such acts of library surveillance are not often explicitly tied to the inequities we discuss above, although entire bodies of critical library scholarship exist that demonstrate how libraries as institutions embody and perpetuate inequities. Some work clearly nods to (non-digital) surveillance practices and the harms they perpetuate in libraries. Examples include critiques of police presence in libraries given law enforcement agencies’ violence against people of color, undocumented people, and queer people (Dario et al., 2020); as well as work which points to microaggressions experienced by marginalized patrons and library workers during interpersonal interactions (Sweeney & Cooke, 2018). There are, however, additional and more explicit connections between libraries and surveillance. A non-comprehensive list of topics covered by critical library scholars include:

- Inequitable classification practices that are symbolically violent towards people of color, indigenous people, and queer people (Adler, 2012; Drabinski, 2013; Howard & Knowlton, 2018; Olson, 2001).
- Arguments that professed core library values such as claims of neutrality are fallacious and in fact upholders of oppression (Gibson et al., 2017, 2020; Lankes, 2008).
- Exclusionary collection development practices (Wagner & Crowley, 2020).
- Critiques of uneven and sometimes performative attempts to incorporate diversity and inclusion into library milieux (Cooke et al., 2016; Lawrence, 2020).

Moreover, scholars note that library-related inequities are not simply results of individual librarians’ biases but are instead systemic and baked into the design of libraries and intersecting institutions (Gibson et al., 2017).

Critical library literature points to many of the same problems as work that critiques surveillance. For example, traditional library values such as neutrality mirror narratives that claim technologies are neutral. Arguments that problems with the library lie in misguided individual librarians are similar to claims that technical problems can be blamed on bad actors. We also see that library structures such as classification, assistance of patrons, and policing

are forms of surveillance with the same inequitable consequences as more typically cited examples of surveillance practices and tech—the same classificatory inequities that intersect with racism and transphobia in the design and deployment of facial recognition software manifest in library collections and catalogues. However, while current surveillance literature may too quickly center technologies in discussions of perpetual inequities, library literature may too quickly discount it.

The American Library Association has not updated its Library Privacy Guidelines since 2016, and these guidelines arguably do not engage the stakes of inequitable surveillance beyond a general focus on individual people's privacy (American Library Association, 2016). We therefore posit that libraries' *own* use of surveillance tech remains underexplored, but certainly present. For example, everyday procedures that (perhaps) seem benign such as maintaining a patron's check-out history are examples of digital tracking. Libraries may offer public computers and tablets with built-in webcams, and webcams are a concern because of their potential to be remotely accessed without a person's knowledge or permission. Further, tablets patrons take home may include software that uses location-based and other forms of tracking such as RFID that provide information in real time as well as logging it for later use. Makerspaces often contain myriad technologies that raise surveillance concerns which compound racialized and gendered elements of these spaces (Melo & Nichols, 2020). Surveillance tech should perhaps be a greater focus in critical library literature because public libraries are intricately tied to the state (e.g., for funding) while school, academic, and some special libraries are tied to educational institutions that utilize analytics and other programs which have been shown to digitally exacerbate inequities (Doty, 2020; Raber, 2003). As Nunn (2020) argues, libraries are institutions that preserve—but also have the capacity to resist—technocapitalist injustice. It is therefore worthwhile to further explore surveillance tech in libraries to draw increased attention to both institutionalized inequities *and* potentials to resist them.

ADDRESSING SURVEILLANCE WITHIN AND OUTSIDE OF THE LIBRARY

Critiques of both libraries and surveillance may complement each other in a broader effort to move towards liberation in library and tech-oriented places (which, of course, overlap). Liberation here refers to structural changes that foster emancipation and equity (Benjamin, 2019). For example, inequities within library and surveillance practices intersect in areas such as classification, policing (both in terms of law enforcement and phenomena such as the normative gaze), and tracking. Making these connections explicit allows us to use resources developed by scholars, practitioners, and activists within tech and library sectors to combat surveillance practices and the structural inequities they perpetuate, with the ultimate goal of moving away from systemic oppressive phenomena such as the surveillant assemblage, Big Data, surveillance capitalism, and platform capitalism towards more careful and collective technology design and use.

Lessons from the Library

As noted above, there is fertile ground to explore and theorize about surveillance, and in particular the surveillant assemblage, Big Data, surveillance capitalism, and surveillance tech, so that it acknowledges the historical roots of our current surveillance state beyond digital technology development (see, e.g., Browne, 2015; Foucault, 1977; Lyon, 2006, 2018). Critical library literature provides a model for how this may be done because it often incorporates elements of libraries' history—for example, the rise of professional organizations (Gregory & Higgins, 2018), the development of classification schemes (Olson, 2001), and the origin of libraries themselves (Cheshire & Stout, 2020; Linares & Cunningham, 2018; Schlesselman-Tarango, 2016)—into discussions of current iterations of oppression. Such work allows library scholars to connect library practices to evolutions of colonialism, segregation, and surveillance (Andrews, 2018; Callison et al., 2016; Erdede et al., 2020). These and other scholars deeply contest the largely hegemonic narrative of the library as the “people's university,” literacy, and liberatory and, instead posit the library as a homogenizing, controlling, disciplining, and policing agency of social control. Literature on surveillance tech can take a similar approach. While “the surveillance state” or “surveillance capitalism” may seem like larger phenomena than “the library,” critiques of particular technologies or companies clearly should situate the design and development of these topics within, at minimum, broader histories of systemic discrimination against particular populations (Couldry & Mejias, 2019; Mohamed et al., 2020). Further, there are examples of libraries and library systems pushing back against corporatized and government-sponsored surveillance capitalism—consider the University of California's break with Elsevier (McKenzie, 2019), longstanding library programming focused on privacy literacy (Carpenter, 2015), and librarians' resistance to the “library provision” of the PATRIOT Act (Elliott, 2013). Such initiatives demonstrate how institutions and their workers may resist and educate the public about systemic surveillance.

Lessons from Surveillance

Critical library scholarship can also develop alongside work on surveillance tech, the surveillant assemblage, surveillance capitalism, and related topics. In particular, there are many opportunities to explore whether and how libraries employ surveillance tech such as facial recognition and property technologies. As modeled by activist organizations such as The Library Freedom Project (*Library Freedom*, 2021) and movements such as the Cop-Free

Library Movement (Fassler & Ventura, 2021), library scholars and workers should consider how surveillance tech intersects with police presences in libraries and what alternatives to digital and on-site policing exist. Further, as literature on surveillance tech uncovers (sometimes) unknown dimensions of seemingly benign technologies, library scholars and practitioners may also more deeply interrogate the ethical, moral, and vocational quandaries that come with libraries' relationship to tracking patrons and their actions (Buschman, 2018; Doty, 2020).

Moving Towards Liberation

In both library and critical surveillance worlds, scholars, practitioners, and activists offer myriad ideas for how to promote equity and renew calls for democratic governance rather than surveillance capitalism and related modes of oppression and control. These ideas overlap significantly, but relatively little work occupies that expansive area of intersection. For example, a growing movement in liberatory tech spaces called Design Justice (Costanza-Chock, 2018, 2020) seeks to understand how marginalized communities may lead tech design in ways that dismantle structural inequities while advancing collective liberation. Calls to decolonize libraries and offer reparations to those who are most harmed by library institutions similarly recommend that librarians relinquish control of some areas of professional practice to marginalized communities so that they are able to create reparative structures and systems (Adler, 2016; Erdede et al., 2020; Tolia-Kelly, 2019).

There is also a burgeoning literature with useful and, importantly, actionable recommendations for librarians of all kinds for addressing concerns about surveillance and the practice of librarianship, particularly with an eye toward blunting the effects of Big Data collections, and of the use of libraries. Asher (2017) provides a strong list of specific, actionable recommendations; Havelka & Lerski (2017) an especially comprehensive approach; Hess et al. (2015) a case study; and Hinchcliffe & Asher (2014) a video presentation. Some of the more salient recommendations (Doty, 2020) include:

- Allowing patrons to use opt in/opt out techniques for data collection and integration related to the use of library services
- Identifying and making explicit specific plans for the analysis and use of all data collected about patrons and their behaviors
- Development of worst-case scenarios if libraries' data about patrons is accidentally or maliciously revealed
- Records retention schedules and other explicit, specific, and actionable strategies for the timely destruction of data
- Provision of information literacy courses to libraries' constituents, especially about general practices of digital hygiene and how to identify and protect oneself from asymmetries of power, especially online
- Programs related to surveillance, intellectual autonomy and freedom, privacy, free expression, and the role of libraries in protecting information about patrons
- Solicitation of informed consent for data collection, storage, and integration
- Programs emphasizing design and implementation of usability principles for libraries' surveillance, privacy, and data statements
- Consideration of eliminating transaction-specific data that can be linked to specific patrons
- Insisting on using only those vendors and licenses that limit the sharing of data about patrons' use of copyrighted digital material, databases, and other library resources.

This list is not comprehensive, but it indicates some of the strategies that librarians could or currently use to protect information about patrons, thereby resisting the surveillant assemblage and maintaining their commitment to the highest principles of ethical and critical librarianship.

Moreover, we can say that the scholarship of surveillance technology and librarianship both possess:

- A focus on ensuring the agency of marginalized communities who are most harmed by systemic inequities and their everyday manifestations
- A willingness to de- and reconstruct places and systems so that they are rooted in non-dominant epistemic and aesthetic standpoints
- An acceptance that "building" new systems in the image of past structures can often exacerbate rather than ameliorate harms
- A recognition that major shifts both within and outside of library and technology sectors are needed in order to achieve important social, political, and intellectual goals including greater social equity and opportunity for self-realization.

Given overlap between these movements, as well as respective insights that critical library and surveillance scholars may lend to each other, we believe that more dialogue between these areas must occur if we are to achieve social liberation.

CONCLUSION

In this paper, we make connections between critical surveillance and library literature to demonstrate that surveillance tech should be of greater concern to library scholars and workers. At the same time, critical library literature may move work on surveillance beyond a too common narrow focus on digital technologies. We further argue that a dialogue between scholars and activists who work in both surveillance and library places will help ameliorate shortcomings in each domain and offer paths towards liberation in libraries and society more broadly. Although a discussion of how to build relationships among scholars, activists, and communities lies outside the scope of this paper, we point to Costanza-Chock's (2018, 2020) and D'Ignazio and Klein's (2020) works as substantive scholarship in this area. As Dillon reminds us, "information as a component of human culture warrants study by the best minds, regardless of intellectual orientations or alliances" (2012, p. 273). Further, literature on injustices within surveillance tech and libraries have key commonalities, including concerns with inequitable classification schemes; tracking; the dispelling of myths about neutral technologies and policies; deep expertise about technologies of all kinds; informed skepticism about these technologies; and engagement with politics, social values, and the primacy of human beings and our aspirations in this work.

It is clear that library literature must further explore how surveillance, and especially surveillance tech, manifests in libraries, just as critical library perspectives lend insights into more general sociotechnical work that seeks to dismantle instantiations of the surveillant assemblage, Big Data, and surveillance capitalism in our world. Future work should further explore connections between libraries and surveillance, particularly in relation to liberatory efforts. In this way, the "L" in LIS is more relevant than ever before, as library values and ethos are vital to any fight for justice within the "IS."

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Analysis of Mapping Knowledge Domains for Privacy Issues in Data Ethics Research

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ABSTRACT

This paper is based on the Web of Science database and takes advantage of CiteSpace, a scientometric software, to conduct visualization analyses. It is found that privacy issues in data ethics have reached the research peak in the past two years. The findings of this paper are that the current global research in this field is characterized by three different periods and multidisciplinary perspectives. And the hotspots of this field are relatively concentrated and gradually deepened. Besides, the research in this field has moved from the theoretical stage to the practical application stage. This paper attempts to present the scientific knowledge structure, patterns and distribution of privacy issues in data ethics, exploring the global frontier hotspots, providing inspiration and experience for Chinese academic research and industry practice in data ethics.

KEYWORDS

Data ethics; privacy; CiteSpace; mapping knowledge domains; co-citation analysis

INTRODUCTION

The application of big data technology not only gives rise to the era of artificial intelligence but also provides new development possibilities for improving human life as well as the environment. However, there are deviations between the actual development trajectory and people's expectations of big data. Moreover, the opportunities brought by big data are accompanied by serious ethical challenges. The rapid development of big data has raised many ethical issues that influence the technical level to the market and even social life. The widespread use of data in various industries also causes some ethical issues such as fairness, responsibility and respect for human rights that need to be addressed. Therefore, it is both the inevitable result of the expansion of research on data ethics in the iterative change of the big data environment and the reflection of the positive development of the data industry and the realistic needs of society.

However, the ethical inquiry of big data often includes reflection and criticism on big data technology. In the intelligence era of communication, data information is closely related to the privacy of Internet users. Thus, privacy is one of the core issues in data ethics research. In the Internet platform, users' behaviors are stored in the form of data so that the platform can analyze users' information to obtain related interests. Thus, the data ethics issue of privacy is gradually highlighted. The ethical issue of privacy exists from the perspective of information leakage and rationality of obtaining user information in the context of any technology. Especially in the present technical conditions of big data, the relationship between online users and platforms also keeps changing dynamically. Undoubtedly, with the tremendous progress of big data and the improvement of artificial intelligence technology, deeper studies of data ethics cannot be separated from the exploration of the core issue of privacy.

The research problem of this paper is that what are the past evolution, current hotspots and future frontier of the research on privacy issues in data ethics in the era of big data worldwide? To be specific, as for the research of privacy issues in data ethics, the research questions are: What is the annual distribution of published articles within recent few years? What about the cooperation in different countries and in different academic institutions? What are the repeated keywords that catch scholars' attention? What are the key articles and its disciplines, and how these key articles interact? What are the highlighted articles during a period of time, and what is the representative article among them? Finally, after answering these questions above, what reference can this paper provide for future research?

Therefore, this paper takes advantage of CiteSpace to conduct objective, systematic and quantitative research based on 5,115 related articles that are derived in the Web of Science database. The outcomes of research are used to elaborate logical evolution, frontier hotspots and classic articles through Citespace. There are main purposes of this paper. The first one is to present the scientific knowledge structure, laws and distribution of privacy issues in data ethics. The second one is to reveal the academic communication in this research field and the main members of the academic community. The third one is to explore the frontier hotspots or key concerns in this research field. The fifth

one is to provide valuable insights and references of theoretical research, practical exploration and data industry promotion for Chinese data ethics research.

About related research, Wang & Lu (2020) used Citespace to study the data related to big data in the Web of Science and CNKI database from 2008 to 2017, mainly conducting Country cooperation network analysis, keyword analysis and co-citation analysis to analyze and forecast the research hotspots and future development trends in the field of big data. Wang et al. (2020) took Web of Science core collection as the data source and used traditional statistical methods and CiteSpace software to carry out the scientometrics analysis of "Social Media Big Data", which showed the research status, hotspots and trends in this field. It can be seen that there is still no paper which focuses on research on privacy issues in data ethics. Thus, this paper can fill the research gap on privacy issues in data ethics to certain extent.

RESEARCH DESIGN

Research Methodology

This paper mainly utilizes CiteSpace, a Java-based information visualization software developed by American Professor Chaomei Chen, as a research tool for analysis. The main analysis methods include research network analysis, keyword co-occurrence analysis and article co-citation analysis which can be used to present the structure, pattern and distribution of scientific knowledge through visualization approaches. At present, Chinese scholars use CiteSpace mainly in economics, library and information science, education fields, but less in journalism and communication, digital marketing, ethics studies and other fields. Therefore, as shown in Figure 1, this paper will use CiteSpace to conduct a series of analyses on the retrieved 5,115 citing articles.

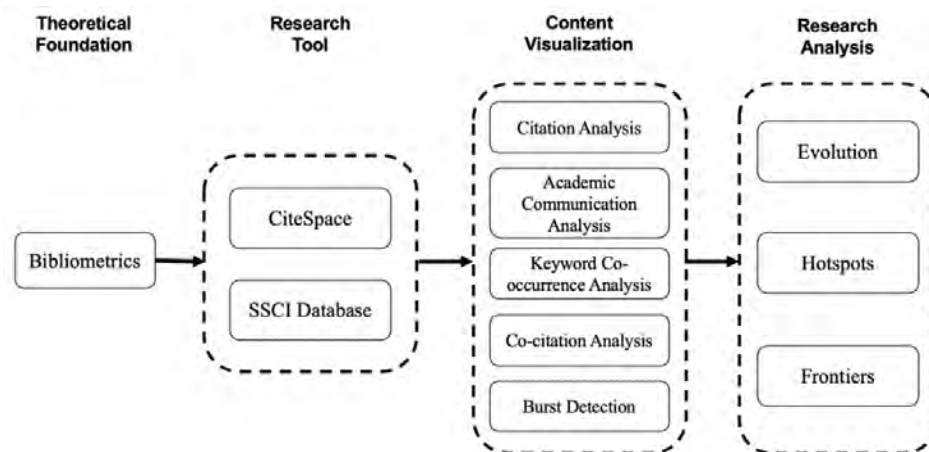


Figure 1. The research framework of this paper

Data Collection

In this paper, Web of Science (WOS) database is used as the source of the article samples. When retrieving articles, the paper selects the "SSCI" database, "Timespan = All years", "Document types = Article", then input TS = (data AND ethics AND privacy) in the advanced search. Furthermore, this paper extends 524 cited articles to 5,115 citing articles as the research samples of this paper in order to enhance the recall ratio.

VISUAL ANALYSES OF PRIVACY RESEARCH IN DATA ETHICS

Academic communication analysis

Author co-citation analysis

Author co-citation analysis, which refers to two authors who are jointly cited by other articles, is one of the best tools that used to identify prominent representative authors in a research field. This paper utilizes CiteSpace to map the author co-citation network. Table 1 shows the information of the top three authors in terms of co-citation frequency, which represent the top scholars on privacy issues in data ethics. danah boyd, Rob Kitchin and Viktor Mayer-Schonberger are the three most noteworthy scholars in this research field. Their main research fields cover data and ethics or privacy issues.

Rank	Author	Nationality	Research domain	Co-citation frequency	Betweenness centrality	First-year of co-citation
1	danah boyd	US	Algorithmic responsibility, big data, social media, internet	1357	0.12	2012
2	Rob Kitchin	UK	Human geography, urban studies, software studies	445	0.04	2015
3	Viktor Mayer-Schonberger	Austria	Big data, information governance, information economy, privacy issues	308	0.04	2014

Table 1. Three main scholars on the research of privacy issues in data ethics

danah boyd is a key author and major contributor to privacy issues in data ethics. She has been cited 1357 times, which is far more than the other scholars. In addition, she has the highest betweenness centrality of all authors and reaches the value of 0.1. According to WOS, the article Critical questions for big data has been cited 1949 times and is ranked in the top 1% of "highly cited papers" in ESI. In addition to her research on the ethical issues of big data, danah boyd also focuses on various issues faced by youth groups in new media and social media such as privacy issues. Moreover, danah boyd brought up six controversial issues on the future of big data that laid the groundwork for the study of privacy issues in data ethics. At present, she has gradually attracted more and more scholars to discuss and do research in privacy issues in data ethics from various disciplinary perspectives.

Institution cooperation network analysis

Figure 2 shows the institution cooperation network map of privacy issues in data ethics. In the network, the size of the nodes represents the number of articles published by specific institutions. The Links between the nodes are the cooperation of the institutions. As can be seen from Figure 2, the top five institutions and their number of publications are: University of Oxford, published the highest number of papers, with 108 articles; University of Toronto published 93 articles; University of Washington published 89 articles; Monash University published 60 articles; University of Sydney published 50 articles.



Figure 2. Mapping of institution cooperation network analysis

Country cooperation network analysis

Figure 3 shows the map of country cooperation network analysis on privacy issues in data ethics. The top five countries and their number of publications are: the United States published the highest number of papers, with 1,656; the UK published 793 articles; Australia published 450 articles; Canada published 408 articles; Germany published 304 papers. Besides, the betweenness centrality of the United Kingdom and the United States is 0.22 and 0.20 respectively, ranking the highest among all countries. The purple outer circle in the figure indicates that the United Kingdom and the United States are important countries in this research field and have made great contributions to the research in this field. In other words, the two countries are the main leaders in this research field.



Figure 3. Mapping of country cooperation network analysis

Keyword co-occurrence analysis

Keyword co-occurrence analysis is mainly used to reveal the research hotspots or key objects of concern in the research field. In CiteSpace, it is equal to a direct analysis of the authors' original keywords and the database's supplementary keywords, which has the advantage of intuitive results and easy to interpret. The keyword co-occurrence analysis itself is used to present the dynamic hotspot changes and knowledge structure evolution process in the research field. Based on the annual distribution of citing articles in the previous section, this paper speculates that the privacy issues in data ethics can be divided into three research stages from 2010 to 2015, 2016 to 2018 and 2019 to 2020. As can be seen from Table 2, there are two commonness of three stages. The first one is that the research scope is relatively concentrated, which "big data, ethics and privacy" are the three constant research hotspots. Another one is that the research content of each stage is gradually deepened and more in line with social issues.

Research period	Rank	Keywords	Co-occurrence frequency	Betweenness centrality	First-year of burst
Stage 1 2010~2015	1	Big data	83	0.04	2013
	2	Ethics	81	0.12	2010
	3	Privacy	65	0.04	2011
	4	Information	53	0.07	2011
	5	Informed	52	0.07	2011
Stage 2 2016~2018	1	Big data	462	0.04	2016
	2	Privacy	221	0.02	2016
	3	Ethics	190	0.01	2016
	4	Social media	186	0.02	2016
	5	Health	134	0.01	2016
Stage 3 2019~2020	1	Big data	393	0.05	2019
	2	Privacy	229	0.02	2019
	3	Ethics	217	0.01	2019
	4	Social media	200	0.04	2019
	5	Technology	194	0.01	2019

Table 2. Keyword co-occurrence analysis of the three stages

Article co-citation analysis

High co-citation frequency articles analysis

Article co-citation analysis and its cluster analysis are often used to explore the key articles and research frontiers of a research field. The cited articles are usually considered to reflect the "knowledge base" of a research field, i.e., the nodes displayed in the graph, while the citing articles represent the "research frontier" of a research field through

clustering analysis. Thus, article co-citation analysis and further cluster analysis are therefore valuable for understanding the knowledge base and research frontiers of privacy issues in data ethics.

Figure 4 shows the co-citation analysis map derived by using CiteSpace. In the following section, this paper conducts a co-citation analysis from two key article categories which are high co-citation frequency articles and high betweenness centrality articles. The top five co-citation frequency ranked articles are shown in Table 3.

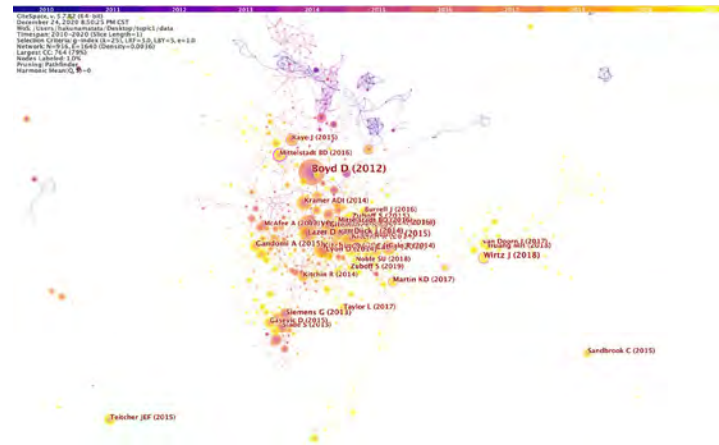


Figure 4. Mapping of co-citation analysis

boyd & Crawford (2012) pointed out that it was necessary for the public to critically question the assumptions and biases of big data in the era of big data in consideration of big data as a socio-technical phenomenon. She listed and discussed six controversial issues about big data that suggest big data is a cultural, technological and academic phenomenon built on the interplay of technology, analytics and methodology, which has sparked related debates and research hotspots in academia. This article has the highest total number of co-citations at 545.

Kitchin (2014) explored the availability of big data and how new data analytics are challenging established epistemologies in nature science, social science and humanities. He also assessed the extent to which they are producing paradigm shifts across multiple disciplines. He argued that big data and new data analytics are disruptive innovations; academic institutions should soon engage in a broader critical reflection on the epistemological implications of the unfolding data revolution. This article ranks second of co-citations number at 125.

Wirtz et al. (2018) argued that technological innovation has the potential to dramatically change the service industry. Firstly, he proposed a definition of service robots and describe their key attributes. Secondly, he examined consumer perceptions, beliefs and behaviors associated with service robots then proposed a service robot acceptance model. Thirdly, he outlined the ethical issues surrounding the provision of services by robots on the individual, market and societal levels. This article contributes to a better understanding of service robots and its potential future applications. This article ranks third of co-citations number at 108.

Rank	Co-citation frequency	Author	Year of publication	Title of articles	Source journals	Disciplines
1	545	danah boyd	2012	Critical questions for big data	Information Communication & Society	Information Science, Communication Studies
2	125	Rob Kitchin	2014	Big Data, new epistemologies and paradigm shifts	Big Data & Society	Information Science, Sociology
3	108	Jochen Wirtz	2018	Brave new world: Service robots in the frontline	Journal of Service Management	Management
4	77	David Lazer	2014	The parable of google flu: traps in big data analysis	Science	Information Science
5	72	George Siemens	2013	Learning analytics: the emergence of a discipline	American Behavioral Scientist	Psychology

Table 3. Top five articles in terms of total co-citation frequency

Analysis of high betweenness centrality articles

The clusters in CiteSpace represent the most prominent fields of research common to a number of related citations and are often used to present the structure of knowledge in a discipline or field. In the cluster map, the larger the cluster size, the smaller the number, generally starting from 0 (the map also uses "#" to mark the cluster name); the larger the cluster module, the more articles the cluster contains; the cluster color represents the average year of first publication of all the articles in the cluster; modularity takes the value $Q = [0,1]$; silhouette is used to measure the network homogeneity of clustering, taking the value $S = [0,1]$. In general, when $S=0.7$, the clustering results have the highest confidence. Compared with high co-citation frequency articles, high betweenness centrality articles are not only a significant contribution to existing disciplines or fields but also a key article for creating and advancing new disciplines or fields.

As shown in Figure 5, this paper clusters the obtained co-citation analysis maps then conducts several clusters. The result shows that $Q=0.7762$, which is much larger than 0.3, indicates that the clustering is very significant; $S=0.8954$, which is closer to 0.7, indicating a high confidence level. As shown in Table 4, for the privacy issues in data ethics, the top five clusters are social justice, algorithmic model, big data, ethical consideration, and service robot. The top five clusters are #social justice, #algorithmic model, #big data, #ethical consideration and #service robot, indicating that the current research frontiers in this field focus first on analyzing and addressing social justice issues arising from ethical issues of big data, and then on the technology itself, ethical issues and the application and practice of big data. In fact, Critical questions for big data, the most frequently cited article with a betweenness centrality of 0.11, is the turning point article that contributes significantly to #social justice. It helped #social justice become the first major cluster, as it started from #ethical considerations which argued that the public needs to look critically at big data. Furthermore, boyd & Crawford (2012) discussed six controversial topics about big data, which triggered the discussion and research from #ethical considerations to #social justice in academia.

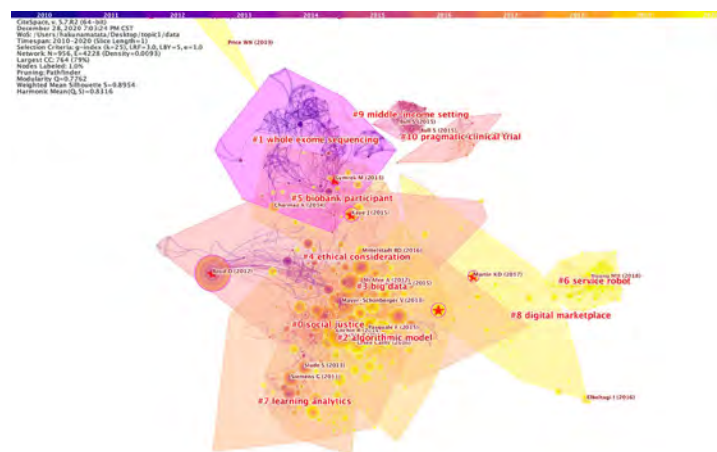


Figure 5. Cluster map based on co-citation analysis

Rank	Clusters	The number of articles	Silhouette	Average year of publication
1	#Social justice	159	0.759	2014
2	#Algorithmic model	86	0.846	2015
3	#Big data	77	0.907	2014
4	#Ethical consideration	74	0.925	2012
5	#Service robot	55	0.975	2018

Table 4. Information on the top five clusters

This paper also showed that in addition to #social justice cluster, #digital marketplace cluster is the one that is involved in the greatest number of turning point (3 times). From figure 5 we can know that #digital marketplace serves as a bridge between the theoretical clusters #social justice, #algorithmic models, #big data and #ethical considerations on the left and #service robots on the right. Therefore, this is why #digital marketplace has been addressed several times. On another hand, the cluster color represents the average time of the first publication of the article in the clusters.

There are five articles with purple outer circles in Figure 5, indicating that the betweenness centrality of these articles is greater than 0.1 and serve as the turning point. Table 5 lists the top ten articles in terms of betweenness centrality. The articles, as turning points, with high betweenness centrality all connect two clusters respectively, which means they connect two different research fields.

Acquisti, Brandimarte & Loewenstein (2015) summarized the connections between the different schools of empirical research on privacy behavior and presented insights on the role of public policy in protecting privacy in the information age. He used three themes to connect insights from the social and behavioral sciences: first, people's uncertainty about the consequences of privacy-related behaviors and their own preferences for these consequences; second, people's concern for privacy or lack of contextual dependence; finally, the extent to which privacy concerns are shaped by commercial and governmental interests. This article has the highest betweenness centrality and serves as an important turning point linking the two research fields of #8 digital marketplace, where the article is clustered, and #6 service robot. It can be argued that the beginning of research in the service robot field was strongly influenced by the digital marketplace field. Besides, His paper was the turning point for the main research in the service robot field.

Martin & Murphy (2017) described the current state of privacy research in marketing and related disciplines. She reviewed theoretical perspectives and empirical findings on data and information privacy as well as argued that future relevant research should be conducted using a multidimensional approach because of the multiplicity of related issues that characterize contemporary privacy issues in marketing. Relevant research in this field remains critical and necessary because internal and external stakeholders are subject to multiple potentially unforeseen effects of data privacy issues. This article serves as an important turning point linking the two research fields of #8 digital marketplace, where the article is clustered, and #3 big data.

The article Critical questions for big data has been described in detail above. This article serves as an important turning point linking the two main fields of #4 ethical consideration, where the article is clustered, and #0 social justice.

Kaye et al. (2015) combined biomedical research with the use of data in information technology to break away from the static, paper-based mechanisms of informed consent. She proposed a new approach to consent, known as dynamic consent (DC), which had been developed primarily in the context of biobanking. This article serves as an important turning point linking the two research fields of #5 biobank participant and #8 digital marketplace.

Mittelstadt, Allo, Taddeo, Wachter & Floridi (2016) explained that the gap between the design level and the operational level of algorithms and the differences in human understanding of their ethical implications can lead to serious consequences that affect individuals, groups and the whole society. This paper serves as an important turning point linking the research fields of #2 algorithmic model, where the article is clustered, and #0 social justice.

Rank	Betweenness centrality	Author	Year of Publishment	Title of article	Source journal	Disciplines
1	0.18	Alessandro Acquisti	2015	Privacy and human behavior in the age of information	Science	Information Science,
2	0.14	Kelly D. Martin	2017	The role of data privacy in marketing	Journal of the Academy of Marketing Science	Information Science
3	0.11	danah boyd	2012	Critical questions for big data	Information communication & society	Management
4	0.11	Jane Kaye	2015	Dynamic consent: a patient interface for twenty-first century research networks	European Journal of Human Genetics	Information Science
5	0.10	Brent D. Mittelstadt	2016	The ethics of algorithms: Mapping the debate	Big Data & Society	Information Science

Table 5. Top five ranked articles in terms of total co-citation betweenness centrality

Burst detection

In addition to co-citation analysis, burst detection is another way to identify research frontiers in a particular field. When analyzing research frontiers, the burst strength of an article indicates the emergence of the citing article in a selected period of time. Specifically, the burst strength means that the co-citation frequency of an article in the

network changes significantly in a short period of time. Generally, this change implies that the article becomes a research hotspot in the period of its burst. Table 6 provides information on the top five articles ranked in terms of burst strength.

The two articles written by danah boyd and George Siemens have been elaborated above and therefore will not be repeated to discuss here.

Zimmer (2010) presented a case study of a Facebook profile data privacy risk incident at a university in the US in 2008. He addressed a number of ethical issues that must be addressed in the future development of social networking sites, including "the Nature of Consent", how to properly identify and respect the privacy expectations of social networks, strategies for anonymizing data before it is publicly released and how experts should conduct research projects based on data collected from social media.

According to McAfee & Brynjolfsson (2012), big data would be as fundamental a resource in the operation of the economy as land, oil, and capital in the future. It has been estimated that data is growing at a rate of more than 50% per year, which means that every twenty months or so, the world's data will double. Data can generate value because information is reflected behind the data. Big data will set off a management revolution that will have a major impact on the business, academic and political worlds.

Rank	Burst strength	Author	Title of article	Year of publishment	Begin year of burst	Finish year of burst
1	165.33	danah boyd	Critical questions for big data	2012	2014	2017
2	24.09	Michael Zimmer	"But the data is already public": on the ethics of research in Facebook	2010	2012	2015
3	15.55	Andrew McAfee	Big data: the management revolution	2012	2015	2017
4	14.24	Hsinchun Chen	Business intelligence and analytics: from big data to big impact	2012	2015	2017
5	11.28	George Siemens	Learning analytics: the emergence of a discipline	2013	2014	2018

Table 6. Top five article in terms of burst strength of total citation

Taking the article Critical questions for big data as an example, this article was published in 2012 and started bursting in 2014 then ended bursting in 2017. The article lasted for about 4 years with a burst strength of 165.33, which is much larger than several other articles. It indicates that there was a steep and large increase in its total co-citation frequency between 2014 and 2017. In figure 6, we can see a steep increase from 2014 to 2017, which indicates that a strong burst of the article occurred during this period. Combined with the co-citation analysis in the previous section, this paper believes that this development is because the article Critical questions for big data started from the #ethical consideration. In addition, it also inspired the research enthusiasm of scholars on #social justice. In short, this paper was at the bedding period before 2014 and was at the forefront period from 2014 to 2017.

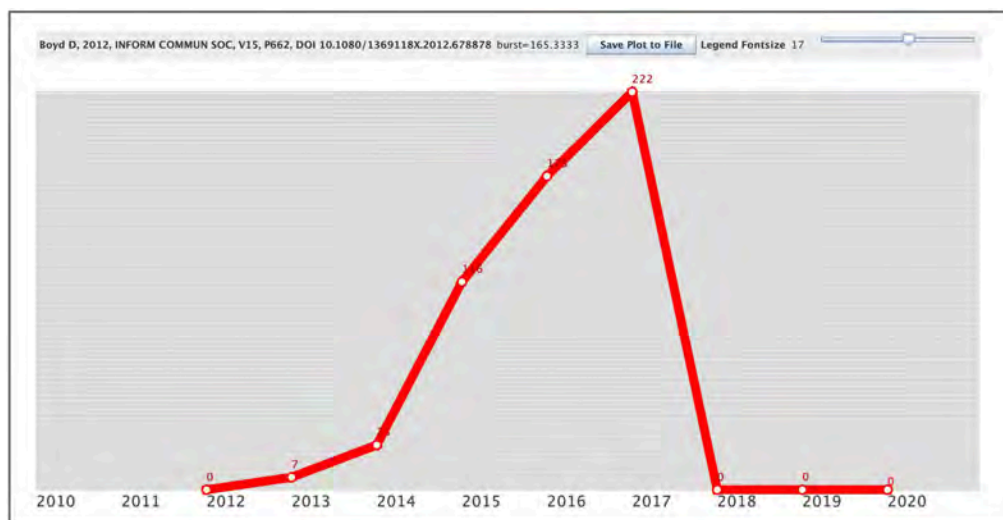


Figure 6. Annual citations distribution of the article Critical questions for big data

CONCLUSION

The evolution of research: three stages

Based on the articles selected from the Web of Science database on advanced research of topics "TS=(data AND ethics AND privacy)" within the Archives of Social Science Citation Index (SSCI), the research development about privacy issues in data ethics can be divided into three stages. The first stage was from 2010 to 2015. During this stage, scholars generally tried to understand, analyze and summarize some specific research topics from the perspective of information science and sociology. The second stage was from 2016 to 2018. Scholars with a full understanding of big data begin to explore the feasibility of applying big data in many fields. The third stage was from 2019 to 2020. With the rapid development of the mobile internet and the impact of the Covid-19, people were forced to learn and work from home so that the digital economy had entered an unprecedented "leap development". Moreover, the average number of articles published in this period is nearly 100 per year.

Disciplinary perspective: coexistence of multiple disciplines

This paper conducts cluster analysis to show the knowledge structure of privacy issues in data ethics. Moreover, this paper identifies and summarizes the specific disciplines involved in this research field from top-ranked articles in terms of total co-citation frequency and total co-citation betweenness centrality. From the perspective of disciplines, articles are from information science, sociology, communication, psychology, management, law and other disciplines. As a whole, they carried out multidisciplinary, interdisciplinary and cross-disciplinary research on the privacy issues in data ethics. At the same time, the fact also reflects that privacy issues in data ethics have attracted the attention and research of different scholars from different disciplinary fields. Therefore, the study of privacy issues in data ethics needs not only to sort out the key issues from information science and social science but also to use psychology and management science to analyze individuals and social groups as well as to combine with marketing science to explore further applications.

As a consequence, the research on privacy issues in data ethics has two major characteristics. One is that the whole research can be divided into three stages. Another is that academia has cut through multiple disciplinary perspectives to conduct comprehensive discussions and studies.

Research focus: relatively concentrated, gradually deepened

As for privacy issues in data ethics, the three stages of research have some common characteristics and relatively concentrated on certain scopes. For example, the first three keywords with the highest frequency are "big data", "ethics" and "privacy". Separately, the research content in each stage has been gradually deepened. In the first stage, the co-occurrence network of keywords was relatively sparse. The academia firstly focused on "ethics" in 2010, then on "privacy, information and informed consent" and finally in 2013 did they start to focus on "big data". This does not affect the fact that big data is the most frequent co-occurrence keyword in this stage. It means that big data serves as a core notion in the research of scholars during three stages. Next, the research mushroomed in the second stage. "Social media" and "health" had replaced the previous two keywords, reflecting that scholars had started to pay attention to the privacy issues in data ethics in specific scenarios such as social media and biomedical field. It could be regarded as a big step from theoretical studies to practical applications. The third stage was similar to the second stage, but "technology" replaced "health" due to the "leap development" of emerging technologies from 2019 to 2020 and the influence of Covid-19. It led to an increasing contact frequency of technologies in people's lives, while it also brought about new privacy issues. Hence, there were more and more scholars joining in the research of privacy issues.

In summary, "big data", "ethics" and "privacy" were the three major research keywords among scholars from 2010 to 2020, which created a solid network of keywords in the map of CiteSpace. In addition to these three keywords, new hotspots had emerged at different stages to replace the previous ones. The hotspots had changed with the depth of related research and social conditions.

"Digital marketplace": a bridge between theory and practice

The most popular keyword is "social justice", followed by "algorithmic model", "big data", "ethical consideration" and "service robots". This suggests that the current research frontier focuses firstly on analyzing and addressing social justice issues arising from the ethical problems of big data. Then scholars discuss the issues of technology itself, ethical issues and the application of big data. From the perspective of betweenness centrality, the first five articles serve as turning points connecting five different clusters. Among these five articles, the article Critical questions for big data contributes significantly to the formation of existing clusters; Alessandro Acquisti and Kelly D. Martin's articles, the top two in terms of betweenness centrality, have constructed "digital marketplace" as a bridge between theoretical clusters and practical clusters. In details, this bridge converts the occasion that scholars were focusing on exploring and addressing privacy issues in data ethics at the theoretical level from 2012 to 2016 to the occasion that scholars tried to identify and address privacy issues through the practical applications of big data.

In particular, this conversion inspired scholars to do further research on "digital marketplace" and "service robot" for the most part. It led to the transition from the first stage to the second stage and the third stage in the end.

Consequently, it can be found that the research presents an evolutionary logic from theoretical to practical. The "digital market" serves as a bridge between theoretical clusters and practical clusters.

RESEARCH TREND

First, from the data perspective, the article Critical questions for big data and other articles mentioned above are among the highly cited papers in Web of Science. It indicates that articles with high co-citation frequency contribute a lot to the privacy issues in data ethics, which implies that these articles are the frontier of the research field.

In addition, this paper generated the top thirty articles in CiteSpace in terms of burst strength and ranked them in terms of the burst starting time. This paper found that the burst in the first stage usually lasted for 3~4 years, while the burst in the second stage usually lasted for 1 to 2 years, but no burst has yet occurred in the third stage. The main reason is that, on the one hand, the research in the first stage is biased toward problem identification and theoretical discussion of big data, ethical issues and privacy issues etc. The research outcomes in this stage can provide a solid theoretical foundation and potential research directions for later scholars for a longer period of time. For example, Zimmer (2010) brought about some ethical privacy issues that needed to solve urgently in the development of future social network site. On the other hand, with the development of new technologies and the rapid progress of society, the speed of technological updates and iterations is getting faster and faster, which brings about more and more ethical issues. In order to adapt to such changes and keep up with the research trends, scholars constantly do lots of new research. Therefore, the duration of burst of key articles lasts less and less. This paper predicts that the burst of the third stage, from 2019 to 2020, will follow the previous trend, i.e., the duration of the burst will become shorter and shorter. The duration of the burst of most articles will be within 1 year.

LIMITATIONS AND IMPLICATIONS

Despite the conclusion above, there are also some limitations in this paper. First, in sample selection part, the research data are only from the literatures in the core journal database Web of Science. Thus, in the future, comparative studies can be carried out in combination with Chinese databases to enrich the data sources. Second, although CiteSpace has certain advantages in quantitative, objective and visual analysis, this paper focuses on the outline elaboration of privacy issues in data ethics. Therefore, subsequent studies can conduct qualitative analysis to enrich the research topics and explore the deeper meaning hidden behind the data.

This paper is a visual analysis and summary of the research on privacy issues in data ethics from 2010 to 2020. The results of this paper indicate that, first of all, the research development can be divided into three stages. However, in the case of the burst in the number of papers published by scholars in the past three years, there is no obvious burst article in this time. It demonstrates that the theoretical foundation of privacy issues in data ethics is very solid and profound. Second, co-citation analysis, cluster analysis and burst detection jointly presented the research hotspots. It can confirm that the privacy issues in data ethics is not only information science discussion and social issues, but a dissection in three main parts, which are individual, industry and government based on a multidisciplinary perspective. However, most of related articles start from a macro perspective of the industry and have a strong sense of commercialization, while there are few articles related to the privacy issues of individual citizens. Finally, the Covid-19 background accelerates the development of information age, so that the future research trend is easy to recognize. boyd and other scholars have laid a solid theoretical foundation for the future practical research. It also reminds the later researchers should pay more attention to the evolution and early theoretical basis of privacy issues in data ethics when they conduct related research.

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“Can You Search for Me?”: Understanding and Improving User-System Dialogues for Complex Search Tasks.

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ABSTRACT

Most voice-based personal assistants are suitable for simple tasks which are not conversational but single-turn question-answering. To address this limitation, we investigate the dialogue capabilities of commercial conversational systems and compare them to the standards expected by the users. We designed a set of moderately complex search tasks and used two popular personal assistants to evaluate the user-system interaction. A laboratory-based user study was conducted with twenty-five users and seventy-five search sessions to collect user-system conversational dialogues (for three search tasks). Next, we show that using a set of simple rules, which could be implemented in the immediate future, it is possible to improve the users' interaction experience and make the system more anthropomorphic. Using a conceptual prototype where a human (Wizard) played the role of the system (unknowing to the users), we demonstrate the efficacy of the guidelines and provide design recommendations for future conversational search systems.

KEYWORDS

Conversational Search Systems; Information-seeking Dialogues; Discourse; Spoken Search; Voice-based Personal Assistants.

INTRODUCTION

Searching is an act of problem-solving where the information seekers state their problem to the intermediary, and the intermediary retrieves relevant documents or information to resolve the information problem. While technology has optimized the knowledge resource for fast and efficient access, newer and more efficient ranking algorithms have been developed to evaluate the relevance of documents. Also, research in human-computer interaction has explored the design of user interfaces to make them more helpful, easy to use, and friendlier. Attempts have also been made to improve the communication aspects (system responses, reactions, and feedback) to facilitate user-intermediary interaction.

In a traditional query-response-based information retrieval (IR) system, the system is responsible for knowledge representation, organization, and retrieval. At the same time, the user formulates the problem, represents it using formal queries, and evaluates the retrieved information (Figure 1). A browser-based search interface allows a textbox for entering the query, and despite many improvements over the last decade, it is not ideal for the following situations:

1. The user is unsure of what his information problem is and cannot explain it using the exact set of query terms (Belkin, 1980);
2. The user wants to explain the context for the search task for more relevant results; and
3. The search is being conducted using a mobile device or as a secondary activity (with another ongoing primary activity like cooking, driving, working out).

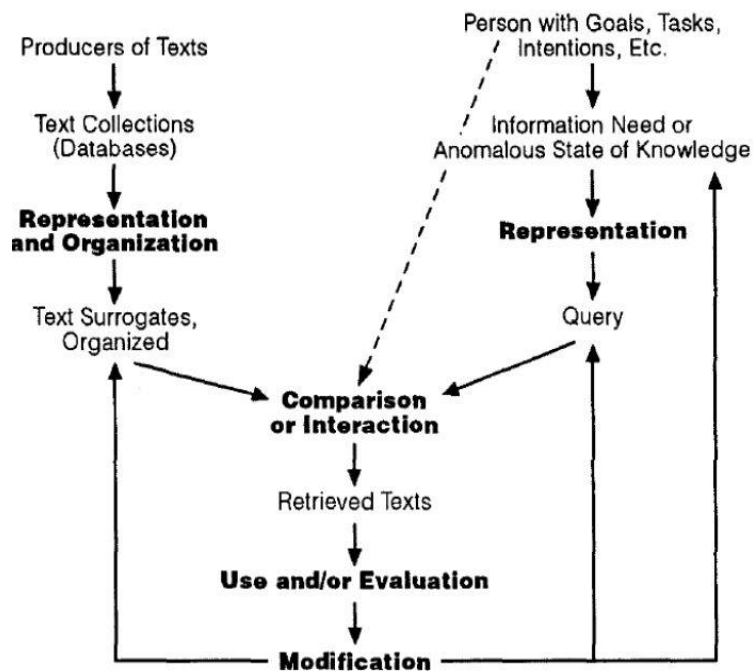


Figure 1. Structure of an IR System (Belkin and Croft, 1992)

The popular, commercially available, voice-based personal assistants perform satisfactorily for simple search tasks. For example, if one asks factoid questions, like, “Who is the President of the United States?” or “What is 90 Fahrenheit in Celsius?”, the system responds with the right answer. However, such interactions are not conversational but single-turn question-answering. The popularity of personal assistants can be attributed to their ability to perform simple tasks like setting reminders or alarms (e.g., “[Name], set a timer for [15 minutes]”, “[Name], what time is it?”), playing music (e.g., “[Name], play music for [mood].”), reporting weather updates (e.g., “[Name], will it [rain] [today]?”), and messaging or calling a contact (e.g., “[Name], call [contact name]”, “[Name], send [contact name] a message.”) (Ali, 2018; 99firms, n.d.). As is shown in the examples, all these tasks can be performed using voice commands without typing (hands-free) or looking at the screen (eyes-free). Therefore, the user can multitask (Ghosh, 2019; Guy, 2016; Frummet et al., 2019) with the user-system interaction as a secondary activity.

Despite all the affordances provided by conversational systems, they are not search-oriented and should not be perceived as such. A conversational search system—cognitively more complex than the widely available commercial personal assistants—should maintain long, multi-turn conversations, perform complex search tasks, and allow the user to explore the search space. The system should also stay on-topic (relevance), consider short and long-term context, and be useful.

While conversational search systems are still in the nascent stage, they can remedy the limitations of browser-based search systems. As the users can explain their information problem in natural language—and are no longer constrained by the search box—they do not need to formulate the query terms. Representing information using query terms is not only difficult for the users at the early stages of an information-seeking episode, but it is also harder for the system (or intermediary) to build enough context using the query terms (or keywords) alone. An interactive search environment—as in conversational systems—allows multiple rounds of query reformulation and result presentation to suit the user’s needs. As the search process is dynamic and the user’s states of knowledge and information needs keep evolving, the interactivity offered is vital for search success (Brooks & Belkin, 1983). An ideal conversational system should be capable of emulating human-human interactions in a human-system scenario. Spoken conversation is the standard and preferred way of exchanging information and communicating between two humans. Therefore, when our knowledge is anomalous, and information needs are evolving, spoken dialogues should be the natural way of expressing ourselves. For human-human conversations, co-presence is also essential, as it allows para-linguistic and nonverbal communication to occur, invoking senses other than hearing (in verbal communication). The conversation between a librarian and a patron is an example of how information systems should interact with the user if required technology support is available.

Recent technological advancements have made it possible to automatically recognize human speech (with reasonable accuracy) and generate audio responses (in human-like voice). However, a human-human conversation is more than listening and speaking. Humans combine context with conversational principles (Tannen, 2005) to automatically correct wrong utterances, understand implications (Grice, 1989), and express emotions (Brave and Nass, 2009). While human-like conversational systems are significantly more complicated, they are a solution to the existing problems in information retrieval. Also, the use cases of spoken conversational search systems include but are not limited to people with visual impairments (Sahib et al., 2012; Guy, 2016), dyslexia (Klemmer et al., 2000), or limited literacy skills (Trippas, 2015). Open-domain conversational systems have also been used to help individuals—both adults and children—with stress, anxiety, depression, and trauma (Winata et al., 2017). The applications can be extended beyond medical domain to social situations as well. Clavel and Callejas (2015) and Ring et al. (2013) explored how such systems could engage in conversations with active adults and help them avoid isolation. Therefore, it can be argued that research in conversational systems is both essential and timely as they can be deployed in social situations, medical domains, and personal lives of users.

In this work, we investigate the dialogue capabilities present in existing commercial conversational systems and compare them to the expected standards. We designed a set of search tasks that were moderately complex and required multiple rounds of context building and dialogue between the user and the system. Next, we used two popular personal assistants and evaluated their interaction with the users. We conducted a laboratory-based user study with twenty-five users and seventy-five search sessions to collect user-system conversational dialogues (for the given search tasks). We hypothesized that by using a set of simple rules (or guidelines)—based on human-human conversations—it is possible to make the system more anthropomorphic and thereby improve the users' interaction experience. Therefore, we designed a Wizard-of-Oz study to test the performance of a conceptual prototype for the same search tasks. We compare the conversational and behavioral patterns visible in the user-wizard interaction to those of the existing systems. By analyzing the search dialogues and the exit interviews, we demonstrate that many usability problems could be alleviated by using the guidelines. Finally, we provide some recommendations based on the interviews, which should improve the user experience with future conversational search systems.

LITERATURE REVIEW

Dialogues are an essential aspect of human life and the most typical way of exchanging information. Since its early days, various researchers in the information science community have acknowledged the shortcomings of browser-based systems and proposed dialogue-based retrieval systems as a possible solution (Oddy, 1977; Sitter & Stein, 1992; Stein & Maier, 1995). Winograd et al. (1986) modeled information-seeking dialogues as a network with two participants (the user and the system). Each node in this network represented a dialogue state, and each action by the user (or system) helped transition from one state to another. This theoretical model—also known as the Conversation for Action (CfA) model—used the philosophy of language to simulate any conversation. The author also highlighted that the meaning of each utterance is not isolated but socially constructed and interpreted in context by the conversational partner. In other words, the behavioral expectations of the participants controlled the transition between states and the actions performed by the searcher and the intermediary.

A later model, called the Conversational Roles (COR) model (Figure 2), was proposed by Sitter and Stein (1996), which analyzes generic dialogue scenarios and extends the CfA model described earlier. The COR model focuses on the intention of the participants and devises a dialogue plan for the searchers to navigate the search space through dialogues. In separate work, Belkin et al. (1995) used case-based reasoning (CBR) (Riesbeck & Schank, 1991; Schank et al., 1994) to explain the human-system interaction present in an interactive information retrieval (IIR) system. The information-seeking strategies proposed by the authors (Belkin et al., 1995) use example scripts to understand, model, and optimize the interactions between the searcher and the intermediary. Various researchers (Daniels et al., 1985; Radford, 2006) have also looked at the interpersonal nature of communication in human-human information-seeking dialogues. Daniels et al. (1985) proposed a hierarchical structure of goals and problems to explain how they form the focal point of information-seeking dialogues and can be leveraged to guide the user during the search process. Radford (2006) explored chat reference transcripts to identify the interpersonal dimensions that facilitated or hindered librarian-patron communication.

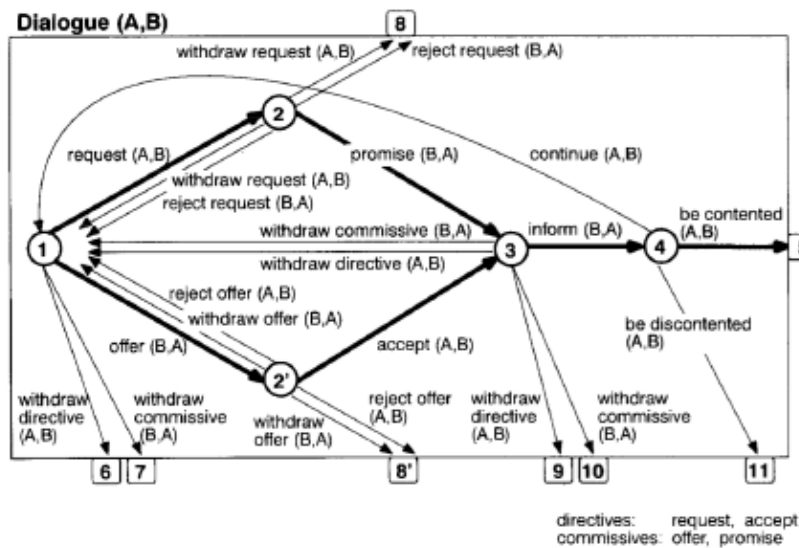


Figure 2. Conversational Roles (COR) Model (Sitter and Stein, 1996)

In addition to the interaction strategies discussed above, research in philosophy, communication, and discourse looked at various factors essential for effective communication. While a comprehensive analysis is beyond the scope of this work, the concepts of conversational implicature (Grice, 1989), grounding (Clark and Schaefer, 1989), and affect (Brave and Nass, 2009; Maslow et al., 1943) are of particular importance to conversational systems. Grice (1989) proposed a theory to explain and predict hidden meanings in conversation. An implicature is an act where the speaker means (or implies) one thing but says things that are entirely different. The use of different figures of speech—irony, sarcasm, hedged negation, hyperbole, metaphor—is a stylistic and pragmatic aspect of human conversation. Grice suggested using the cooperative principle (the four maxims of quality, quantity, relation, and manner) to understand implicatures. In a similar vein, Clark and Schaefer (1989) defined conversation as a “collaborative action” where the participants establish common grounds. Grounding in mediated conversation (as in human-system interaction) can be facilitated through clarifying questions and is essential to reduce the user effort. Finally, human conversations are functional and affective in nature. Therefore, we must also consider the hierarchy of human needs (Maslow et al., 1943), as shown in Figure 3. The need pyramid demonstrates the order in which humans prioritize needs. An artificially intelligent being, like conversational systems, must be designed to differentiate between different levels of user emergency and provide proper support to address the need. For example, when the users are threatened by physiological needs (like food, water, shelter) or safety needs (like medical emergency or law enforcement situations), the agent must call for human help (emergency services, emergency contact). Higher-order needs—love needs, self-esteem, and self-actualization—should also be addressed to increase user satisfaction and the likelihood of resuing the agent in the future. These needs could include psychological support through active listening, respecting the cultural and conversational protocols, and upholding the user’s self-esteem.

Although the frameworks proposed in the early 1990s are still valid for spoken search, the recent popularity of conversational systems calls for revisiting the user-system dialogue patterns. Recently, some research works (Azzopardi et al., 2018; Trippas et al., 2017; Vakulenko et al., 2017) suggested preliminary frameworks to explore the connection between user utterances and search actions. Without reinventing the wheels, we investigate the dialogue patterns observed in popular voice-based personal assistants. First, we highlight the deficiency of the existing systems using the communication paradigms and need hierarchy. Next, the suggested guidelines were implemented in the user study (prototypical system) to observe user interactions. Lastly, we use the user study data to compare and recommend interaction patterns for future systems.

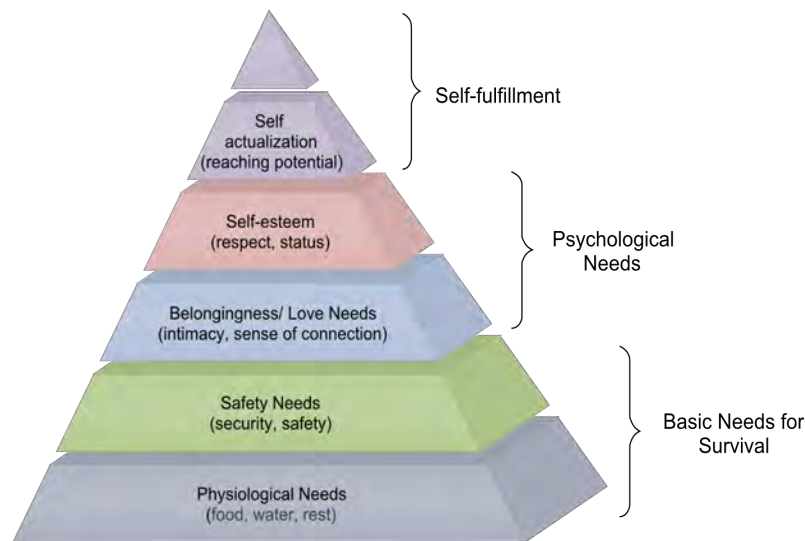


Figure 3. Maslow's Hierarchy of Human Needs

METHODS

This section explains our methodology for this research, which includes the task development and the experimental procedure.

Search Tasks

Simple tasks can be completed in a single turn and do not lead to a conversation. Therefore, to explore the dialogue patterns in commercial voice-based personal assistants, we needed to design a set of tasks that were not simple. According to Borlund (2000, 2002), if the users are placed in a real-life search situation—with a backstory and an accompanying search task—they exhibit naturalistic search behavior. We created three pairs of backstories and search tasks for the users. The backstory created an information problem with a search context. Although the search task and the backstory are constant for every user, the task description did not explain how to search. Therefore, the users interpreted the situation based on their own personal, social, and cultural backgrounds.

We developed three search situations that satisfied the properties of real-life search tasks highlighted by Borlund (2003) and White et al. (2006):

- realistic enough for the user to relate;
- interesting for the user to become curious; and
- imaginative and yet, open-ended for the user to interpret in his way.

Our tasks, which simulated naturalistic search behavior among experimental subjects, were adopted using the Taxonomy of Learning (Bloom et al., 1956). The taxonomy consists of six different levels—Remember, Understand, Apply, Analyze, Evaluate, and Create—in increasing order of complexity. We closely followed the literature (White et al., 2006; Kelly et al., 2015; Byström & Järvelin, 1995; Wildemuth & Freund, 2012) to develop the three search tasks (as explained in Table 1). Task 1 required the users to find a sequence of factual information related to a health topic, while Tasks 2 and 3 required the users to compile a list of recommendations. The users were required to write down their findings at the end of the tasks.

Searching with the Prototype (Wizard of Oz)

We designed a laboratory-based, controlled user study to collect user-system interaction data for a futuristic system. Our goal was to collect interaction data that satisfied two parameters:

- The collected data should give insights into expected dialogue capabilities from future systems; and
- The conceptual prototype should not be too cognitively complex to implement in a few years.

Tasks with Backstory

Task 1 (Level: Remember and Understanding)

It is May, and you are in North America. You have been sneezing every morning and have red, watery eyes. Investigate the following: (1) What could be the cause of that? (2) Medicines and/or Home remedies. In a few lines, state your findings.

Mental Activities: Identify, Compile.

Target Outcomes: Fact, List.

Task 2 (Level: Analyze and Evaluate)

You are a researcher planning to submit your first paper in one of the top conferences in Artificial Intelligence and/or Natural Language Processing. However, you are not sure which conference would be the best option for you. To finalize the conference, you may want to consider the following factors: (1) Are you interested in Artificial intelligence or Natural Language Processing? Or both? (2) Writing the paper takes time. Are you looking for early- or late- 2020? (3) The location could be: North America, Europe, Asia. Which one would you prefer? Once you have made the decision, write about the choices which you made and which conference you picked, and why (in brief)

Mental Activities: Compile, Describe, Compare, Decide.

Target Outcomes: List, Recommendation.

Task 3 (Level: Analyze and Evaluate)

You want to gift perfume to your dad for Christmas. You know that your dad loves the smell of Bergamot in perfumes. To decide, you may consider (1) Bergamot as one of the notes (scents) in the perfume. (2) How much you want to spend (for example, you may want a perfume under 100 USD, but your budget allows you to go as high as 150 USD) (3) You may add any seasonal preference. Once you have made the decision, write about the choices which you made, and which perfume you picked, and why (in a few lines)

Mental Activities: Compile, Describe, Compare, Decide.

Target Outcomes: List, Recommendation.

Table 1. Search Tasks with Backstories and Target Outcomes (Ghosh, 2020)

Due to limitations in available technology, existing conversational systems have limited cognition and are incapable of supporting long conversations or complex search tasks. Therefore, we used a human Wizard to simulate the role of the search system. This approach is popular in human-computer interaction research, where a conceptual prototype is tested using human Wizards before implementation. However, as noted in prior user studies (Thomas et al., 2017; Trippas et al., 2018), revealing the human nature of intermediary leads to human-human search dialogues, which are different from human-system conversations. Since such conversations are cognitively more complex, it is hard to replicate them in a system. In our study, we concealed the Wizard's human nature from the users to collect more realistic dialogues. The users assumed that they were interacting with a prototypical system (called Joanna), and therefore, the information-seeking conversation was more human-system than human-human.

The study involved twenty-six participants: twenty-five users and one Wizard. There were 20 females and five male participants who played the role of the searcher (or user). The mean and median ages of our users were 21.64 and 21, respectively. The maximum age among the users was 29, while the minimum age was 19. The Wizard was male and an experienced searcher. He also identified himself as a native speaker of English. Twenty-two users reported themselves as native English speakers, while the remaining three identified Greek, Hindi, and Gujarati, respectively, as their first languages. The users were asked to rate their English speaking and listening skills (which were essential for our study) and search skills on a 5-point Likert scale. Based on the self-reported scores, where one represented *Novice* and five represented *Expert*, the mean scores for English speaking and listening were 4.8 and 4.92, respectively. The users also reported a mean score of 4.6 in online web search skills. Two users never used voice search before, while six users used five or more voice searches per week. The users self-assigned a mean score of 3.2 to rate their success when interacting with voice-based assistants (where 1 = Low and 5 = High).

The user and the system (Wizard) were located in two different rooms, and the only mode of interaction was over a voice channel. The user had access to the backstories and had to talk to the system to solve the information problem. The Wizard not only searched for the information but also maintained a dialogue with the user to learn more about

the context of the search and preferences of the user. All responses from the Wizard were typed in and converted to speech using Amazon Polly (<https://aws.amazon.com/polly/>), a text-to-speech software. The users were given twenty minutes to search and write their findings for each search task. We also conducted brief interviews at the end of the study to evaluate the overall experience of the users.

Rules of Interaction

The human Wizard was instructed to behave like a system with low cognition levels, that is, not too futuristic. We formulated the following set of rules for the Wizard:

- **Rule 1:** If the user begins the conversation with “Hi, Joanna,” acknowledge by responding with “Hi, I am Joanna, how may I help you today?”.
- **Rule 2:** Every time the user asks something, acknowledge and ask him to wait.
- **Rule 3:** Do not cut off the user. If the user frames a long, complex question that is hard to understand, the system should respond with “Can you please restate the question?”
- **Rule 4:** No response should be longer than four sentences or 50 words, whichever is lower. No need to count; just an estimate is sufficient.
- **Rule 5:** A faster response is preferable to a more detailed one.
- **Rule 6:** Always end the search sessions with “It is always great talking to you, bye!”

Searching with Personal Assistants

It was essential to evaluate the existing commercial voice-based personal assistants and investigate their dialogue capabilities for non-factoid information-seeking tasks. We used Amazon Alexa (<https://developer.amazon.com/en-US/alexa>) and Google Voice Assistant (<https://assistant.google.com/>) to accomplish the search tasks developed before. First, we used Google Voice Assistant for the tasks mentioned earlier. We had to make sure that the assistant was set for long, contextual conversations. Therefore, in the settings, we turned on ‘*spoken results*’ and ‘*use text from the screen*’ (to prioritize reading out results than displaying them). Additionally, ‘*continued conversation*’ was turned on to allow follow-up questions, and the ‘*speech output*’ was set to ‘*full*’ to make the system more conversational. For Amazon Alexa, we turned on the ‘*follow-up mode*’ and turned off the ‘*brief mode*.’ The user issued voice commands to both Google Voice Assistant and Amazon Alexa for all three tasks (in separate search sessions). The spoken interaction between the user and the system was recorded and transcribed for analysis.

SYSTEM-LEVEL OBSERVATIONS

In this section, we report our observations about the systems and compare them across different themes. The dialogue transcripts in the examples have been altered to include punctuations and placeholders to make them more readable.

Cuts off the user for long queries

In a complex query, the user may want to explain his search context using longer sentences. Ideally, the ability to explain the problem in natural language should be one of the advantages of conversational search systems over browser-based systems. However, our first observation (with Alexa) was that the system repeatedly cut off the user when the query became too long.

User: *It is [pause: 1 sec]. I am in North America. I have been sneezing every morning.*

Alexa: *This might answer your question. North America has six time zones, but you can ask me the time for a specific country or city.*

Not only did the system interrupt the user, but it also misunderstood the problem domain. The system behaved in violation of conversational norms and could be perceived as an insult (threatens the self-esteem of the user per Maslow’s need hierarchy). Let us compare that with the user-wizard conversation (for the prototypical system, Joanna). Here, the utterance by the user is too long for the searcher. Following Rule 3, the Wizard asked the user to restate the question but did not interrupt him.

User: *Hi Joanna, I need some help regarding a conference that I need to go [pause]. I am planning to attend an artificial intelligence conference sometime in early 2020. Can you suggest me some options around that?*

Joanna: *Can you please restate your question?*

User: *I am interested in attending a conference on artificial intelligence in early 2020 in North America. Can you provide me some options?*

Frequent Loss of Context

Existing conversational systems are often criticized for losing context, and rightly so. For each of the search tasks, both the systems lost the context entirely two to three times.

Example 1:

User: *Hey Google, can you give me a good perfume with Bergamot in it.*

Google: *I like all perfumes but not too much perfume.*

Example 2:

Alexa: *A red eye is one of the cardinal signs of ocular inflammation which can result from many conditions.*

User: *What are the conditions?*

Alexa: *Currently, traffic on your commute looks pretty clear. The fastest route takes about [more details of commute].*

Example 3:

User: *What is the best perfume?*

Joanna: *Do you have any specific preferences? I can try to narrow the results down.*

User: *Um with Bergamot.*

Joanna: *Okay, please let me look into it. Give me a few minutes.*

The user wanted to know about perfume in the first example, but Google Assistant responded with an out-of-context comment. In the second example, the user queried about possible medical conditions that could cause inflammation of the eye. However, Alexa interpreted the question as related to traffic conditions and responded with commute times. In the last example, since the Wizard (Joanna) is a cognitive being, he was able to keep track of the context and respond accordingly.

Query Feedback

In some cases, the users posed queries that were either too long or too complex. While an ideal system should form a gist of a complex query, there should be some feedback if it does not. Here is one example where the user asked a complex query, but Alexa did not respond. After waiting for twelve seconds, the user repeated with a simpler query. Similar situations were also observed using Google Voice Assistant. The system stopped responding after providing a list of results.

Example 1:

User: *Alexa, what could be the cause of sneezing and red watery eyes?*

[12 seconds]

User: *Alexa, why am I sneezing?*

[Alexa responds]

User: *[Are] any of these perfect suitable for winter?*

[7 seconds]

Example 2:

User: *Are any of these perfumes suitable for winter?*

[6 seconds]

User: *Google, which perfumes are good for winter?*

The user-wizard interaction (reported in Example 3) was more in line with how conversational systems should behave. The system either understood the query and requested time to look for the answer or asked the user to restate the query (if the query was too complicated). The Wizard also took the initiative to transform a vague query into a meaningful representation of the user's information need. As the user no longer had to simplify the queries, the cognitive workload was reduced for the user.

Example 3:

User: *Can you share which is the best perfume to get this Christmas?*

Joanna: *Do you have any specific preferences? It could help me narrow the results down.*

User: *Yes, I need Bergamot as one of the scents in the perfume.*

Joanna: *Will the perfume be for women or men?*

User: *It will be for my dad.*

Joanna: *Okay, please let me look into it. Give me a few minutes.*

USER BEHAVIOR

The novelty of conversational systems obscures their lack of search and dialogue capabilities. The unique selling point of existing personal assistants is the ability to control smart home devices using voice commands. We observed two different categories of users in our study—early adopters who have experience searching with conversational systems and the group of users who were performing voice searches for the first time. While the second category of users was often frustrated with how the system responded, the first group had low expectations from the system. In this section, we report the different types of search and interaction behavior exhibited by the users.

Breaking the Query into Smaller Sub-queries

The users often started the session with longer queries but modified their query behavior midway through the search session. Instead of trying to build context, the focus shifted to issuing smaller but more useful queries. For example, one of the users issued an initial query: *“Alexa, I have been sneezing every morning, and I also have red, watery eyes. What could be the cause of that?”* As the system did not respond, the user framed two shorter queries: *“Alexa, why am I sneezing?”* and *“What could be the cause of sneezing and red eyes?”* The user processed the individual system responses to make sense of the situation and followed up with *“What medicines will help treat allergies?”*

For the conceptual prototype (Joanna), some users described the entire search situation in a single turn and were prompted by the Wizard to restate the query. For others, the system would gradually build the model of the user by asking them for more contextual information at each turn: *“Can you tell me more about what you are looking for?”* or *“Do you have any specific preferences? It could help me narrow the results down.”* Knowing about the preferences of the users helped the Wizard provide more relevant results and solve the information need of the user.

Re-contextualizing the Discussion

As we observed before, the system would often lose the context and perform irrelevant searches based on keywords alone. For example, in the following example, Alexa used time as a keyword and looked for a reference to time within a Wikipedia article on natural language processing. The user realized that the system was going off-topic and decided to reformulate the query to re-establish context.

User: *Alexa, what is the time and venue of empirical methods in natural language processing [conference]?*

Alexa: *Here is something I found from the article Natural language processing on Wikipedia. In the 2010s, representation learning and deep neural network-style machine learning methods became widespread in natural language processing [more irrelevant details]*

User: *Alexa, where will empirical methods in natural language processing be held in 2021?*

When interacting with the Wizard, there was no loss of context. The users either volunteered information or were prompted by the system to reveal additional details about their information need.

DISCUSSION

Conversational search systems are one of the innovations that have been trending over the last few years. There are some inherent challenges in developing conversational systems, including but not limited to the absence of cognition and the dynamic nature of the search process. Findings from prior research (Sa & Yuan, 2020; Turunen et al., 2012; Luger & Sellen, 2016) have highlighted that conversation systems are task-based and incapable of performing complex or exploratory search tasks.

In this study, we explored the user-system dialogues for search tasks of low and moderate complexity. The findings highlight that the dialogue capabilities of existing systems are barely enough to support simple search tasks (like weather reports). The systems do not follow most of the norms of spoken conversation: it cuts off the user if the sentence gets too long or if multiple sentences are involved. Turn-taking is an essential aspect of human-human conversations (Sidnell, 2007; Stivers, 2009; Drew & Heritage, 2006). While the social conventions vary based on cultures, cutting off a speaker is mainly avoided. The conversational system is not a cognitive being, but it must adhere to semblances of propriety and politeness during a conversation. A simple solution would be to allow a small gap after the users finish their turn.

We also observed a complete loss of context on a few occasions. When we investigated the possible reasons, it appeared that the system extracts keywords from the users' utterances to form an idea of the topic of discussion. When the user specifically requested a perfume with a specific aroma, the system responded with a generic comment about perfumes. In a separate session, while discussing health issues with the user, the system assumed that the word 'conditions' is related to traffic and not health. While it is acceptable to confuse closely related topics, the system should not assume that the topic has changed (from prior turns) unless it is confident enough. Lastly, there were situations when the system chose to stay silent instead of responding to the users' queries. The effect of silence has been explored thoroughly in discourse literature (Roberts et al., 2006; Kurzon, 2007; Wilson &

Zimmerman, 1986) and is regarded as a predominant source of miscommunication (Lemak, 2012). Suppose the system faces difficulty processing a long or complex query. In that case, it could use standard responses—requesting the user to repeat or restate or explaining its inability to handle long sentences—instead of not responding.

Informed by our semi-structured interviews, we propose a few recommendations. When using the conceptual prototype (Joanna), the users appreciated the longer, detailed responses during complex searches (“*I liked the fact that it is able to give you more than just your yes or no and simple responses*”). Also, when the system responds with multiple answers from a list, it should present one item from the list at a time and ask the user for confirmation before reading out the next item. For search tasks, the users often prefer writing down the results. Interviews with participants revealed that many of them preferred some mechanism through which they could save the information or forward the results or the chat transcript to an email or phone number (“*...it would be nice if it could have some type of way that it could store the information that I could access it later*”). Writing down the agent responses was cognitively demanding (in a laboratory environment) and is not feasible in real life (for many of the use cases of conversational search systems). The situation is not uncommon in librarian-patron conversations where the chat transcripts are shared with patrons to refer and follow up. While our prototype supported repeating the last utterance (which all users found helpful), some users also wanted the added functionality of pausing and resuming playback when required.

CONCLUSION

This research examined the dialogue capabilities supported by current voice-based personal assistants. By conducting a user study under controlled lab settings, we collected seventy-five sessions of user-system information-seeking dialogues. The search tasks—which ranged from low to moderate in complexity—were designed to promote conversation between the user and the system. Next, we devised a set of simple guidelines that any conversational system should adhere to. These guidelines are meant for systems with low cognition, which could be implemented in the immediate future. Through qualitative analysis of the user-system dialogues and the exit interview data, we highlight that implementing these guidelines could solve many usability issues that plague modern-day voice-based search systems. Lastly, we made some design recommendations based on the semi-structured interviews, which should improve the end-user experience and make the conversational systems more anthropomorphic.

There are also a few limitations to our paper. A majority of our participants were female and undergraduate students. In the future, we would like to recruit users from different age categories and backgrounds, which would be more representative of the sample population. Another limitation was the topic of the selected search tasks and their generalizability for various user categories. Our work can be extended to several new directions to support search and improve the interaction experience of the end-users. It would be interesting to explore how people with visual and manual disabilities use conversational search systems (Guy, 2018; Sahib et al., 2012). We plan on using snowball sampling to recruit sufficient participants for the study. Another possible direction will be to investigate the presence of gender- and race-specific biases in these systems and possible techniques to mitigate those biases. Our findings should inform the theory and development of spoken conversational systems by revealing how systems could be more user-centric, empathetic, and fair.

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What is the Thermal Conductivity of Copper? The Production of a Fact Through Scientific Forgetting

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ABSTRACT

What is the thermal conductivity of copper? This straightforward question leads to a fascinating instance of the production of scientific facts through documentation practices. Ho, Powell and Liley's 1974 *The Thermal Conductivity of the Elements: A Comprehensive Review* is examined as an artifact of scientific reference data production, and its answer to the initial question is traced to modern-day search engine results. A short history of the Center that produced the book and some initial research into its authors is provided.

Kuhn's concepts of normal science and normic lexical structures are utilized to clarify the Comprehensive Review's functioning within the broader scientific fields in which it is utilized. Bowker's concepts of memory practices and the jussive Archive help identify the forgetting embedded in the production of reference data, producing what Star called global certainty. Far from impugning the internal validity of these scientific facts, this forgetting is shown to be licensed by scientific rigor.

This paper presents a novel historically informed investigation of how documentation practices produce scientific facts, and connect these activities to modern-day knowledge graph information retrieval. The theoretical analyses provided show how scientifically licensed forgetting is a key mechanism of fact production, what Hayles termed constrained constructivism.

KEYWORDS

Science studies; History of Information Science; Scientific Facts; Memory Practice.

INTRODUCTION

What is the thermal conductivity of copper? This is a reasonable question for a physicist, physical chemist, materials scientist, or electrical or mechanical engineer to ask. Search engines provide a succinct and apparently well-cited answer: 400 Watts per Meter-Kelvin. Tracing this answer through its sources yields the graph in Figure 1, which arrays hundreds of empirical results underneath a Recommended line showing the relationship between thermal conductivity and temperature. How is it that the massive complexity of Figure 1 could be collapsed into a single data point? How do search engines arrive at such certainty within their knowledge graph-based question answering services? The answers to these questions drive to the heart of information studies's contribution to science studies, foregrounding the document as a primary site of the scientifically licenced forgetting that is critical to the production and ossification of scientific facts. By tracing this process in an historical example, this paper reveals that this phenomenon is indeed present in the modern regime of datafication but precedes it. The collapse of forgetting, where local uncertainty is forged into global certainty (Star, 1985), is central to the enterprise of science, especially what Kuhn termed normal science.

Ho, Powell and Liley's 1974 *The Thermal Conductivity of the Elements: A Comprehensive Review* (hereafter, the *Comprehensive Review*) is the source of the graph in Figure 1. Comparable graphs and coordinated bibliographies and commentaries were produced for all of the then-known elements. This 800 page scientific literature review and its visual, bibliographic and tabular reference elements have many of the most interesting logical and systemic characteristics of far more complex systems, making it an excellent site to investigate the process of scientific fact production more broadly. It lets us study the role of published artifacts in the production of scientific facts suitable for the needs of scientists, engineers, and students performing calculations and experiments in adjacent fields, broadly consonant with Frohman's deflationary approach to connecting science studies with documentation (2004). In addition, the historical, intellectual and economic contexts surrounding its production connect it to several fascinating topics, including the foundational years of the field of information science.

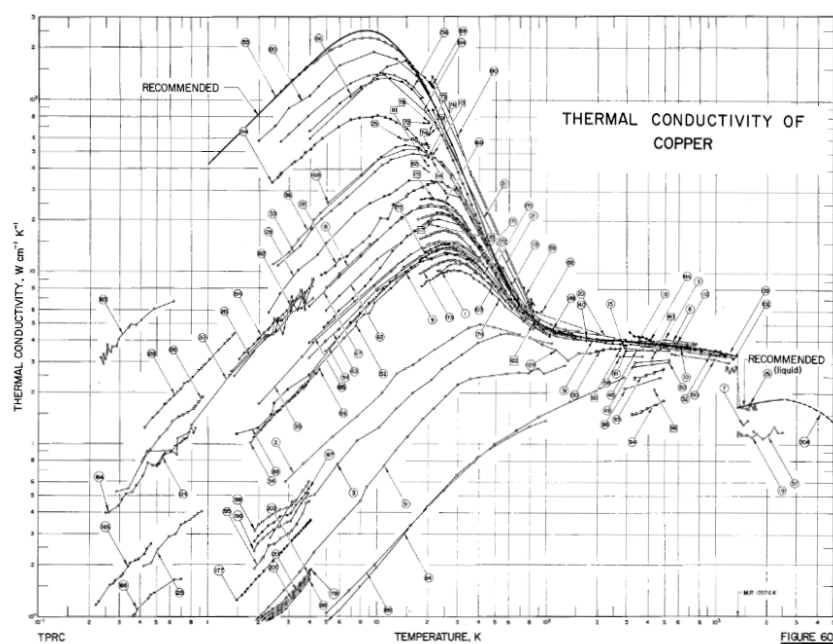


Figure 1. The thermal conductivity of copper (Ho et al., 1974, pp. I–244)

Each labeled series refers to a bibliographic table containing important metadata about the underlying study. Over 200 studies are represented, some from as far back as the 1800s. The *Comprehensive Review* claims to include all relevant studies completed through 1971.

Though this is the first paper dealing with the *Comprehensive Review* and the circumstances as an object of study, I'm not the only one outside the fields of thermophysical reference data or mechanical engineering to take an interest in this text. Edward Tufte included the chart in Figure 1 in his landmark *The Visual Display of Quantitative Information* (Tufte, 1983), which is where I first learned of it. Tufte couldn't recall where he had encountered the chart and, despite using it or related charts in at least one subsequent work, hasn't deeply investigated the source text (E. Tufte 2016, personal communication, 1 April). As I continued to examine a physical copy of the *Comprehensive Review* I realized it represented an important graphical and bibliographic artifact in the production of scientific knowledge.

As will be seen, the *Comprehensive Review* is in some ways an ideal subject for this investigation. The recommended values listed in this work serve as the basis for many of the figures listed in the most recent, 98th edition of the *CRC Handbook of Chemistry and Physics*, a popular reference for scientists, engineers, and students. Over the past 45 years or so, the *Comprehensive Review* seems to have become the final word on many aspects of its topic. This makes it a particularly well-documented and successful example of the production of durable scientific facts.

Limitations and Circumscriptions

The production of scientific facts has a long and interdisciplinary history as a topic of research. The present study will not engage with several adjacent approaches that I will mention briefly here. This is for considerations of space, and to keep the focus upon what historically informed information science can contribute to this ongoing discussion. First, in contrast to the bulk of work from the field of science studies (e.g., Latour & Woolgar, 1979), this investigation is artifactual and historical, not ethnographic. While Latour and Woolgar describe the role of the inscription within daily laboratory life, this paper will trace inscriptions through time, an approach more consonant with that of Bowker and Star (1999). This paper will also not consider the rhetorical or political functions of scientific facts, or issues of the public's right to know (e.g. Fahnestock, 1998). While of critical importance, the relatively muted political import of thermophysical facts allows other aspects of scientific fact production to rise to the surface. Finally, the *Comprehensive Review* can certainly be said to be an instance of a peculiarly scientific genre of text. Potential connections to the rich literature on genre studies of science (Agre, 1998; Bazerman, 1988; Graves, 2014; Yates & Orlikowski, 1992) are left to future work. The conclusion highlights additional points of connection and departure suggested by the paper.

THE PRODUCTION OF FACTS IN INFORMATION SYSTEMS

Kuhn, Normal Science, and Normic Lexical Structure

A widely influential touchstone for many analyses of how science produces facts is the work of Thomas Kuhn (Barker et al., 2002; Burger, 1997; Davies, 2013; T. Kuhn, 1970). Kuhn set out to explain the phenomenon of scientific revolutions. Drawing from examples of historical scientific ‘paradigms’, Kuhn articulated how systems of thought such as modern chemistry invalidated and replaced earlier systems like phlogiston chemistry, that, while to some degree internally consistent and suitable, encountered ‘crises’. These crises could be endured for a time, but historically had precipitated revolutions in scientific thought that involved paradigm shifts and, often, *de novo* delineation of new sets of scientific facts that were incommensurable with knowledge from the old paradigm. Kuhn’s thought evolved considerably in his later years, and his discussion of his yet-unpublished final work suggests that he had come to focus on the concept of lexical structure as the most important tool for describing scientific change (T. S. Kuhn, 1993). This later focus on language specifically has licensed and paralleled a wider interest in language as a medium of scientific knowledge production. The works discussed in this paper form a perhaps quintessential example of what Kuhn termed *normal science* (T. Kuhn, 1970). The facts produced by the *Comprehensive Review* utilize normic lexical structures (T. S. Kuhn, 1993, pp. 316–317) and contrast sets of terms to scientifically divide their subject areas into well-defined regions of scientific understanding that nonetheless anticipate small variations or imprecision. As we shall see, the careful tracing of normic variability in the *Comprehensive Review*, shown graphically in Figure 1, is collapsed in modern knowledge graphs to a single scalar value. This represents a radical shift in the practices of fact production that has important consequences for the interpretation of scientific facts so arrayed.

Bowker, Memory Practices, and the Jussive Archive

The second perspective on the production of scientific facts that I’d like to bring to bear in this analysis is Bowker’s concept of the jussive Archive in *Memory Practices in the Sciences* (Bowker, 2006). Bowker, following Derrida, notes that the scientific Archive is characterized by its ability to control what and what form of information about the past is preserved. For Bowker, this indicates that “memory practices,” such as they are, in fact license a scientific forgetting. Couldry and Hepp emphasize how Bowker’s conception identifies the mechanism whereby science collapses complexity into facts (Couldry & Hepp, 2017, pp. 129–190). Bowker’s book traces several historical examples of memory practices, including the field of Cybernetics popular during the years in which the TPRC was active. Bowker views Cybernetics as an attempt to license a radical forgetting of all actual facts, in favor of cybernetically defined dynamical models, from which facts could be derived as needed. This represented a massive shift in the conception of the role of science, and of the Archive (Bowker, 2010). As we shall see, the TPRC would seem to demand some revision to, or at least qualification of this account: the Archive they have produced does license a forgetting, but is infused with empirical results, themselves facts of a kind, rather than models.

Constructivism and Scientific Validity

Finally, I’d like to comment on the relationship I see between these ideas and scientific validity. In a very real sense, we’re able to speak, write, and make information systems in a practically unlimited number of ways; this can be said to be a core insight of constructivism. Though traditionally seen as questioning the legitimacy of science, Hayles has argued convincingly that science be seen as ‘constrained constructivism’ (Hayles, 1993), whereby a rule-bound constraint of thought is seen as science’s defining characteristic within the broader enterprise of human knowledge. By constraining the forms which information may take, and excluding all else, systems make discrete, unambiguous, and easily cognizable claims. This power to exclude is precisely why we use systems to understand, what makes them so powerful, and what inherently makes both science and information systems subsets of human knowledge. Jussive processes are the site which we should examine to understand how facts and certainty about facts are produced within information systems such as the *Comprehensive Review*. It is in this spirit that I shall proceed.

THERMOPHYSICAL REFERENCE DATA IN THE COLD WAR UNITED STATES

The production of scientific facts, like the production of all knowledge, is deeply informed by the cultural and historical forces surrounding its production. The *Comprehensive Review*’s historical and cultural context is inextricably linked to Cold War politics and the United States military-industrial complex. Before moving on to examine the charts and tables more closely, a bit of background on history and state of the scientific concept of thermal conductivity will be helpful. It is hoped that this brief and initial account will hopefully situate this artifact suitably within its fascinating academic and industrial context. As we will see, both primary and secondary sources on this topic are lamentably thin; future work is needed to better understand this crucial moment in the history of scientific information.

Thermodynamic Origins

The study of thermodynamics was a driving force in 18th and 19th century physics, and the transfer of heat between and within solids, which thermal conductivity partially describes, presented an important problem to be solved for scientists of the era. Narasimhan (1999) gives an excellent review of the context surrounding French mathematician

Joseph Fourier's development of a diffusion equation that has been widely influential in explaining both thermal and electrical conductivity, and still serves as the theoretical framework in which it is understood in a classical sense. Amongst the foundational concepts that developed alongside the modern concept of thermal conductivity: the difference between heat and temperature, the effect of geometry on conduction, the idea of lattice waves, convection, and electrical conductivity. Each of these related concepts plays a role in the modern understanding of the concept and, as we shall see, in the character of the facts the *Comprehensive Review* produces. Together, they form a normic Kuhnian lexical structure within which the concept of thermal conductivity as used by Ho et al. is situated.

Thermal Conductivity as Scientific Concept

An intuitive and complete explanation for thermal conductivity is still elusive, as an accepted understanding of quantum thermodynamics is still under intense development and debate (Castelvecchi, 2017). This suggests that the concept has experienced a period of normal science for years, primarily focused on determining a numerical measure of thermal conductivity for various natural and synthesized materials. If the pattern of Kuhnian revolution holds, the concept may one day be subject to a paradigm shift wherein the data and recommendations provided in Ho et al. will be fundamentally restated in quantum terms. If that happens, thermal conductivity will no longer be representable via a graph of Watts per meter Kelvin by temperature in Kelvin. This potential restatement may be an aftershock of the quantum revolution which began a century or more ago rather than a separate, full scale revolution, but regardless it helps contextualize the value and current use of the reference data. Until such time, Ho et al.'s work retains its utility to its audience.

Thermophysical Facts and Government Funded Reference Data in Cold War America

The production of scientific facts, like the production of all knowledge, is deeply informed by the cultural and historical forces surrounding the site of production. Starting in 1901, the United States National Bureau of Standards (NBS) was chartered to develop and maintain standard units of weights and measures for the country. The NBS was the predecessor to the modern-day National Institute of Standards and Technology. With the postwar momentum behind government-funded science and engineering more generally during the cold war, the NBS took responsibility for funding the publication of standardized scientific reference data. The 1960s was a golden age of materials properties research, and during this time, the NBS organized and promoted the National Standard Reference Data System (NSRDS) (Brady & Wallenstein, 1964, 1967), which established decentralized data centers to produce, analyze and publish standard reference data for scientists and engineers.

One of the initial 10 NSRDS-funded centers was Purdue University's Thermophysical Properties Research Center (TPRC) (Purdue Alumnus Magazine, 1964), which Ho, Powell and Liley worked out of. The TPRC, later spun out of the university as a private corporation and now known as CINDAS (CINDAS LLC, 2017), was founded at Purdue University by Yeram S Touloukian in 1957. Just two years later, Purdue hosted the first Symposium on Thermophysical Properties, which was organized by the K-7 Standing Committee on Thermophysical Properties of the Heat Transfer Division of the American Society of Mechanical Engineers (ASME) (Haynes et al., 2002). This activity was largely funded by engineering and manufacturing companies, and the federal government, including the Air Force and the NBS.

Purdue's Thermophysical Properties Research Center

Against the historical and conceptual background above, we can now turn to the specific conditions and history surrounding the *Comprehensive Review*. Touloukian was a mechanical engineering professor and apparently had a research interest in a cybernetics-inflected perspective on the role of entropy in informational and biological systems (Touloukian, 1956). But by 1957 and alongside the Sputnik-fueled bonanza in government funding for material properties research, it appears that he totally changed the character of his research. In fact, he was present and contributed a paper to the 1959 International Conference on Scientific Information, a seminal conference in the then-emerging field of information science (Lykoudis et al., 1959). By the time of his death in 1981, Touloukian had risen to the pinnacle of the field of thermophysical properties research (Cezairliyan, 1981), and major awards in the field bear his name.

Authors Cho Yen Ho, Robert Webster Powell and Peter E. Liley worked out of the TPRC. Though obviously eminent in their field, their relative historical obscurity is demonstrated by the fact that I had to resort to their obituaries to determine their first and middle names (e.g. The Burlington Free Press, 2009). While tantalizing details have emerged, such as Liley's stint as a World War II British codebreaker or that Ho's wife was a Purdue chemist of some note (Xie, 2008), it seems that primary source research will be required to determine more about the biographies and day-to-day lives of these and other employees of the TPRC. Regardless of future historical insights, Ho, Powell and Liley's *Comprehensive Review* can be seen as a typical product of NSRDS centers. In fact, there is evidence that the TPRC was seen as an exemplary member of the NSRDS: in a report justifying the need for

continued funding for the program, a graph from the *Comprehensive Review* was provided as a key example (Lide, 1977, p. VII.1.1 & Figure 4, page VII.1.9).

Because of the importance of this data to the production of aerospace weapons, the Center was funded by government agencies such as the NBS and the Air Force alongside a veritable who's who of the aerospace defense industry such as Boeing, Northrop Grumman and Lockheed. In the fall of 1961, C. F. Lucks convened about 40 researchers at the Battelle Memorial Institute in Columbus, Ohio for the first Thermal Conductivity Conference (Ho & Taylor, 1969). The conference was held annually for the first thirteen years, and continues on a biannual schedule to the present day (*ITCC/ITES*, 2017). Modern iterations of the conference largely focus on the thermal properties of new materials rather than pure elements. But in the 1960s and 70s, in journals such as the *Journal of Physical and Chemical Reference Data*, in which Ho et al.'s treatise was published as a supplement, researchers gradually determined and collected comprehensive chemical and physical data about elements and simple alloys to support the pure, applied, and engineering sciences. Much of this data remains unchanged in modern reference works. Thermal conductivity was just one of many properties, and though scientists continue to hold conferences and examine new substances, it has inevitably assumed its position as a lesser god in the scientific pantheon: Thermal conductivity, for instance, was not accepted as fundamental enough for a proper noun to be granted as its standard unit, like Newtons, Kelvin, or Ohms. A proposal was advanced in 1968 to name the SI unit for thermal conductivity (Watts per meter Kelvin) the "fourier" (Touloukian et al. 1969), a proposal that was subsequently rejected. In this larger context, the *Comprehensive Review* can be seen as a partial but exemplary part of Cold War America's exuberant embrace of science, technology, standardization, and government support for all of these activities.

In the midst of the Nixon presidency, however, funding began to run dry. Peter Liley was the chair of the 1973 Sixth Symposium on Thermophysical Properties, which represented a nadir in terms of attendance. Liley blamed the lack of attendance on the lack of government funding for basic research, and recommended broad changes to future events, including a special focus on international participation (Haynes et al., 2002, p. 374). The Symposium has persisted, along with its various property-specific siblings, and continues in a slightly altered form today.

The TPRC spun out of Purdue University around this time as CINDAS LLC, and continued to produce reference data. In its modern incarnation it continues to produce and maintain databases for government and corporate customers. In some ways, though, it was a victim of its own success. Products like the *Comprehensive Review* became the final word on their subjects, necessitating the selection of an ever expanding range of specialized chemical compounds for its data producing activities. In addition, the majority and perhaps all of CINDAS-produced data sets are proprietary, forming the products it sells to its customers.

THE COMPREHENSIVE REVIEW AS JUSSIVE ARCHIVE

We can now turn to the *Comprehensive Review* itself, viewed as an artifact of scientific knowledge production. The book is apparently designed to be used in several distinct ways. Reference users seeking a thermal conductivity value or curve for use in a calculation will treat the system as a source of certainty (and would thus likely use a handbook, or perhaps the abridged version, to find this value). Experimentalists might utilize the system as an inventory of other researchers' results, plotting empirical results alongside those charted by the authors. And materials science or thermophysical reference data experts might utilize the full, attributed power of the attached bibliographic tables to critically assess the authors' recommended values or mathematical methods. Different components of the book (or, as we'll see, even an abridged version) cater to these distinct needs. Interestingly, these distinct uses call to mind Busch's distinction between Historical Information Retrieval (Busch, 1992, 1994) and the relatively simple needs of a reference user.

Figure 2 shows the simplified graph that Ho et al. produce to facilitate the use of their work by others, erasing the empirical and attributed portions of their full work. Figure 2's tabular component makes this even more plain by isolating the table of numerical values that has been so extensively reproduced in scientific handbooks. These are the specific sites where jussive action creates the certainty that has so successfully been promulgated by scientific handbooks. The example of the *Comprehensive Review* lends support to the argument that information itself is inherently jussive (Hauser, 2018a) by demonstrating the jussive nature of thermophysical information.

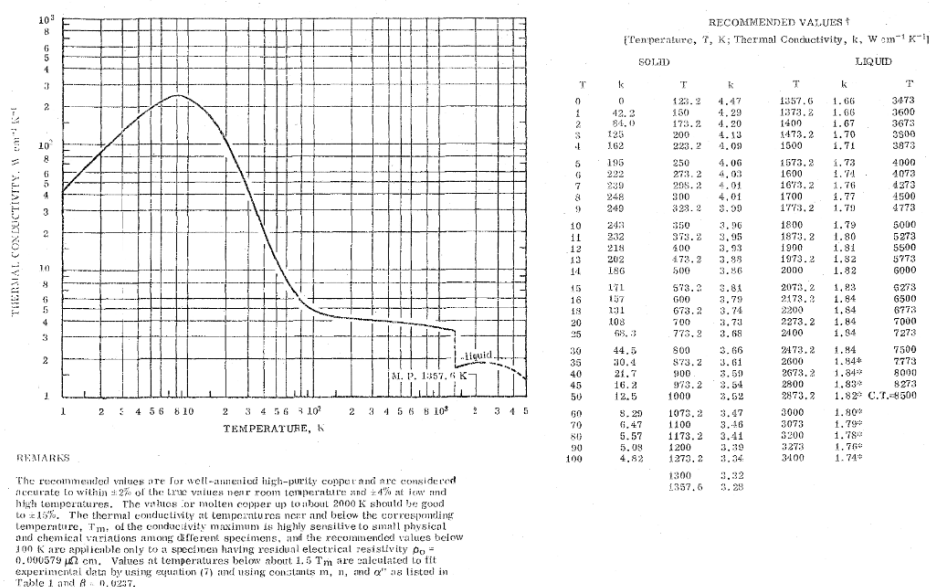


Figure 2. The thermal conductivity of copper: recommended values only, from the abridged version of the Comprehensive Review (Ho et al., 1972, p. 332)

A reference user *wants* certainty, which in their case equates to authority, about the correct number to use in their calculation. A researcher might instead take the Recommended lines as attributed and contestable, and would likely utilize the full system as a bibliographic information system. Ho et al. have succeeded in both exploiting the certainty of unambiguous definition while also providing the tools others would need to re-state or challenge their recommendations. In this way, they embody academic responsibility and transparency in their system design, which is likely to earn them cognitive authority with their readers (Wilson, 1983).

Cognitive Authority: Earning Incorrigibility

I offer the above observations by way of a vindication of sorts of Ho, Powell, and Liley's project; whatever criticisms may be leveled at sources like Wolfram Alpha or even the CRC Handbook, they cannot be said to apply in equal measure to the *Comprehensive Review*. Ho, Powell, and Liley sought to produce acceptable recommended values, and their recommended values have been accepted. Though resources like the CRC Handbook, may make it difficult or impossible for users to encounter the original reasoning underlying the recommendations, and ones like Wolfram Alpha rather egregiously collapse it into a single, de-contextualized data point, Ho, Powell and Liley should be commended for their excellent and responsible scholarship. They have earned the incorrigibility (D'Agostino, 2014; Hauser, 2018b; Hoyningen-Huene, 2005; Rorty, 1970) of the data they produced by evincing what Wilson has termed cognitive authority (Wilson, 1983). Cognitive authority within the thermophysical reference data space is essentially equivalent to Bowker's memory practices: acts which, in this case license a forgetting, as opposed to licensing the consultation of second-hand knowledge by library users that Wilson investigated.

Though it might seem at first that the full graph of empirical results shows Ho et al. discarding empirical results that conflict with their assumptions, on closer inspection they convincingly justify their reasoning for plotting their recommended line so much higher than the empirical results, particularly at low temperatures. They provide a table that idealizes the impact of impurities on thermal conductivity, which provides a framework for them to extrapolate or validate the values of studies that used the purest samples. Each decrease in purity induces a concomitant decrease in the conductivity maxima observed at cryogenic temperatures, as shown in Figure 3, curves which all begin to converge upon approach to the element's Debye temperature.

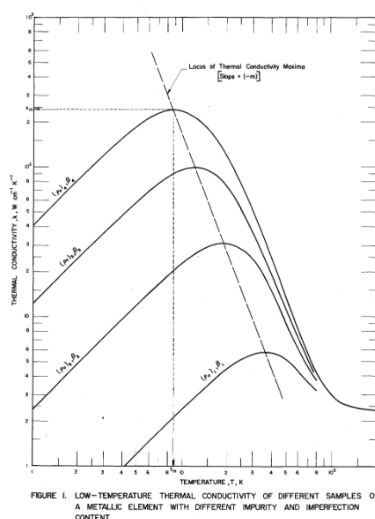


Figure 3: The effect of metallic purity on thermal conductivity at low temperature (Ho et al., 1974, pp. I–13)
This graph is presented as a justification for the recommended curve's deviation from empirical results at cryogenic temperatures, since higher purity increases thermal conductivity in a predictable way

What's more, whenever they discuss low temperature thermal conductivity, they plainly note that the recommended values line at cryogenic temperatures is only valid for intensely pure samples, provide an unambiguous definition of purity in terms of electrical resistivity, and provide the curves above which might allow the extrapolation of thermal conductivities for relatively impure samples.

Thermal Conductivity and Scientific Certainty

The information needs of reference users include a need for *certainty*; they are seeking a set of unambiguous facts. After all, these users must enter a specific number into an equation. This global certainty, as Star (1985) termed it, is produced as results, or in this case, fact, travel out of local, disciplinary uncertainty into adjacent disciplines. Star's work on the production of certainty laid an intellectual foundation for her later development of the concept of boundary objects (Star & Griesemer, 1989), but is far less well known. Thermophysical facts as discussed here are most certainly not boundary objects (Star, 2010). It is her earlier account of the production of certainty that is most useful, in my opinion and experience, of studying 'aligned' normal science, as opposed to the possibilities of coordination amongst disciplinarily diverse stakeholders best explained by the boundary objects concept.

From a distance, the discipline of thermophysical properties research may seem to meld with adjacent domains. But the users of this reference data, which include engineers, electrical physicists, physical chemists, and so on, lie on the other side of disciplinary and even methodological boundaries. Thus, the certainty that Ho et al. have provided for the reference values of thermal conductivity is produced by the incorrigibility inherent in the structure of their system's graphs and tables (specifically, the Recommended Values therein). Jussive in Bowkers sense, yet scientifically irreproachable, this example seems to add considerable nuance to a common critique of science. I don't deny that this set of facts is socially conditioned (Fleck, 2012), historically situated (Poovey, 1998), and rhetorically presented (Fahnestock, 1998). But the collapse of science into facts alongside the resulting incorrigible, global, certainty produced, and the resulting durability of thus-ossified facts are together essential to satisfying the information needs of the system's users. It is the lens of information need that distinguishes the present approach to the production of scientific knowledge artifacts from prior ones.

Ho et al.'s *Comprehensive Review* can be seen as a paragon expression of normal science. Though this term is sometimes deployed dismissively, as if its practitioners were willingly oblivious to potential advances, Kuhn did not intend it that way. *Comprehensive Review* is an example of normal science done right, by the lights of its own audience, and lends support to Kuhn's view of revolutionary and normal science as partners in expanding human knowledge. With well-defined and widely accepted graph components operationalizing the relevant lexical structures, these scientists have produced data useful to anyone operating within the current paradigm. The inescapably jussive process of providing a Recommended curve is exhaustively detailed and explained. It is impossible to tell how long the paradigm surrounding and enabling this interpretation of thermal conductivity will last. With intense investigations underway in quantum thermodynamics (Castelvecchi, 2017), it's not inconceivable that alternate lexical structures will be invented to better characterize any of the three main graph components. Until

or unless that happens, it is likely that the *Comprehensive Review*'s certainties will continue to undergird the scientific facts of thermal conductivity of the elements.

Pathological Incorrigeability

The knowledge graph based answers displayed by search engines such as Google and Wolfram Alpha take this simplification too far, ignoring the normic relationships of the variation of thermal conductivity with temperature, instead collapsing it down to a single value. This is exemplified by Comparing Figure 1 and Figure 2, Ho et al.'s simplification of their results for convenient consumption by scientists and engineers, with "400W/mK", the answer given by Wolfram Alpha to the query "thermal conductivity of copper" (Figure 4). Presumably, such knowledge graphs extracted the thermal conductivity of copper from a datafied table, but did not preserve the inherent relationship between thermal conductivity and temperature, let alone the crucial detail that the listed value was only valid at the element's Debye temperature. Careful system design is required to preserve and enable the utility that makes scientific facts valuable in the first place. 'Pathological incorrigibility' is offered as a term to help diagnose and correct these failings in system design. In this specific case it's clear that knowledge graph's data model of what thermal conductivity is insufficient, but the potential problems this case implies for graphs with potentially billions of similarly oversimplified nodes are much larger. 'Constrained constructivism' only works if the rules of responsible constraint are followed uniformly. Here, the technologies of information access fail to embody the constructed norms of science.

CONCLUSION: LESSONS FROM THERMOPHYSICAL REFERENCE DATA

The production of scientific facts is of broad scholarly interest. This contribution examined one specific site of the production of such facts within its historical context and has sought to synthesize and apply concepts from information studies to contribute to this pre-existing discourse.

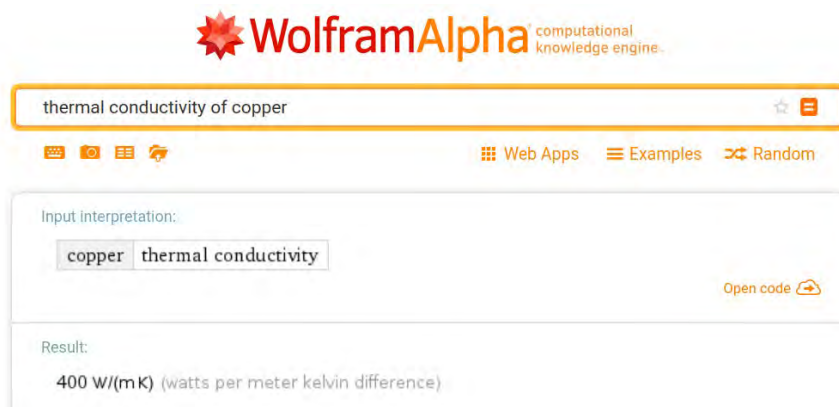


Figure 4. Wolfram Alpha's result for the query "thermal conductivity of copper" Compare the answer, "400W/(mK)", to the graph of empirical results in Figure 1 and manifold Recommended Values of Figure 2

This paper has focused exclusively on a single scientific fact, the historical context and means of its production, and theoretical issues raised by its history and subsequent collapse in search engine knowledge graphs. While similar analyses of each scientific fact are infeasible, following the documentary chains of fact production reveal a wealth of rich phenomena, and information studies' ability to inform science studies, particularly through a focus on documentary artifacts (Frohman, 2004).

Learning From The Comprehensive Review

Despite the narrowness in scope, this paper's example was not chosen randomly. There is evidence beyond Tufte's identification of their charts as exemplary visual displays of quantitative information that Ho et al.'s work has had a broad impact within the field of thermophysical research data. For instance, their work, and the graph of the thermal conductivity of copper in particular, was offered as evidence for the need of the National Standard Reference Data System overall (Lide, 1977, p. VII.1.1 & Figure 4, page VII.1.9). More work is required to more fully understand rhetorical and political aspects of how these particular scientific facts were used by scientists to justify requests for funding, and how those funding sources expected to see the military-industrial impact of this basic scientific work. The 1960s and 70s were a critical period in the formation of the discipline of information science, in which the authors of the *Comprehensive Review* and the TPRC more broadly participated. Understanding more of how trained disciplinary scientists came to devote their careers to what is essentially an early form of informatics, the production of critical scientific information infrastructure, could better inform our understanding of modern-day practices and future possibilities for the field.

Regardless, the authors' pragmatic approach to developing their Recommended lines and corresponding numerical tables helps to demonstrate how the creation of scientific reference data supports the production of scientific certainty. Though the authors of the *Comprehensive Review* diligently note the restrictions and limitations of their approach, users of scientific reference works like the CRC Handbook have a need for hard numbers to use in calculations. They have a need for a collection of unambiguous, consumable facts. The certainty with which these numbers are presented in handbook reference tables obviates the considerable complexity and nuance present in the *Comprehensive Review*, but thereby encapsulates a scientific fact ready for consumption. This is the 'constraint' of Hayles' 'constrained constructivism' in action, operationalized via the jussive, licensed forgetting of what Bowker termed memory practices.

Fact Production in Cold War America

As Bowker and Star have noted in their examination of the World Health Organization's International Classification of Disease (Bowker, 1998; Bowker & Star, 1999), the archival records of government (or, in the case of the WHO, treaty-based organizations) produced facts and standards are often treated as an afterthought. In my research so far I've been unable to uncover archival records of the TPRC's extensive (and proprietary) bibliographic control and abstracting facilities or practices, let alone the intermediate work products used in the production of works like the *Comprehensive Review*. Thus, in this article I've attempted to focus on a specific artifact produced by the TPRC as part of a larger program of scientific reference data creation during the cold war. This has been largely out of necessity, as national burthe secondary literature on the TPRC and other NSRDS centers is extremely thin. The histories that do mention them tend to themselves be government-funded; the two most prominent are published by the NBS/NIST itself. (Cochrane, 1966; Passaglia, 1999). Clearly, further primary source research is needed to inform our understanding of the birth of Cold War scientific information, its effects on the development of the field of information science, and the material bases for this work. Tantalizing evidence of this rich history is available in the form of two YouTube copies of videos produced in the 1970s by Touloukian, showing TPRC researchers, possibly including C.Y. Ho (CINDAS LLC, 1976a, 1976b, both linked from 2017). The credits of this film alone have proved invaluable in understanding the extent to which aerospace and defense industry companies had become vital to the Center's funding. While an analysis of the artifacts produced by these researchers, labs, universities, and corporations can yield some insights, it is my hope that future work will enhance this archaeological project with primary source based historiography.

Certainty, Jussive Archives, and the Production of Facts

While the *Comprehensive Review* may have been shown to be a site of scientifically licensed forgetting, just as Bowker might have predicted, we still don't understand as much as we could about this process and its ramifications. Though this study was historical (or perhaps archaeological) in nature, there are important theoretical questions that need to be addressed in future work. Is it significant that the things that were forgotten were empirical (the measurements) and dialectical (the bibliographic index) in nature? And what of what remains? What is the logical status of the information that Ho, Powell, and Lilley have produced? Is it truth-apt? By their authors' own admission, the Recommended Values are the products of mathematical curves. In a sense the Recommended Values seem something like a speech act, a concept with a long history of application within our field. In particular, Searle's *social ontology* (Searle, 2010) might be a fruitful starting point, one that has already informed analysis of information production in organizations (Beynon-Davies, 2016, 2018). Application of Searle's work, and speech-act oriented analysis of scientific practice in general, holds great promise for connecting document-oriented perspectives with science studies of information production broadly. I hope that this paper is able to stimulate research towards these and related questions as we seek to better understand how specific systems and practices create and shape knowledge, facts, and certainty.

ACKNOWLEDGMENTS

I would like to thank anonymous reviewers for helpful comments on this and previous versions of this paper.

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Forensic Analysis of Memetic Image Propagation: Introducing the SMOC BRISQUeT Method

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ABSTRACT

This paper introduces a mixed-methods approach for forensically reconstructing the propagation of visual media via networked digital devices. The authors present case studies drawn from political misinformation around the January 6, 2021 riots at the U.S. Capitol. Using interpretive analysis, the authors identify traces of user interfaces that remain in images being shared about the riots. Using computational analysis, the authors evaluate compression levels in digital photographs of the events in question, thus identifying which instances of the image are closer to the source (as well as which images appear to be identical). By combining these two approaches, the authors argue that SMOC BRISQUeT refines our understanding of misinformation’s memetic spread—helpful in curbing future abuses as well as in guiding the production of more effective cross-platform spread when desired.

KEYWORDS

Social media, misinformation, digital forensics, image compression, memes.

INTRODUCTION

This study proposes a two-step process for understanding the memetic spread of images via social media networks. The affordances of many social networking platforms facilitate more effective and widespread sharing of images when compared against video, text, or other media formats. Images are typically sourced from one post on a social platform, downloaded to a user’s device, and uploaded elsewhere online. Furthermore, in the wake of increased platform moderation around sensitive topics, controversial content is frequently spread via screenshots, archive links, and other novel methods in order to evade automatic filtering and moderation processes (Acker and Chalet, 2020). This paper demonstrates two separate methods for understanding the memetic spread of imagery, before demonstrating the combined use of both approaches. The authors begin with interpretive human identification of diegetic elements in a digital image in order to retrace a general sense of its path across multiple users and platforms. Next, the authors apply a newly trained blind, no-reference image-quality analysis algorithm in order to generate a quantified score of image characteristics that can identify the level of JPEG compression across a corpus of images.

By combining human interpretation with computational analysis of compression, the authors generate a more robust account of the images’ specific genealogical histories than either technique alone. This richer account of memetic copying and distribution offers insight into the specific vectors of spread used to propagate controversial content and evade moderation on social platforms. Differences between digitally generated images and “natural” photographs make certain images more amenable to interpretive and computational analysis, respectively. The techniques discussed in this paper can be used to forensically reconstruct the spread of damaging content online, and the combination of human and machine-driven analysis ensures that conclusions are sensitive to both cultural specificity and imperceptible visual changes, respectively.

Background

Every time an image is uploaded to a social platform, it is compressed using some form of algorithm in order to reduce its required bandwidth and streamline user experience (Joshi and Sarode 2020). At the same time, user behaviors such as screen capture can produce new visual features related to the on-screen elements present on their device, including user interface elements like captions, commentary, or GUI elements. Therefore, each time an image is propagated from one place to another, it will undergo a subtle change in both its visual and technical composition. The paper presents a methodology for understanding both of these elements in media distribution via social platforms, using a combination of machine learning and human interpretation.

First, we develop a linear visualization of memetic spread using interpretive analysis of diegetic interface elements in a method that we name SMOC (Sourcing Memetic Online Content). We assess the spread of content using memetic propagation analysis (MPA) techniques in order to produce a linear, graphical memetic analysis (LiGMA) to visualize the spread of our examples over time. Next, we assess the visual quality of imagery and changes in

visual compression between discrete copies of memetic images using a specially trained version of No-Reference (NR) Image Quality Assessment (IQA) enabled by Mittal, et al's (2011; 2012) Blind/Referenceless Image Spatial Quality Evaluator (BRISQUE), which we have retrained for our purposes and named BRISQUEt (an acronym for "Blind/Referenceless Image Spatial Quality Evaluator: reTrained"). Based on the study, the authors conclude by making estimates concerning the specific avenues and extent of spread afforded to different copies of key sample images.

RQ1: How can the human interpretation of diegetic image components be used to understand the spread of memetic image content online, and in what contexts is such an approach most productive?

RQ2: How can computational analysis of image compression be used to interpret the spread of memetic image content online, and in what contexts is such an approach most productive?

Related Work

The ability to copy and distribute digital media is often seen as one of its key attributes. Significant existing research within media and cultural studies offers useful definitions and critical interpretations that can enrich technical research (Parikka 2007, Davison 2012, Shifman 2014, Stein et al 2014, Gaboury 2015). Computer and information science has tackled these issues by automating various forms of content identification, evaluation, and classification, with a particular focus on identifying content that is false or misleading (Farid 2006, Gupta et al 2013, Ma et al 2013, Conroy et al 2015, Rubin 2016). A more recently emerging and still-developing third thread of research also exists, which combines the aforementioned humanistic and computational approaches to understanding memetic distribution (Teyssou et al 2017, Acker and Chalet 2020, Singh et al 2020).

The present study joins recent scholarship in the small but growing field of literature that combines technical and humanistic methods. In particular, we demonstrate the value of interpretive analysis that focuses on the presence of user interface elements from a user's personal networked device in images and video (thus attesting to certain details about that user's personal information practices), as well as the computational identification of image compression (which attests roughly to the number of times an image has been re-uploaded and compressed by online social networks). By combining these threads of research, we advance a mixed-methods approach to understanding media sharing online and work toward developing a richer, more well-balanced methodological toolkit for media and information research to employ when conducting their work.

Humanistic media studies scholars have developed robust definitions and critical approaches to digital media, in particular exploring the subtle effects of certain definitional decisions. For example, while the terms "meme" and "viral" are often used interchangeably to describe the spread of digital media, scholars like Shifman (2014) point out that these terms come from different origins and possess different meanings. Viral media was originally used to refer specifically to media that is, or is thought to be, self-replicating within host machines in the sense of a biological virus (Parikka 2007). The notion of a meme, on the other hand, emerges from evolutionary studies emphasizing the role of social activity in transmitting cultural habits (Davison 2012). In this study, we prefer the notion of memetic spread, which builds on the study of memes, as well as its etymological roots in terms like mimesis and copying.

Existing information and computer science research addressing memetic spread has addressed the detection of doctored content online in considerable depth. Early in the 21st century, Farid (2006) began developing forensic tools to detect alterations and distortions in photography (2006). Gupta et al (2013) demonstrates a different approach, using metadata drawn from specific social networks (such as user details and timestamping) in order to identify fake images. Conroy et al (2015) build further on this approach by using network analysis combined with computational linguistics. Additional research using linguistic identification, such as that by Rubin et al (2016), has worked to identify misleading content that is primarily textual in nature. In the realm of video, Teyssou et al (2017) have also developed new software that can identify falsification in video, expanding upon previous research addressing images and text. Teyssou et al also highlight an important characteristic of research problems in media verification, noting "the problem of online information verification is very complex and touches upon a number of research fields, including media studies and journalism (p. 23). The present study builds on Teyssou's multi-pronged approach by drawing on both technical and humanistic approaches.

Singh et al (2020) provide another example of multi-pronged analysis of online media, by automating both visual and textual analysis. Yet where multi-pronged approaches like those of Singh et al and Teyssou et al still primarily aim to automate the detection of misleading media, the present study focuses on understanding memetic spread, rather than detecting veracity. By demonstrating a methodological approach that can help researchers forensically reconstruct the information behaviors of users that spread memetic content, this study enriches scholarly knowledge about the ethos of sharing and specific techniques employed when images are shared across multiple platforms and networks.

CASE STUDIES

Case Study 1: Interpretive Analysis Using the SMOC Method (Sourcing Memetic Online Content)

In order to demonstrate interpretive analysis of memetic content, this case study examines a series of social media posts (image and text) collected and preserved during the storming of the U.S. Capitol Building on January 6, 2021. After collecting the corpus, two particular screenshots posted to Twitter are analyzed for the visual characteristics that identify unique patterns of cross-platform propagation from the same original post. By identifying the specific social networks whose user's handles and interface elements are displayed in the images, as well as evidence of the technical modalities used to reproduce the images, we are able to draw qualitative conclusions about the nature of sharing and copying among proponents of a particular memetic object. We term these visual elements “diegetic user interface elements,” using a notion of “diegesis” that is drawn from cinema studies to refer to visual markings that are contained within the frame of a selected media object. In this case, the user interface elements are *diegetic* to the social media post because they are included in the post contents, rather than being superimposed around the post as they would be when viewing an object through the social network's user interface.

Data collected for this portion of the research was manually curated into a GitHub repository comprising screenshots of the posts in question, copies of the images included within posts, and a record of metadata for all collected tweets (Berk and Chalet 2021). For the sake of demonstrating interpretive analysis, a tweet by the Twitter user “StunningTruthSeekr” (@stunningtruthsr) was selected for further analysis (see Figure 1), alongside a separate tweet by Twitter user “RC0076” (@rwacollins). The posts in question are exemplary of the layered quality that visual elements often accumulate during the process of circulation. Like the rings of a tree, interface elements can stack up next to one another over time, with each instance attesting to a hierarchical unit of time—in this case, one act of sharing. These qualities are most clearly visible in the two images attached to the post in question. This dataset includes both screenshots and post URLs. While screenshots are generally useful for interoperability between contexts, post URLs and archived versions thereof provide richer contextual information. For more information, see Nelson (2021).

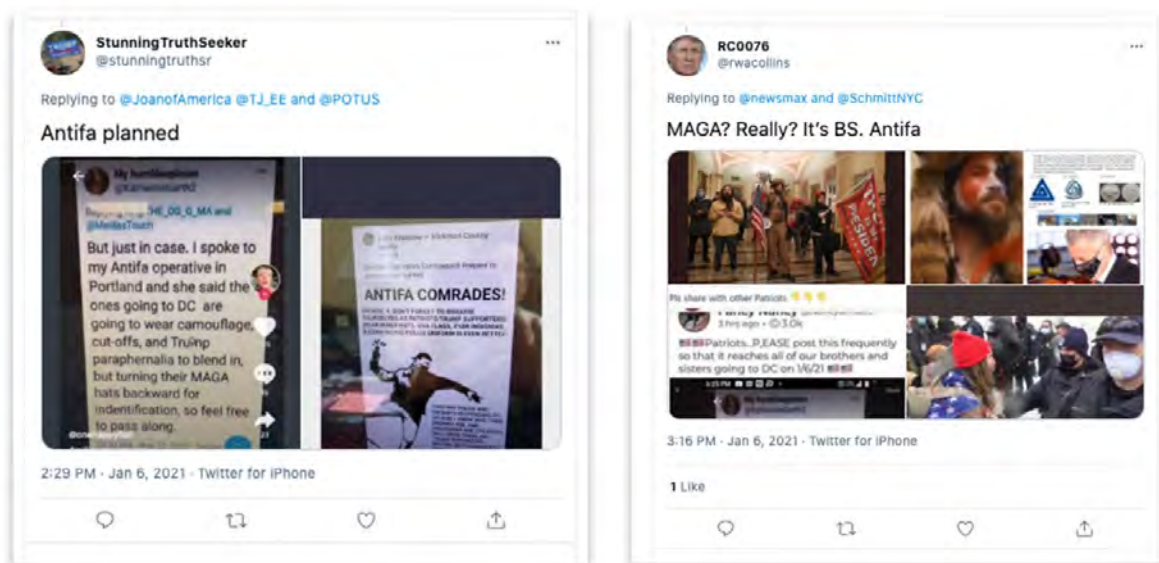


Figure 1. Tweets containing memetic content

In the first Twitter post in Figure 1, StunningTruthSeekr includes two popular images that suggest members of left-wing “Antifa” (short for “anti-fascist”) groups may have planned to participate in the January 6 actions while disguised as members of right-wing “Patriot” or “MAGA” groups loyal to then-president Donald J. Trump. The second image included depicts a Twitter post by RC0076 (@rwacollins), which includes as its third attached image (bottom left) a slightly varied copy of the purported “Antifa operative” screenshot. The narrative that left-wing agitators were responsible for the unrest on January 6, 2021 was widely deployed in right-wing media as a way of deflecting associations with the insurrectionists that stormed the U.S. Capitol (Grynbaum et al 2021). By examining the specific techniques and paths used to spread this narrative through memetic means, an interpretive analysis of the post's contents, we note the cross-platform spread, as well as the coexistence of both screen capture and photographic duplication (taking a photo of one's screen)—two particular information behaviors that complicate attempts at automating detection of misleading content in methods established by existing research.

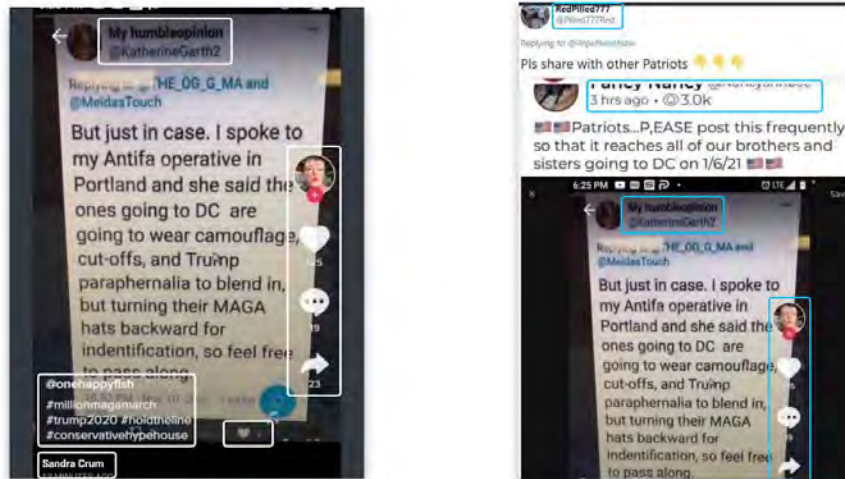


Figure 2. Detail of image included with Tweets Left image depicts original attachment to StunningTruthSeekr tweet. Right image depicts further spread of this image via screenshots, Parler, and additional Twitter reposts. Diegetic interface elements contained in memetic images are highlighted.

The first image included in StunningTruthSeekr’s Tweet (Figure 2) shows evidence of at least three acts of cross-platform sharing—first on Twitter, then on TikTok, and finally on Facebook. This finding is informed by the main content, which contains the word “Twitter” and a characteristic timestamp at bottom of the white screenshot containing the image’s main contents. It is also supported by the avatar, heart icon, comment icon, and share arrow present along the image’s right edge, all of which are characteristic of TikTok’s user interface. Additional evidence of an intermediary appearance in Twitter can be faintly identified by the presence of a twitter user interface (with black background) just beneath the main image’s white field. Finally, the black bar at bottom of the image reading “Sandra Crum” and “13 minutes ago” are consistent with the mobile interface for Facebook. Thus before StunningTruthSeekr reposted this image via Twitter, it had already been propagated across different social networks at least three times, and shared at least four times overall. Also present in StunningTruthSeekr’s first image is a skewed perspective and reflection of artificial lighting, suggesting that the image was captured by photographing the user’s screen, rather than downloading or screen capture. The second image in Figure 2 depicts another vector of transmission for the “Antifa operative” post initially spread by StunningTruthSeekr. In this image, the same post appears to have been screenshotted and re-shared in the Parler app, before being shared to Twitter by RedPilled777 (@Pilled777Red) (see Figure 2 for detail of diegetic elements). “Vernacular” information practices such as these screenshottng behaviors complicate efforts at rationalizing and predicting user behaviors and are therefore challenging to automated systems (Gaboury 2015), and therefore make the identification of diegetic evidence a useful step in expanding researchers’ kit of methods and tools for disinformation detection efforts.

The second image of StunningTruthSeekr’s post also contains diegetic interface elements and evidence of screen photography. The image appears to display a Facebook post on the “Hickman County Antifa” Facebook page by “Katie Krasnow,” while the image’s skewed perspective and surrounding desktop environment suggest that it was downloaded to a user’s Macintosh desktop before being photographed for additional sharing. The white stripes on either side of the image suggest that this photographed image was subsequently recorded via screen capture over a white background. The black stripes above and below suggest the image was screen shotted once again afterwards, while the grey stripe at bottom indicates that this final act of screen capture was performed on an Apple iPhone X or later, after the manufacturer introduced the “home bar” as a replacement for its earlier “home button” designs (Patel 2017). These diegetic interface elements suggest that the original Facebook post was photographed at least once and screenshotted at least twice. They also suggest that the two images in StunningTruthSeekr’s post arrived through different histories of sharing and mimesis.

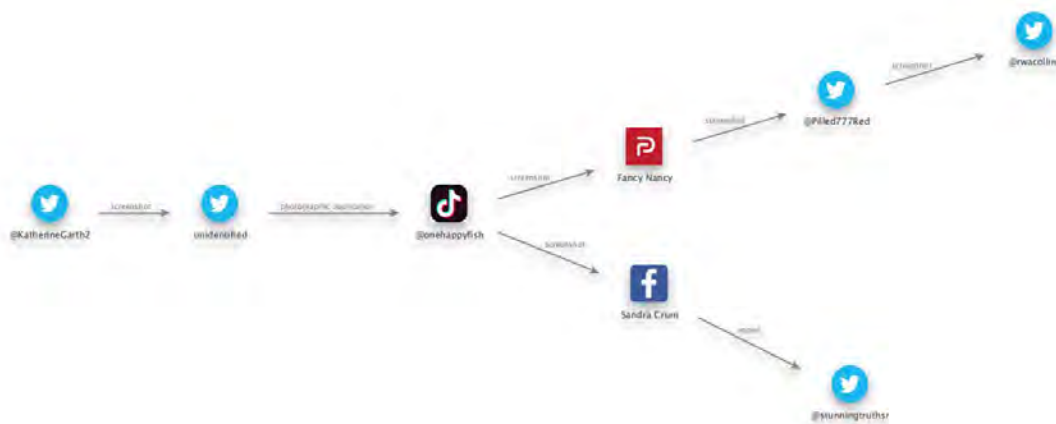


Figure 3. Linear graphical memetic analysis (visualizing spread of imagery in question)

By enumerating the particular acts and techniques of sharing used to spread this particular narrative, this case study shows that human users can interpret interface elements and qualitative properties of an image that may be skewed in perspective, obscured by lighting effects, related to specific interfaces and interface changes, and subject to inconsistently colored or oriented arrangement. Furthermore, by comparing findings using this method on multiple instances of the same memetic image, we demonstrate a method for tracking multiple branches of the memetic spread. This approach is most effective in identifying features and pathways for further exploration, whether automated or performed by humans (RQ1). At the same time, this approach has clear limitations. It does not track all sharing, but rather only detects sharing actions that produce some form of visible alteration to the image. For more subtle variations, computational analysis is warranted. In ideal cases, both approaches would be applied together in order to most effectively identify the paths used in distributing a particular unit of misinformation. Like a forensic crime scene investigation, reconstructing the specific timeline of events during analysis may help to identify the particular parties, environments, and tools used in carrying out the acts in question. These findings are generated using human perception and knowledge of the rapidly changing sociotechnical operating environments within which memetic content spreads. Thus this portion of study enables a reconstruction of activities that may not be readily identified using automated methods.

Case Study 2: Computational Analysis Using BRISQUEt (Blind/Referenceless Image Spatial Quality Evaluator: reTrained)

While digital-born imagery such as screenshots often carry diegetic markers of their propagation histories, measuring the spread of natural imagery must be analyzed separately. We analyze the propagation of natural images by measuring the compression artifacts present in natural imagery (a form of digital decay) by applying a newly trained blind, no-reference image-quality analysis algorithm in order to generate a quantified score of image characteristics that can identify the level of JPEG compression across a corpus of images. These methods help to establish provenance, hierarchical genealogies, and fingerprinting, and expand upon simple perceptual hashing with rough estimations of spread. Such findings are not readily perceived by unassisted human users, and thus the machine-driven method we propose can help to enrich interpretive analyses with additional sources of data.

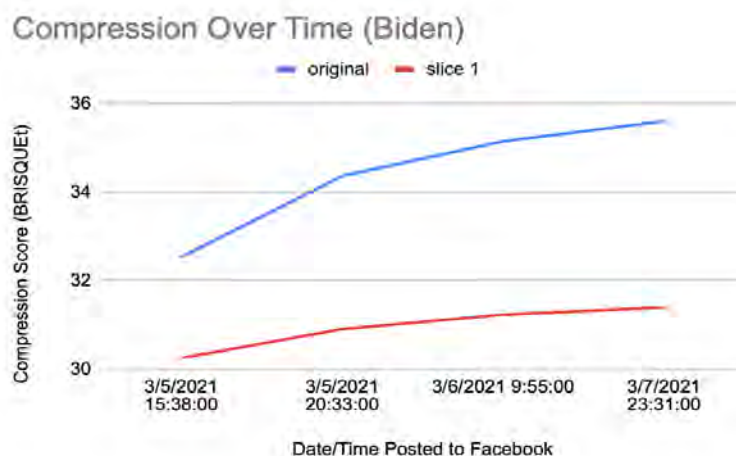
By measuring the visual quality of natural imagery, subtle changes in compression associated with reposting can be quantified, allowing for a visual fingerprinting method which functions in a similar manner to a perceptual hash, while allowing for a generalized hierarchy to be assumed. This data can be interpreted as a “genealogical” record of how close images are to the point of origin. Assuming that imagery gets more compressed as it gets shared, changes in visual compression can be used in combination with other metadata, such as timestamps, to determine patterns of sourcing and propagation.

The spread of natural imagery begins with its inception: the time, date, and location, and device with which it was captured. The original image serves as a ground truth for quality. In order to assess the spread of a particular piece of content, a memetic propagation analysis can be created, which maps the various locations discrete copies of the same image have been posted. A linear, graphical memetic analysis encapsulates the spread of an image over time while associating it with other metadata in order to assume a genealogy of spread.

BRISQUEt is a “retrained” version of the Blind/Referenceless Image Spatial Quality Evaluator (BRISQUE) tuned specifically for JPEG Compression. The authors selected 300 images sourced from a Facebook group which were exemplary of memetic content and features and compressed the collection of imagery at 35 discrete, increasing

levels of JPEG compression. Authors then repurposed existing MATLAB code for BRISQUE and produced BRISQUeT by retraining the algorithm on extracted features from the above dataset of compressed imagery. The initial BRISQUE algorithm was trained on the LIVE IQA Database, which featured 779 distorted images across five discrete distortions—JPEG and JPEG2000 compression, additive white Gaussian noise, Gaussian blur and a Rayleigh fast fading channel distortion. These natural scene statistics are used to compute a score which correlates with human opinion scores rating the quality of natural imagery. Next, a mapping is “learned from feature space to quality scores using a regression module, yielding a measure of image quality. The framework is generic enough to allow for the use of any regressor” (Mittal et al 2012, p. 4701). To train BRISQUeT, the authors compiled a database of 300 images sourced from an online conspiracy community. This initial dataset was then compressed at 30 separate JPEG compression levels, comprising 900 images total—30 copies of each image, each compressed at a different level. By limiting BRISQUeT to one distortion, JPEG Compression, and removing the other four, the remapped output score measures visual quality solely as a function of the amount of compression within an image. BRISQUeT is capable of measuring imperceptible differences in compression between multiple copies of the exact same image, calculating visual fingerprints for each instance as an image spreads on social media. A hierarchy can be assumed based on the increase in compression score. The output score is representative of BRISQUE’s original human opinion score mappings—the output score for BRISQUeT has been arbitrarily mapped based on the new features, so the output score functions similarly to the original BRISQUE scores while the actual output values are discrete to BRISQUeT. When all images selected for comparison are discrete copies of the same image, with no changes in resolution or aspect ratio, the original files can be compared directly using BRISQUeT. In other cases, changes in aspect ratio, user edits, diegetic interface elements, and other visual phenomenon can skew the results of BRISQUeT. When a corpus of imagery incorporates differences in aspect ratios, resolutions, etc., we align the images using automated scripts for common image manipulation software, so that a representative sample is sliced from each image where they overlap (Walter 2021). This ensures that images can be accurately compared. Next, we developed a GUI in MATLAB for the model, which allows users to easily open a single image for analysis, and returns a visual compression score. The code and dataset are now readily available and open-source (Hodges et al 2021).

A frame from a YouTube video filmed during the Biden presidency (occurring at the 01:22 mark) serves as an exemplary “ground truth” selection of determining a genealogical hierarchy from multiple discrete copies of the same image (Weekly Conversation 2021). This frame was selected as an ingredient asset within a new work, an image macro unrelated to the original video, and then spread memetically across many publicly accessible social networks (see Figure 4). We analyze four separate posts from March 5-7, 2021 on Facebook, each containing a discrete copy of the image. Since each of these images are discrete copies, we can directly compare both the original images and representative slices thereof. When the individual BRISQUeT scores are mapped to the timestamps posted, the image appears to “age” or “decay” as compression increases over time, leading to subtle decreases in visual quality. Determining a definite relationship as to the sourcing and reuploading of these examples requires further interpretive work, such as interviewing the page owners. However, using BRISQUeT a hierarchy can still be identified between images that are “upstream” (closer to source) and those that are “downstream” (further from source). From these findings further interpretive work can determine which copies came “before” or “after” the others.






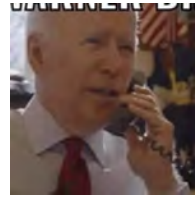
			
30.252573	30.91004	31.235117	31.39871
1	2	3	4

Figure 4. Example of digital compression that grows over time

Index	Source	File size	Original	Slice 1	Timestamp
1	<u>MCxK2</u>	38 KB	32.53254	30.252573	3/5/2021 15:38:00
2	<u>TheKinoplex</u>	30.4 KB	34.36434	30.91004	3/5/2021 20:33:00
3	<u>WheresFrankOceanAsWell</u>	31.9 KB	35.14824	31.235117	3/6/2021 9:55:00
4	<u>IndecentAsAllHell</u>	31.4KB	35.60043	31.39871	3/7/2021 23:31:00

Table 1. Sources of Biden image

Index	Source URL	Handle	Archive URL
1	https://www.facebook.com/MCxK2/photos/a.100696408010497/464898614923606/	<u>MCxK2</u>	https://websatchel.com/j/pages/O83q89UjiWDjZvQOcOhMyTyk/avAM75Bg1Pi94Ojm18KuM1bQ/
2	https://www.facebook.com/TheKinoplex/photos/a.104157184829866/205288104716773	<u>TheKinoplex</u>	https://websatchel.com/j/pages/O83q89UjiWDjZvQOcOhMyTyk/A0fiQC3YiMvCgdVlk9PqbWjj/
3	https://www.facebook.com/WheresFrankOceanAsWell/posts/285096592980532	<u>WheresFrankOceanAsWell</u>	https://websatchel.com/j/pages/O83q89UjiWDjZvQOcOhMyTyk/fBIyMxaPM0jvrScc3uFUntVO/
4	https://www.facebook.com/IndecentAsAllHell/posts/280265963455011	<u>IndecentAsAllHell</u>	https://websatchel.com/j/pages/O83q89UjiWDjZvQOcOhMyTyk/dYtfoV8WPqBHIDkR2a0EO2Wb/

Table 2. Source URLs and archived URLs for Biden image

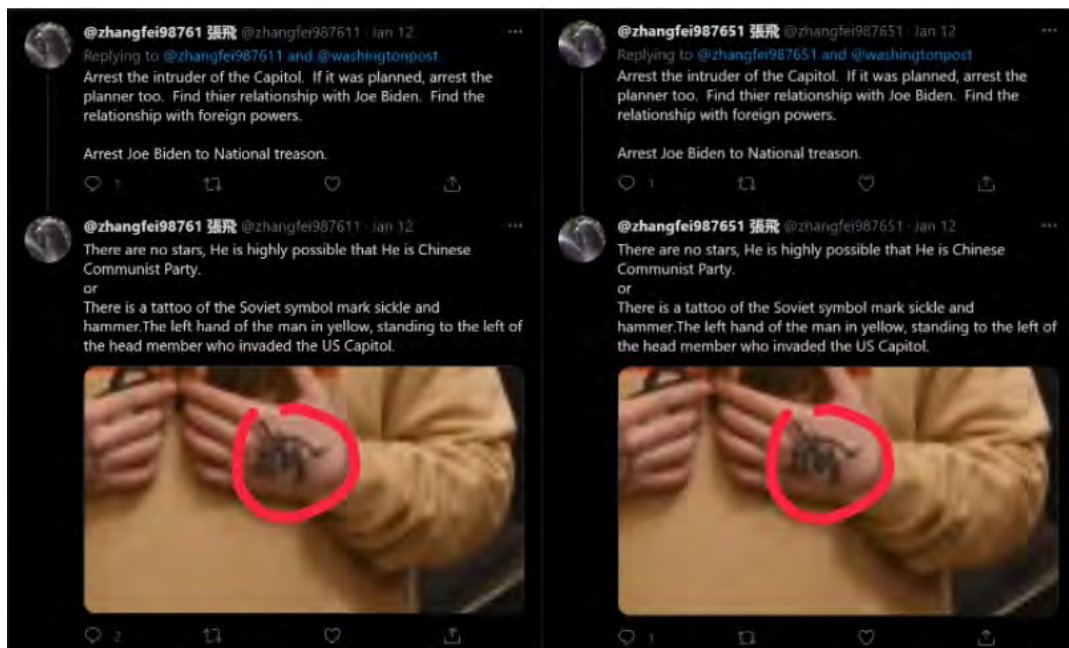


Figure 5. Selection of tweets and images examined with BRISQUEt

In addition to identifying hierarchies, BRISQUEt can also be used to fingerprint discrete copies or slices of a corpus of imagery. This method can be used to determine content sources programmatically using visual quality alone. We detail an example of coordinated inauthentic behavior (CIB), where two different Twitter accounts, @zhangfei987611 and @zhangfei987651, post the exact same image across 5 separate posts. The similarities in these discrete handles along with the BRISQUEt fingerprinting strongly suggests that these two accounts are managed from a coordinated source, and the image posted across both accounts was sourced from the same content repository. Thus we conclude that BRISQUEt specifically, and computational visual analysis more generally, assists in reconstructing the memetic spread of natural imagery in ways not easily quantified by human viewers (RQ2). Whereas the SMOC method identifies born-digital characteristics like diegetic interface elements, computational analysis with BRISQUEt works best in comparing natural photographic imagery.



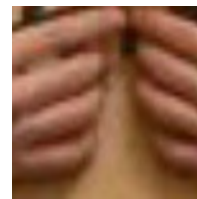
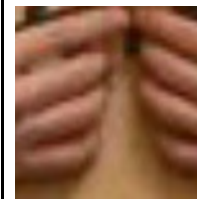
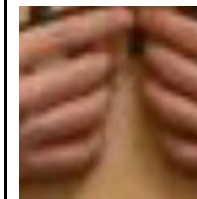
				
zhangfei987611	zhangfei987611	zhangfei987611	zhangfei987651	zhangfei987651
24.03049825	24.03049825	24.03049825	24.03049825	24.03049825
7	8	10	11	12

Table 3. Comparison of image details (appearance and BRISQUEt score)

index	handle	file size	original	slice 1	slice 2	slice 3
7	zhangfei987611	31 KB	30.89832572	28.23423216	27.2201	24.03049825
8	zhangfei987611	31 KB	30.89832572	28.23423216	27.2201	24.03049825
10	zhangfei987611	31 KB	30.89832572	28.23423216	27.2201	24.03049825
11	zhangfei987651	31 KB	30.89832572	28.23423216	27.2201	24.03049825
12	zhangfei987651	31 KB	30.89832572	28.23423216	27.2201	24.03049825

Table 4. Complete BRISQUEt scores for hand tattoo image

index	source	archive
7	https://twitter.com/zhangfei987611/status/1349683852357222402	https://websatchel.com/j/pages/O83q89UjiWDjZvQOcOhMyTyk/EpraGkXKP9hxURJi5vwtiJKY/
8	https://twitter.com/zhangfei987611/status/1349314369990000641	https://websatchel.com/j/pages/O83q89UjiWDjZvQOcOhMyTyk/IRwe8YD4Af8DiUDDXiEY9IqF/
10	https://twitter.com/zhangfei987611/status/1349111386194919424	https://websatchel.com/j/pages/O83q89UjiWDjZvQOcOhMyTyk/rx0g4wA0vLoDmQLC9QPU1hxE/
11	https://twitter.com/zhangfei987651/status/1349014813901529091	https://websatchel.com/j/pages/O83q89UjiWDjZvQOcOhMyTyk/f7UbOfqAOTSr7SILcWh4mpkC/
12	https://twitter.com/zhangfei987651/status/1348934799763795970	https://websatchel.com/j/pages/O83q89UjiWDjZvQOcOhMyTyk/C8ultIhT767gh3NTHgTqYiKd/

Table 5. Post URLs and archived URLs for Tweets examined with BRISQUEt

CONCLUSION

This study has shown a combination of methods for reconstructing the memetic spread of media content online. It has done so by highlighting the roles of specific sharing modalities related to the computing and social networking platforms that users employ in the sharing process. Practices like screen photography, cross-posting on multiple networks, capturing screenshots, and uploading in new compressed media formats all leave forensic traces of user activity in the media objects. For visual characteristics related to photography and cross-platform spread, an interpretive approach can effectively enumerate the layers of evidence created by specific sharing actions. For subtler visual characteristics related to image compression, a computational analysis can help to establish which instances of a file are further “upstream” (closer to source), and which are further “downstream” (further away from source). By combining these methods, the SMOc BRISQUEt model can assist in reconstructing the spread of imagery that is both natural and digital in origin. By combining the human and computational methods demonstrated in this paper, researchers can develop sophisticated accounts of memetic spread online, sensitive to both the subtleties of cultural practices as well as those of computational objects.

While this approach is limited by its inability to ascertain exact numbers of sharing actions and/or image re-uploads, it nevertheless provides an enriched sense for the techniques and networks used in circulating any given image. Thus while existing and current research effectively addresses the question of identifying misleading information online, our approach instead shows a method for understanding the spread of misleading information once it has been identified. Future research concerning the memetic spread of online content can be enriched by employing the methods in this paper insofar as these methods work to reveal the interrelated human and computational factors that determine information spread. Rather than favoring either cultural or computational analysis alone, this paper shows the potential for combining both.

ACKNOWLEDGMENTS

The authors thank Dr. Alan Bovik and the UT Austin Laboratory for Image and Video Engineering for valuable input concerning the image quality evaluation algorithms used in this project. Thanks also to Emily Berk for her archival work and research support, and Jansen Derr for finalizing the software release. The authors also thank all reviewers, as well as publications and support personnel affiliated with ASIS&T during the production and review of this project.

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Measuring Quality of Wikipedia Articles by Feature Fusion-based Stack Learning

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ABSTRACT

Online open-source knowledge repository such as Wikipedia has become an increasingly important source for users to access knowledge. However, due to its large volume, it is challenging to evaluate Wikipedia article quality manually. To fill this gap, we propose a novel approach named “feature fusion-based stack learning” to assess the quality of Wikipedia articles. Pre-trained language models including BERT (Bidirectional Encoder Representations from Transformers) and ELMo (Embeddings from Language Models) are applied to extract semantic information in Wikipedia content. The feature fusion framework consisting of semantic and statistical features is built and fed into an out-of-sample (OOS) stacking model, which includes both machine learning and deep learning models. We compare the performance of proposed model with some existing models with different metrics extensively, and conduct ablation studies to prove the effectiveness of our framework and OOS stacking. Generally, the experiment shows that our method is much better than state-of-the-art models.

KEYWORDS

Wikipedia article quality assessment, language representation model, deep ensemble learning.

INTRODUCTION

As an online encyclopedia and collaboratively writing tool, Wikipedia has been frequently used to obtain knowledge (Anderka, 2013). However, since Wikipedia articles can be created and modified by visitors without any threshold, their quality may differ considerably. Since information quality is proved to be highly associated with the experience and satisfaction of users on information services (Rowley & Johnson, 2013; Yaari et al., 2011), there is an urgent need to maintain the quality of Wikipedia articles. In Wikiproject, a small number of articles are manually classified into six categories according to their quality (Shen, Qi, & Baldwin, 2017). However, approximately 30 million Wikipedia articles exist in 285 languages, and the number has been continuously increasing, making it impossible to assess the quality of all the Wikipedia articles manually.

To solve this problem, researchers have proposed various approaches. Some of them applied metric-based methods to classify article quality (Betancourt, Segnine, Trabuco, Rezgui, & Jullien, 2016; Cozza, Petrocchi, & Spognardi, 2016; Dang & Ignat, 2016a, b, 2017; Zhang, Hu, Zhang, & Yu, 2018). In most of these methods, human efforts are still needed. To achieve automatic classification, machine learning algorithms have been increasingly used to assess and predict the quality of Wikipedia articles (Anderka, 2013; Arazy & Nov, 2010; Blumenstock, 2008a; Dalip, Gonçalves, Cristo, & Calado, 2009). But many of them treated article quality assessment as a binary classification task. While structure features, edit history, and other features are considered, the existing research often ignores article content. A few attempts have been made to apply deep learning algorithms to solve this problem. However, most of these models demand adjustment and assembling for better performance.

Deep ensemble learning approach, a new combination model built based on multiple simple models (Dasarathy & Sheela, 1979; Hansen & Salamon, 1990; Freund & Schapi, 1995), gains superiority when handling tasks with complex data and fuzzy features. In this study, we propose a novel approach that leverages deep representation models, including BERT (Devlin et al., 2019), ELMo (Peters et al., 2018), and stack learning model to assess the quality of Wikipedia articles efficiently. We firstly applied BERT and ELMo to extract semantic information in Wikipedia article content, and propose a feature framework including auto-extracted features and statistical features. Combining both conventional machine learning models and deep learning models, we propose our deep stacking model. In this model, optimized parameter combinations are obtained through an automatic parameter tuning method. Moreover, extensive comparisons are conducted from different dimensions: classification accuracy, loss, and error.

RELATED WORKS

Various approaches have been proposed to address the problem of Wikipedia article quality assessment. Some researchers have applied metrics to evaluate article quality. Structure features (Dalip et al., 2011; Stvilia et

al., 2005), network feature (Dalip et al., 2009), edit history (Stvilia et al., 2005; Dalip et al., 2009; Wilkinson & Huberman, 2007), writing styles (Anderka et al., 2012; Dalip et al., 2009, 2011), and text statistics (Anderka, 2013; Blumenstock, 2008a) are considered to be efficient features to estimate Wikipedia article quality. In such methods, several indicators are proposed according to the information available in the articles. Limited information makes it hard to characterize articles completely and comprehensively, which may lead to bad performance. Moreover, metric-based approaches are not automatic since the metrics need to be determined manually. To solve that problem, machine learning algorithms have been applied to Wikipedia article quality assessment. They combined machine learning models with hand-crafted features to assess the quality of Wikipedia articles (Shen et al., 2017; Zhang et al., 2018; Ferschke et al., 2012; Khairova et al., 2017; Wang & Li, 2020; Wang et al., 2019). However, semantic features from the article content are often ignored in these approaches. Only a few studies extracted semantic features using simple embeddings, which failed to obtain the deeper semantics of each article.

Regarding the classification model, the existing studies tend to leverage basic models rather than ensemble models. Usually, ensemble models can avoid the disadvantages of the basic models and yield better performances. Many researchers have applied ensemble learning methods on some NLP tasks, such as sentiment analysis (Zhang et al., 2018; Al-Azani & El-Alfy, 2017; Sultana & Islam, 2020), spam detection (Fattahi, & Mejri, 2021), and incident classification (Sarkai et al., 2019). The main reason why ensemble learning performs better than the individual models is that ensemble models invite different models to increase diversity. In light of this, we propose a novel deep ensemble model integrating different classifiers with automatically extracted semantic features by BERT and ELMo and hand-crafted statistical features.

FEATURE FUSION FRAMEWORK

Prior research has integrated all sorts of discrete features of Wikipedia articles, which proved helpful in predicting article quality (Wang & Li, 2020). However, such features are handcrafted and inconsistent with the idea of deep learning to learn semantic features automatically. Therefore, we reconsidered the six quality-related feature sets that have been used. And we find that except edit history features and network features, other features, including text statistics features, structure features, readability scores, and writing styles, are all extracted by the secondary calculation from Wikipedia articles. Hence, in this paper, we decide to replace these manually calculated features with automatic text representation vectors. In particular, we keep edit history and networking features because they cannot be extracted from plain text.

Sequence Model Based Semantic Features

There are two mainstream encoding methods for text classification: the sequence model and the full attention model. Sequence models, such as RNN (Recurrent Neural Network) (Schuster & Paliwal, 1997), LSTM (Long Short-Term Memory) (Hochreiter & Schmidhuber, 1997), and GRU (Gate Recurrent Unit) (Cho et al., 2014), regard a document as a word sequence. ELMo is a contextualized sequence model, where every word presentation relies on the full context of the sequence, and multiple LSTM layers are required to form the representations. The intermediate layers in biLM (bidirectional language model) are leveraged in ELMo. For the i th token in a sequence, a set of representations V_i is obtained by a biLM with K layers in Eq. (1).

$$v_i = \{\vec{L}_{i,j}, \overleftarrow{L}_{i,j}, t_i\} (j = 1, \dots, K) = \{L_{i,j}\} (j = 0, \dots, K) \quad (1)$$

$\vec{L}_{i,j}$: forward representation from LSTM

$\overleftarrow{L}_{i,j}$: backward representation from LSTM

t_i : token representation

To connect to the downstream model, all layers in v_i are flattened into vector \mathbf{ELMo}_i . The computation of \mathbf{ELMo}_i is shown in Eq. (2).

$$\mathbf{ELMo}_i = E(V_i) = \varepsilon \sum_{j=0}^K w_j L_{i,j} \quad (2)$$

Typically, ELMo is combined with a supervised model for specific tasks. For a Wikipedia article D , it can be denoted as a word sequence, $D = \{w_1, w_2, \dots, w_n\}$. Then, the document representation of D is expressed as shown in Eq. (3).

$$V_{elmo} = \{\mathbf{ELMo}_1, \mathbf{ELMo}_2, \dots, \mathbf{ELMo}_n\} \quad (3)$$

Attention Mechanism Based Semantic Features

The full attention model, like BERT, abandons the sequence structure of texts and represents texts with solely attention mechanisms. The innovation of such models lies in the pretraining stage. BERT contains a multi-layer bidirectional transformer encoder. In each layer, a two-way self-attention structure and a multi attention model are

adopted. In this paper, we extract attention-based semantic features with BERT-as-Service (Han, 2018) and a pretraining BERT model. The parameters of BERT architecture used are listed below.

- Bert_{Base}: L = 12, H = 768, A = 12, total parameters = 110 m

L: number of layers (i.e., transformer blocks)

H: number of hidden nodes

A: number of self-attention heads

The BERT features can be denoted as Eq. (4).

$$V_{bert} = BERT_as_Service(D) \quad (4)$$

Feature Fusion with Non-semantic Features

We further enriched non-semantic features, including network features and edit history features, based on feature sets proposed by Wang and Li. (Wang & Li, 2020). In terms of network features, considering that Wikipedia provides a hyperlink called "What to link here" (Redump Wiki, 2019), which provides link URLs of every Wikipedia page, we collected relevant link data and loaded them into a graph. Then we determined the following network features, as shown in Table 1.

Number	Feature name	Description
1	in_degree	Number of articles cited by the article
2	out_degree	Citation count of the article by other articles
3	neighbors	Number of neighboring articles of the article in an undirected graph
4	all_neighbors	Number of neighboring articles of the article in a directed graph
5	page_rank	Page rank of an article, which measures the popularity of the article
6	reciprocity	Number of articles that cite each other
7	clusteringC	Ratio among the number of edges of the node, its n neighboring nodes and the total number of edges
8	translations	Count of translations of the article into another language
9	associativity_in_in	Ratio between the in-degree of the article and the in-degree sum of its neighboring articles
10	associativity_in_out	Ratio between the in-degree of the article and the out-degree sum of its neighboring articles
11	associativity_out_in	Ratio between the out-degree of the article and the in-degree sum of its neighboring articles
12	associativity_out_out	Ratio between the out-degree of the article and the out-degree sum of its neighboring articles

Table 1. Network Features

To feed these features into neural network, we standardized them and transferred them into a vector, as shown in Eq. (5).

$$V_{net} = \text{standardized}(f_{n1}, f_{n2}, \dots, f_{n12}) \quad (5)$$

f_{ni} represents the i th feature in Table 1.

Edit history of Wikipedia is a record of the modification trace of every article, including total edits, editors, first edit, IP edits, month counts, top editors, and so on. After some calculations, edit history features were obtained, as shown in Table 2.

Number	Feature name	Feature Description
1	age	Age of the article
2	age_per_edit_30_days	Mean time between two edit behaviors over the past 30 days
3	avg_edit_per_usr	Ratio between the total number of edits and the number of editors
4	ip_count	Total number of anonymous users represented by Internet protocol who make comment/modification or review on the article
5	total_edits_count	Number of edits made by registered and anonymous users
6	editors_count	Number of registered editors for the article
7	occasional_edit_bhv_rate	Percentage of edits from occasional editors
8	edits_per_Last_3_Months	Ratio between the number of edits made during the past 3 months and the total number of edits
9	Most_active_editors_bhv_rate	Percentage of edits made by the most active editors
10	std_dev_edit_per_editor	Standard deviation of the number of edits made by editors
11	Edits_per_day	Ratio between the number of edits and the number of days the article has existed
12	discussion_count	Total number of discussions by the user for the article

Table 2. Edit History Features

Similarly, we represent the standardized edit history vector as Eq. (6).

$$V_{history} = \text{standardized}(f_{h1}, f_{h2}, \dots, f_{h12}) \quad (6)$$

After all the features had been obtained, we concatenated them to get the vectorized features for quality classification, as shown in Eq. (7).

$$V = V_{elmo} \oplus V_{bert} \oplus V_{net} \oplus V_{history} \quad (7)$$

Overall, the process and architecture of the proposed feature fusion framework can be illustrated as Figure 1.

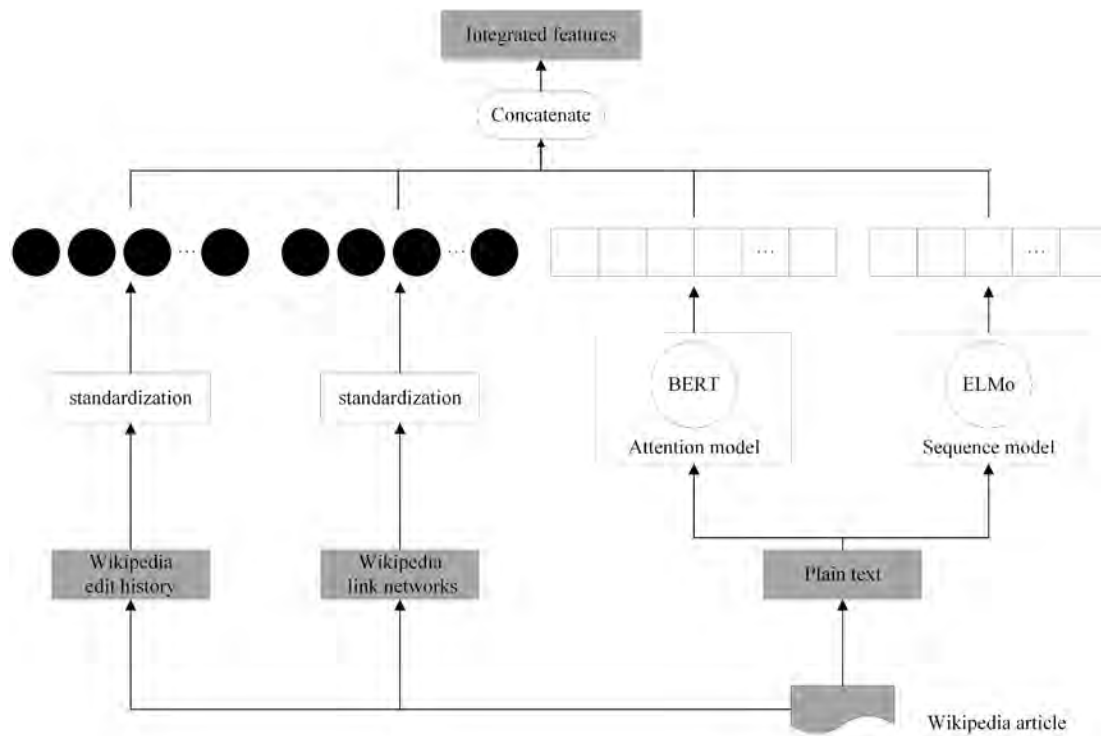


Figure 1. Proposed Feature Fusion Framework

STACKED LEARNING

Generally, stacking learning involves inputting all training data into sub-classifiers and combining the predicted probabilities into a second-round training (Sikora, Al Laymoun, 2015). However, the simply combined models cannot eliminate a model's bias to a specific dataset (Wolpert, D.H. 1992). To fill this research gap, the OOS stacking model is proposed. OOS increases the diversity of the entire model and the diversity of training data. In the model training process, only part of the data is used to train the base models. The OOS stack learning includes two layers: the base model and the meta-learner. Meta-learners are used to reduce prejudice against the basic models. The logic of the OOS is as follows. First, the dataset is divided into training dataset and holdout dataset. Then k-fold cross-validation is performed on the training data. K-fold cross-validation is a popular method of evaluating machine learning models on limited samples by resampling, in which k stands for the number of subsets that a given dataset is to be split into. The k-1 data slices are used to train the base classifier, and the rest is used as the test data. The Holdout data and the test data are respectively input to the training model, and the holdout and test predictions are obtained. Next, the holdout and test predictions are averaged and aggregated separately to build the next layer's testing data and training data. Finally, the meta-model is used to perform classification training using the updated data.

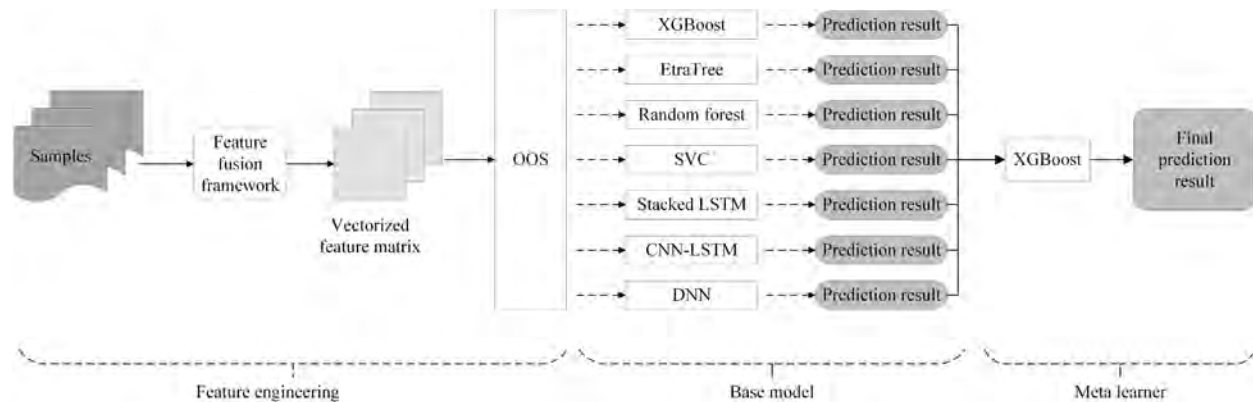


Figure 2. Stacked Model Architecture

Figure 2 shows the architecture of our stacking learning architecture, where base models include seven different models. There are three tree-based models, including Xgboost, Extra tree, and random forest. To increase model diversity, SVC (Support Vector Machine) was also used as the base model. Besides, some deep learning models, including stacked LSTM, CNN-LSTM, and DNN, were added into the ensemble model. At last, Xgboost was adopted to process the output from base models and output final prediction.

EXPERIMENT

Dataset

In this study, we selected 11,136 English Wikipedia articles as experiment data after collecting and cleaning the originally labeled datasets from WikiProject (Wikipedia, 2021). The articles were manually divided into six categories: FA, A, GA, B, Start, and Stub, as listed in Table 3. There are approximately 2000 articles in each quality category. We grouped the original classes into three categories: FA and A as high-quality articles; GA and B as medium-quality articles; and Start and Stub as low-quality articles. One of the reasons for this division is that the limited amount of labeled data is difficult to support accurate classification of multiple categories. The other is that the boundary between adjacent original categories is not very clear since they are labeled manually and subjectively.

Index	Class	Criteria
1	FA	After thorough review by impartial WikiProject reviewers, the article is granted feature article status.
2	A	Impartial reviewers from WikiProject or elsewhere has found the article to be well-organized and substantially complete.
3	GA	After examination by one or more impartial reviewers from WikiProject, the article has attained good article status.
4	B	The article is mostly complete without major problems, but further work is needed to achieve good article standards.
5	Start	The article is under development but still incomplete and might not cite adequate reliable sources.
6	Stub	The article only gives a basic description of the topic. All very-low-quality articles fall into this category.

Table 3. Quality Categories

Results and Analysis

In this part, the experimental results are discussed. The models are implemented in Keras 2.0.8 and TensorFlow 1.1.0.

Classification Accuracy

Table 4 lists the performance of different models on assessing Wikipedia article quality. The metrics include accuracy, precision, F1 and F-beta score. Apart from the proposed model, the performance of some approaches from existing work is listed as baselines, including stacked LSTMs (Wang et al., 2019), Decision tree (Wang et al., 2019), and some models good at NLP like TextCNN. From table 4, we can find out the proposed method yields the best classification performance. Compared to the stacked LSTMs (Wang et al., 2019), decision tree (Wang et al., 2019), and random forest (Warncke-Wang et al., 2015, Dang & Ignat, 2016a), the accuracy of our model with Lookahead optimizer (Zhang, Lucas, Ba, & Hinton, 2019) improves by 4.3%, 4.4%, and 6.2%, respectively. TextCNN yields the second-best performance, which is even better than stacked LSTM (Wang et al., 2019).

From the results, we can find out stacked LSTMs work better than LSTM, partially because stacked LSTMs have more layers than LSTM which can extract more features from Wikipedia articles at the cost of a more complicated model architecture. Compared to the existing approaches, the proposed model improves classification performance significantly. Due to the sheer size of Wikipedia, an improvement of this magnitude will make an enormous difference in terms of quality assessments of Wikipedia articles.

Model	Accuracy	Precision	F1	F-beta
proposed method	0.7546	0.7532	0.7523	0.7524
Stacked LSTMs (Wang et al., 2019)	0.7116	0.7073	0.7085	0.7075
Decision tree (Wang et al., 2019)	0.5978	0.6023	0.5998	0.6012
Random forest (Warncke-Wang et al., 2015, Dang & Ignat, 2016a)	0.6931	0.7136	0.6947	0.7040
TextCNN	0.7214	0.7228	0.7220	0.7225
CNN	0.6884	0.6902	0.6890	0.6896
LSTM	0.6765	0.6960	0.6829	0.6899

Table 4. Model performance

Comparison of OOS Stacking with General Stacking

To validate the effectiveness of the proposed OOS stacking, we applied the general stacking on the same dataset. For the general stacking, the model architecture was the same as our model. However, in the first level, the whole training data was fed into each basic model to predict training data. The prediction results of training data for each model were stacked as the training features for the next level. Based on the stacked features, Xgboost was trained to output prediction for testing data. According to table 5, the general stacking performs well in assessing the quality of Wikipedia articles. Its precision is better than our model, but generally our model yields better performance than the general stacking model. From figure 3, we can find that our model performs better in classifying articles with good and low quality. However, the general stacking model yields excellent performance in classifying medium-quality articles better than our model by 9%.

Model	Accuracy	Precision	F1	F-beta
proposed stacking strategy	0.7546	0.7532	0.7523	0.7524
General stacking	0.7439	0.7554	0.7421	0.7481

Table 5. Model performance comparison of different stacking

Ablation Studies

In this section, ablation studies were conducted in two dimensions: machine learning models and feature sets. For ablation study in machine learning models, each basic model was applied on the same Wikipedia dataset with the combined feature framework. For ablation study in feature sets, different feature sets were used with OOS stacking model.

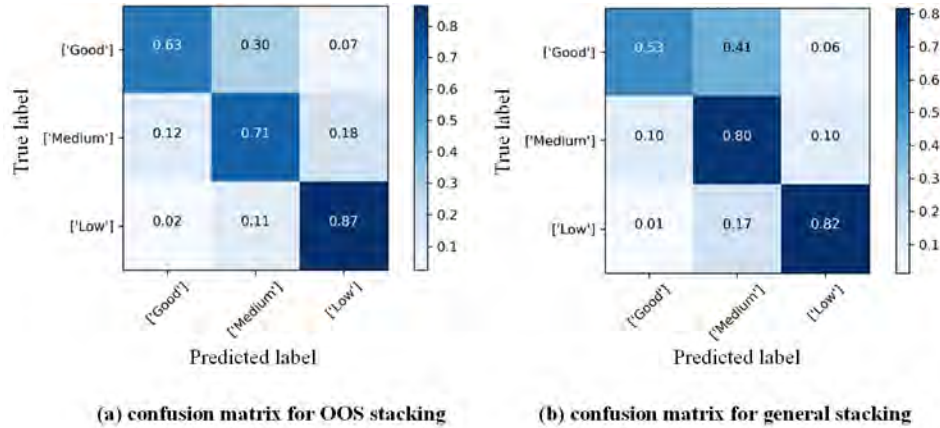


Figure 3. Confusion matrix for OOS stacking and general stacking

1) *Ablation in basic machine learning models*

Table 6 shows the classification performance when only one model is applied to the Wikipedia dataset. Generally, our model performs much better than each basic model. Compared to Xgboost, the proposed model shows superiority in most metrics, while its precision is worse. Tree-based models including Random Forest, Extra tree and Xgboost yield better performance than other models. Even though deep learning models have achieved excellent results in several different areas, Tree-based models, especially Xgboost, are competent due to simpler model architecture and fewer parameters.

Model	Accuracy	Precision	F1	F-beta
Our model	0.7546	0.7532	0.7523	0.7524
Stacked LSTMs (Wang et al., 2019)	0.7116	0.7073	0.7085	0.7075
CNN_LSTM	0.6139	0.6238	0.6103	0.6163
DNN	0.6694	0.6766	0.6716	0.6743
SVC	0.4854	0.4929	0.4652	0.4747
Random Forest	0.6615	0.6775	0.6634	0.6704
Extra tree	0.6941	0.7101	0.6953	0.7025
Xgboost	0.7501	0.7563	0.7517	0.7540

Table 6. Classification performance for each model

Table 7 shows the classification performance of the model which rules out one specific base learner. Generally, the tree-based models yield better performance than others, especially for Xgboost. However, random forest performs poorly in precision and F-beta which has negative effect on classification performance. As to deep learning models, CNN_LSTM improves classification performance most significantly.

Model	Accuracy	Precision	F1	F-beta
Without Stacked LSTM	0.0044	0.0042	0.0043	0.0042
Without CNN_LSTM	0.01201	0.0125	0.0129	0.0128
Without SVC	0.0006	0.0006	0.0004	0.0004
Without DNN	0.0014	0.0014	0.0014	0.0014
Without Random Forest	0.0003	-0.0005	0.0002	-0.0001
Without Extra Tree	0.0033	0.0031	0.0036	0.0034
Without Xgboost	0.0634	0.0645	0.0642	0.0644

Table 7. Classification performance without each model

2) Ablation in feature framework

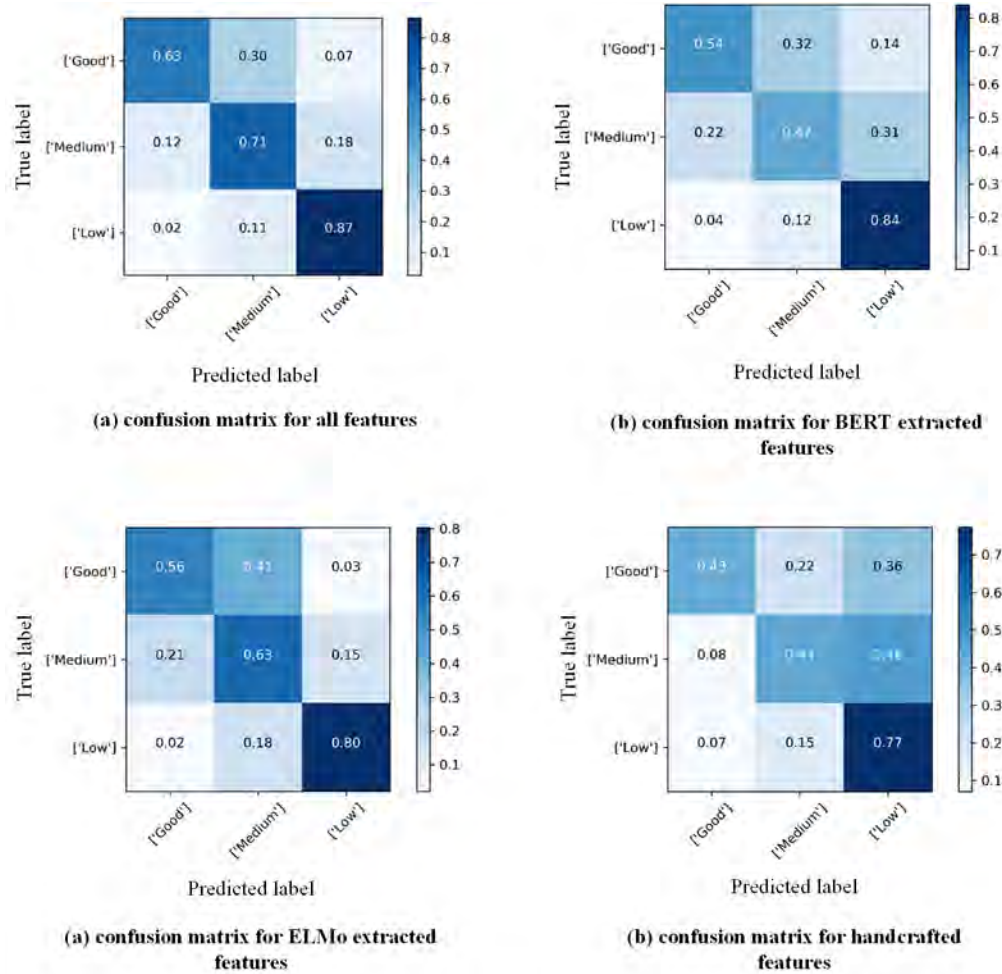


Figure 4. Confusion matrix for different feature sets

In this section, different feature sets were used with the OOS stacking model to assess Wikipedia article quality. Generally, the combined feature set performs significantly better than each separate feature set in table 8. Surprisingly, ELMo extracted features perform much better than BERT extracted ones in spite that BERT has broken many records in several NLP tasks. Compared to auto-extracted features, handcrafted features yield worse performance, because auto-extracted features framework focuses on Wikipedia article content, whereas the handcrafted features are related to Wikipedia link graph and edit history. From figure 4, we can find out all the feature sets can easily identify Wikipedia articles with low quality. However, BERT and handcrafted features fail to identify articles with medium quality largely. The handcrafted features are also not suitable for detecting articles with good quality. In a nutshell, the combined feature set performs better than the separate feature sets largely. The handcrafted features perform the worst in all categories of articles.

Feature sets	Accuracy	Precision	F1	F-beta
All features	0.7546	0.7532	0.7523	0.7524
BERT extracted features	0.6294	0.6198	0.6193	0.6183
ELMo extracted features	0.6819	0.6862	0.6832	0.6848
Handcrafted features	0.5693	0.5826	0.5585	0.5686

Table 8. Classification performance for different feature framework

CONCLUSION AND DISCUSSION

The rapid growth of user-generated content makes it increasingly difficult to maintain its quality. However, the quality of articles is essential to Wikipedia as a source of knowledge. Due to the size of Wikipedia items, it is infeasible to assess each article manually. Consequently, an automatic approach to assess Wikipedia articles is demanding. In this study, we present a novel approach that utilizes deep representation models including BERT, ELMo, and stack machine learning models to fill this gap, which is also our main contribution. We first use BERT and ELMo to extract semantic information in Wikipedia articles, and then propose a feature fusion framework that includes semantic features and statistical features. Combining the traditional machine learning models with the deep learning models, our deep stacking model is proposed to effectively solve the quality assessment problem of Wikipedia articles.

To the best of the authors' knowledge, this is the first paper to assess Wikipedia article quality with feature fusion framework and OOS stacked model. An extensive experiment has been conducted which includes a performance comparison between our model and previous research, ablation studies in feature framework and base learners. Generally, our model significantly improves the classification performance. In the classification of low-quality Wikipedia articles, our model shows very high accuracy. Conclusively, our model shows great promise for automatically classifying articles with different quality. However, our model does not yield satisfying accuracy on neutral- and good quality as expected. Besides, image features are ignored in this paper although images occur widely in Wikipedia articles. So, in future work, we will combine more different feature auto-extraction approaches with the proposed feature framework and incorporate some state-of-the-art models into the OOS stacking model to improve classification performance. More importantly, we will try to fuse text features and image features to conduct multi-modal quality assessment experiment to explore the importance of different kinds of features.

ACKNOWLEDGEMENTS

This work was supported by the National Natural Science Foundation of China [No. 72074171] and [No. 71774121]. The numerical calculations in this paper were conducted on the supercomputing system at the Supercomputing Center of Wuhan University.

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"COVID19 is_": The Perpetuation of Coronavirus Conspiracy Theories via Google Autocomplete

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ABSTRACT

As the impact of the COVID-19 pandemic grew in 2020, uncertainty surrounding its origins and nature led to widespread conspiracy-related theories (CRT). Use of technological platforms enabled the rapid and exponential dissemination of COVID-19 CRT. This study applies social contagion theory to examine how Google Autocomplete (GA) propagates and perpetuates these CRT. An in-house software program, Autocomplete Search Logging Tool (ASLT) captured a snapshot of GA COVID-19 related searches early in the pandemic (from March to May 2020) across 76 randomly-selected countries to gain insight into search behaviors around the world. Analysis identified 15 keywords relating to COVID-19 CRT predictions and demonstrate how searches across different countries received varying degrees of GA predictions. When grouped with similar keywords, two major categories were identified "Man-Made Biological Weapon" (42%, n=2,111), and "Questioning Reality/Severity of COVID-19" (44%, n=2,224). This investigation is also among the first to apply social contagion theory to autocomplete applications and can be used in future research to explain and perhaps mitigate the spread of CRT.

KEYWORDS

COVID-19, coronavirus, Google Autocomplete, conspiracy theory, social contagion.

INTRODUCTION

The COVID-19 pandemic of 2020 rapidly changed the daily lives of people across the globe. It also spread fear. Differing stories about its origin, cures, and appropriate actions for COVID-19 dominated the news and social media platforms (Shahsavari, Holur, Tangherlini & Roychowdhury, 2020). Stemming from this uncertainty, COVID-19 conspiracy-related theories (CRT) arose. In general, a conspiracy theory helps explain major events involving a stealthy plot by a dominant or malicious group (Douglas, 2017). The goal of this research is to understand how Google Autocomplete (GA) is playing a role in propagating COVID-19 CRT through the lens of social contagion theory, taking a geospatial perspective across 76 countries.

It is important to study COVID-19 CRT because conspiracy-related storytelling can spread incorrect or misleading information that helps solidify others' beliefs and inspire individuals to take action (Shahsavari, et al., 2020). Once exposed to CRT, individual's lines of thought may be influenced, even though previously they would perhaps have never considered these ideas. Overall, promoting conspiracy theories can potentially induce long-lasting cynicism toward the government or ruling entities by engaging viewers in messaging and increasing the theory's credibility (Kim & Cao, 2016). Social media is also often used to discuss and promote conspiracy-beliefs (Goreis & Kothgassner, 2020). These technological platforms can potentially spread COVID-19 CRT throughout the population rapidly and exponentially as the popularity of trending posts is frequently more important than facts (Allem, 2020). For comparison, there have been over 52 million posts from conspiracy-related sites regarding COVID-19, while the World Health Organization (WHO) and Center for Disease Control (CDC) released several hundred thousand posts (Mian & Khan, 2020). Additionally, COVID-19 CRT tweets such as #FilmYourHospital gained popularity when going viral in late March (Gruzd & Mai, 2020). These COVID-19 related CRT have become so mainstream that they have been discussed and debated by the news media and politicians (Stephens, 2020).

Aside from research in social media platforms, less obvious ways COVID-19 CRT have been promoted have not yet been explored in-depth. This study seeks to gain insight into the propagation of COVID-19 CRT worldwide through examining GA. GA works by using results known as "predictions" to provide shortcuts for completing a search term (Roy & Ayalon, 2020). When a user begins typing a term in Google's search box, a list of GA predictions (search terms) appears below the box. These search terms can then be easily clicked on by the person initiating the search, although they may or may not have been what the individual intended prior to seeing the "prediction." According to Google's public liaison for search, GA results are called predictions rather than suggestions: "Autocomplete is designed to help people complete a search they were intending to do, not to suggest new types of searches to be performed" (Sullivan, 2018). It is difficult to separate GA's algorithms from the intention of the searcher. However,

according to Roy and Ayalon (2020) "Google autocomplete displays predictors based on actual searches carried out by a population, with some variations owing to a user's personal search history, current events, language, and geographical location. Therefore, Google is a mere reflection of what people wish to know in the first place (p. 1026)." GA thus captures, reflects, and amplifies a population's interests and may thus influence society's perceptions and beliefs (Roy & Ayalon, 2020). GA may act as a subtle yet useful looking glass reflecting trending phrases generated by members of society, thus allowing researchers to gain insight into individual or group perceptions and beliefs to understand what COVID-19 CRT exist and how they are spread.

These predictions may be intended to be a shortcut to complete a user's search. However, in making search predictions immediately visible, GA may influence a person's thought process, curiosity, or knowledge of a particular subject (Roy & Ayalon, 2020), leading the user down search paths that they may not have otherwise discovered. Roy and Ayalon (2020) assert that Google plays a "dual role," first by storing existing attitudes and beliefs, and then by acting as a reflection of this information, reinforcing these beliefs. To take it a step further, GA not only reinforces these beliefs but also spreads them to new individuals, perhaps unintentionally, as users focus on popularity instead of accuracy, as is the case with social media (Allem, 2020).

In addition, this study is significant as it is among the first to apply social contagion theory (Marsden, 1998) as a framework to examine COVID-19 CRT predictions. Social scientific research has shown that beliefs, attitudes, and behaviors can be spread through communities similar to the way an infectious disease passes from one person to another. In social contagion, users actively seek out and propagate the information (Hodas & Lerman, 2014). However, unlike social media, when using search engines users may not be aware of how information (or misinformation) is being propagated through autocomplete. According to Miller and Record (2017), an individual search can minimally influence the autocomplete algorithm, but large groups of individuals in a given region have the ability to trigger the algorithm, making the predictions trend. "Autocomplete inevitably and irreparably induces changes in users' epistemic actions, particularly their inquiry and belief formation. While these changes have potential epistemic benefits for searchers and society, they also have harms, such as generating false, biased, or skewed beliefs about individuals or members of disempowered groups" (Miller & Record, 2017, p. 1959). The authors acknowledge that we are considering GA as a social process, yet recognize that GA predictions are, of course, inherently tied to Google's algorithms.

LITERATURE REVIEW

Conspiracy-Related Theories and COVID-19

Joseph Uscinski of the University of Miami says that CRT "are generally characterized by acceptance of the following propositions: Our lives are controlled by plots hatched in secret places. Although we ostensibly live in a democracy, a small group of people run everything, but we don't know who they are. When big events occur – pandemics, recessions, wars, terrorist attacks – it is because that secretive group is working against the rest of us" (LaFrance, 2020, p. 37). CRT typically gain traction during times of societal crises (Bierwaczek, Kunst & Pich, 2020), and can be defined, measured, and observed, making them suitable for scientific research (Freeman & Bentall, 2017).

Over the past year, there has been a large increase of COVID-19 related CRT. Researchers have examined these theories from multiple, interrelated perspectives, including mental health (Bento, et.al., 2020; Sallam, et al., 2020); behavior and trust (Imhoff & Lamberty, 2020; Karić & Mededović, 2020; Freeman et al., 2020; Jovančević & Miličević, 2020) and social media (Ahmed, Vidal-Alaball, Downing, & Seguí, 2020; Allem, 2020; Bruns, Harrington, & Hurcombe, 2020; Gruz & Mai, 2020; and Stephens, 2020). An underlying theme found in much of this research centers on misinformation and the inherent dangers of CRT (e.g., see Bierwaczek et al., 2020). Generally, conspiracy theories are excluded from the possibility of being a candidate of truth (Bjerg & Presskorn-Thygesen, 2017). Nevertheless, "...some conspiracy theories can in some case have a grain of truth to them, or be based on some facts, and then be wildly exaggerated" (Bartlett & Miller, 2010, p. 4). There may also be some truth specifically within COVID-19 CRT (Bernard, Akaito, Joseph, & David, 2020). Indeed, President Biden has ordered U.S. intelligence to investigate the possibility that COVID-19 was accidentally leaked, focusing particularly on laboratories located in Wuhan, China (Shear, Barnes, Zimmer & Mueller, 2021). However, to prevent the spread of misinformation, large technology companies have sought to remove or block COVID-19 CRT, including Google. A blog post regarding COVID-19 in March, from Google CEO Sundar Pichai (2020) states: "Our Trust and Safety team has been working around the clock and across the globe to safeguard our users from phishing, conspiracy theories, malware, and misinformation, and we are constantly on the lookout for new threats." Yet, as shown by the data analysis below, much proliferation occurred during the early months of the pandemic.

Social Contagion Theory

Originally, the term "contagion" was grounded in research to help understand the spread of epidemic diseases. Within the literature of social contagion theory, the term has been adapted to examine the phenomena of how

information can spread unintentionally through communities, more like an infectious disease than like a rational choice (Marsden, 1998). This theory has been applied in the study of various networked communities (Ugander, Backstrom, Marlow & Kleinberg, 2012; Scherer and Cho, 2003). The theory fundamentally rests on the interactions within these communities (Iacopini, Petri, Barrat & Latora, 2019), and has been applied in analysis of politics, fads, public opinion, and diffusion of new technologies (Ugander, et al., 2012). “Contagion theory suggests that those individuals who are most connected to each other through interpersonal contacts are also most likely to share similar information, attitudes, beliefs, and behaviors on controversial topics. Conversely, individuals who are not in frequent contact are less likely to have the same information about a topic, and are less likely to share similar attitudes and beliefs” (Scherer and Cho, 2003, p. 266). Although there have been multiple vehicles for observing the effects of social contagion, a popularly studied area is within social media.

Social media relies on the deliberate propagation of information content created by system users and consumed by other users (Hodas & Lerman, 2014). If the information is then amplified to many others, this spreading of information is known as social contagion. Research on social media platforms, such as Facebook, “provide natural sources of data for studying social contagion processes” (Ugander, et al., 2012, p. 5965). Studies of other social media sites such as Twitter have also demonstrated how users are exposed to and spread information through methods such as retweets (Lerman, Ghosh, & Surachawala, 2012). For example, if the information reaches a friend on social media who retweets or forwards to many friends, then it may rapidly spread with one consumer of information becoming many (Vishwanath, 2015). In the case of this GA research, the communication is mediated and amplified to become socially contagious through a search engine, as discussed below.

Google Autocomplete (GA)

The autocompletion feature is present in many different types of search engines and provides possible keywords or relevant sentence completion to help the user complete their task quicker. In 2004, Google released “Google Suggest,” a form of autocompletion software (Ward, Hahn & Feist, 2012). It was initially created to assist those with disabilities by reducing keystrokes to complete a search (Popyer, 2016). Google soon realized its potential, and currently this feature, now called Google Autocomplete (GA), is available to all users (See Figure 1).

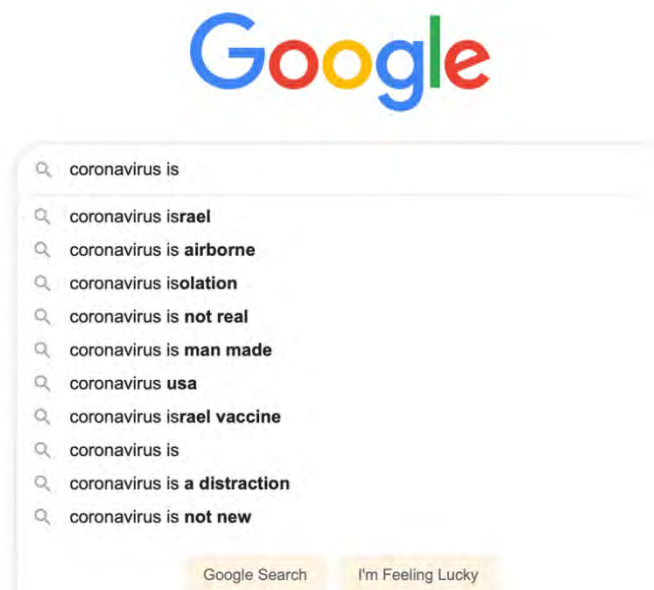


Figure 1. Google Autocomplete Predictions for “Coronavirus is...” (Retrieved on 3/30/20)

Although Google provides general information on how GA functions, details of its inner workings are proprietary. One factor influencing GA is popular, or “trending” searches by communities in certain areas, or world-wide at specific periods. As noted above, research indicates that GA captures, mirrors, and amplifies a population's interests, and via searching predictions, can influence society's perceptions and beliefs (Roy & Ayalon, 2020). Loh (2016) refers to GA as a “double-edged sword.” On the one hand, it can benefit users by allowing them to find information quickly and with fewer keystrokes. Also, GA can provide predictions to a user that are relevant and targeted to their search needs (Popyer, 2016), which has been found to improve search quality, mainly when users have limited knowledge of a specific topic (Ward, Hahn & Feist, 2012), thereby enabling individuals to become self-informed through search. On the other hand, GA can also promote incorrect, misleading, or potentially harmful information (Loh, 2016). This contrast, coupled with the power of social influence that this information has, makes autocomplete a critically important area of study. Furthermore, GA has historically produced harmful results that have been seen

as racist, sexist, and/or homophobic (Baker & Potts, 2013). Noble (2018) has declared search engines to be “algorithms of oppression” and has advocated that these harmful Google results, including GA predictions, should provoke national discussion and action to reveal and ameliorate their effects. Google has been involved in lawsuits such as defamation of character-based content results related to GA (Popyer, 2016). Google has acknowledged that these particular results and predictions are a problem and allows users to report inappropriate GA predictions via their website. However, according to Google, these computer-generated results are not the company's fault (Noble, 2018). Therefore, Google has maintained that they should not be held liable as the results are based on algorithms using data created by users so that results are not created by the company itself (Morozov, 2011).

Though designed to predict users' search interest, based on the previous literature, GA may influence a user's thoughts, views, and beliefs (Roy & Ayalon, 2020). It can be argued that Google would otherwise not put such an effort into preventing certain GA predictions from being displayed. Furthermore, according to social contagion theory, a “simple exposure” can be enough for social transmission to occur (Marsden, 1998). Following the above literature review the following research questions were developed:

- RQ1. How can GA be used as a methodological tool to understand the spread of COVID-19 CRT among google users during the pandemic?
- RQ2. What are the variations in the amount of COVID-19 CRT predictions among Google users across the world?
- RQ3. How does social contagion theory help to explain the spread of COVID-19 CRT through GA?

METHOD

To gather data for this study, the authors created Autocomplete Search Logging Tool (ASLT). During its design, the authors referred to Google's support page (See Figure 2) as this would provide the most accurate and up-to-date information regarding how GA functions.

Where search predictions come from

- Search terms you type.
 - Relevant searches you've done in the past, if you're signed in to your Google Account and have Web & App Activity turned on. Learn how to [see & control your Web & App Activity](#)
 - What other people are searching for, including trending searches. Trending searches are popular topics in your area that change during the day and aren't related to your search history. To get current trending searches, go to [Google Trends](#).
- Search predictions aren't the answer to your search. They also aren't statements by other people or Google about your search terms.

Figure 2. Google Autocomplete Help Center

<https://support.google.com/websearch/answer/106230> (Retrieved on 3/30/20)

From this description, the authors derived three main areas of focus: a) user's search terms, b) user's past searches (assuming the user is logged in), and c) similar or trending searches by other users. Additionally, the findings could be compared to results on Google Trends. Thus, ASLT was created with these three areas in mind and functions by taking input of a specific key term; for instance, “COVID-19 is.” Then, to show variation across geo-location, ASLT accepts a specific country location code (i.e., “US”). Also, to capture variation across time, ASLT was used to collect sample data for 35 days, during the period from March 25 to May 14, 2020.

The queries spanned 76 randomly selected countries. ASLT collected the data in English, as this appeared to be a suitable language across multiple domains (Mazières & Huron, 2013). Lastly, to avoid the influence of researchers' “searches done in the past,” ASLT was run without logging in to Google via a direct API (application programming interface) from the AWS cloud server.

ASLT was created in Python 3 and run on Amazon Web Services (AWS) SageMaker machine learning platform. ASLT iterated through each country and term, returning GA predictions along with the associated country (e.g., France (FR), see Figure 3). The results over the three months of data collection were stored in an AWS storage bucket for analysis.

```
'covid-19 is working from home really the new normal the economist FR',
'covid-19 is working from home really the new normal FR',
'covid-19 is there a disproportionate burden on working classes in france FR',
'covid 19 is caused by FR',
'covid 19 is it slowing down FR',
```

Figure 3. ASLT Output Example for France (FR) (Retrieved on 5/19/20)

DATA ANALYSIS

During the analysis phase, the data was retrieved from the AWS storage buckets and cleaned. Cleaning involved removing data that was not relevant so as to include only COVID-19 related statements, such as “coronavirus is...” and “COVID-19 is...” Next, the data was organized and separated into three columns: a) Phrase (autocomplete result), b) Country, and c) Date. The data was then ready for the authors to tag with the COVID-19 CRT keywords. In order to do so, “Conspiracy” keywords were defined by four characteristics which focus primarily on currently unproven ideas (Freeman & Bentall, 2017; Freeman, 2020). These four characteristics include 1) the world or an event is not as it seems; 2) there appears to be a cover-up by a powerful entity; the believer's explanation of the event is accepted only by a minority; or d) the majority of evidence provided does not support the explanation (Freeman, 2020). The COVID-19 CRT keywords were then used in conjunction with Python's Natural Language Toolkit (NLTK) to help identify conspiracy-related phrases. At the end of the three-month data collection period, analysis of keywords was conducted in a repeated and iterative fashion, until the authors were satisfied that all relevant keywords were included (Saunders et al., 2018).

Once an exhaustive list of COVID-19 CRT keywords was identified, like-words were grouped together that could fit into larger topic clusters. For instance, “weapon,” “bioweapon,” and “biological weapon” predictions were all grouped under the term “Weapon.” This task was completed to reduce redundancy in meaning while, at the same time, identifying major CRT-related topics. A final list of COVID-19 CRT-related keywords of 15 terms was produced (See Table 1) and results were imported into Tableau Desktop for visualization and further analysis.

Man-Made	Over-Blown	Made in Lab
Not Bad	Lie	War
Weapon	Cover-Up	Political
Distraction	5G-related	Manipulation
Not Real	The End	Conspiracy

Table 1. COVID-19 CRT-Related Keywords List

RESULTS

Over the three months of data collection in which data for 35 days were sampled, 21,133 COVID-19-related results were collected in the AWS storage buckets from GA. Of these, 5,056 were COVID-19 CRT related, when users entered any of these three search terms: “coronavirus is...”, “corona virus is...”, and “COVID-19 is...” As shown in Table 2, the most frequent predictions returned by GA were assigned to the keywords “Man-Made,” “Not Bad,” “Weapon,” “Distraction,” and “Not Real.”

Keyword	Count & Percentage (N=5,056)
Man-Made	1,421 (28%) *
Not Bad	979 (19%)
Weapon	690 (14%)
Distraction	487 (10%)
Not Real	463 (9%)
Over-Blown	295 (6%)
Lie	215 (4%)
Cover-Up	124 (2%)
5G-related	102 (2%)
The End	94 (2%)
Made in Lab	71 (1%)
War	48 (<1%)
Political	32 (<1%)
Manipulation	20 (<1%)
Conspiracy	15 (<1%)

Table 2. Counts and Percentages of Keywords

*Note: Percentages are rounded up to the next whole number.

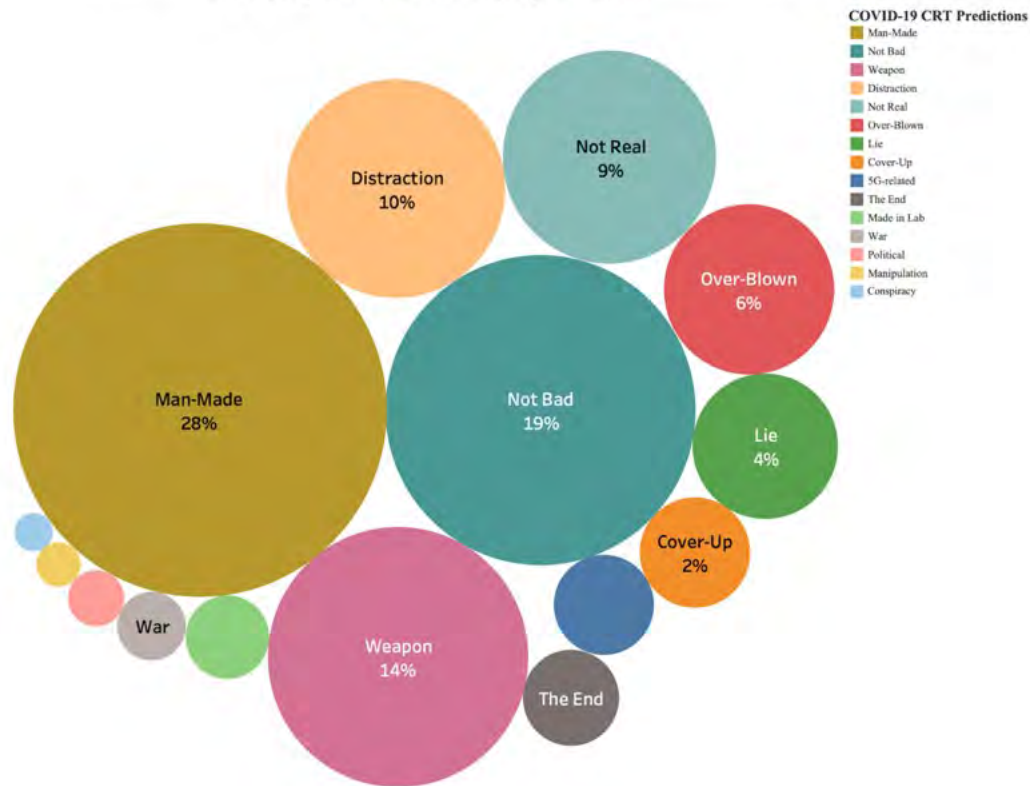


Figure 4. Relative Frequency of COVID-19 CRT-Related Keywords

Note: The smaller circles without percentages represent keywords below 2% of the total (see also Table 2).

These results indicate the most frequent among the 5,056 COVID-19 CRT-related keywords that were assigned to GA predictions across the 76 country codes. As shown in Table 2 and Figure 4, “Man-Made” was the keyword with the highest percentage (28%, $n=1,421$). If connected to the CRT belief that the virus was developed in a lab as a biological weapon, “Man-Made” could be combined with the “Weapon” (14 %, $n=690$), into a larger category “Man-Made Biological Weapon” which would account for a total of 42% ($n=2,111$). Additionally, four of the top five keywords related to questioning the reality and/or severity of the virus: “Not Bad” (19%, $n=979$), “Distraction” (10%, $n=487$), “Not Real” (9%, $n=463$), and “Over-Blown” (6%, $n=295$) could be combined into a second larger category “Questioning Reality/Severity of COVID-19,” accounting for a total of 44% ($n=2,224$).

As graphically depicted in Figure 5, data analysis also revealed the variations of GA predictions across the seventy-six countries studied, indicating which areas, from a geospatial perspective, have higher COVID-19 CRT predictions than others. Figure 5 captures a snapshot of the worldwide dissemination of pandemic-related CRT predictions during the three-month data collection period. As noted above, the COVID-19 CRT-related keywords ($N=5,056$) had also been organized and separated by country, allowing the authors to determine the sum of these keywords for each country. Next, this number was divided by the sum of the total number of all predictions for each country.

The maximum percentage of COVID-19 CRT compared to all predictions per country was 38%, the minimum percentage was 0%, with a mean of approximately 17%. The value of n was different across each country, for instance in Australia the number of all COVID-19 predictions was 717, the number of COVID-19 keywords was 274 (38%). Whereas in Russia the number of all COVID-19 predictions was 459, the number of COVID-19 keywords were 95 (21%). Note that the 13 countries at the maximum value of 38% had the same number of total predictions (717) and COVID-19 keywords (274). It is difficult to interpret why these results were found. One possible explanation is that Google may be using the same parameters for their algorithm for those 13 countries. If this is the case, it is a limitation of this study, as we do not have access to Google’s proprietary algorithms.

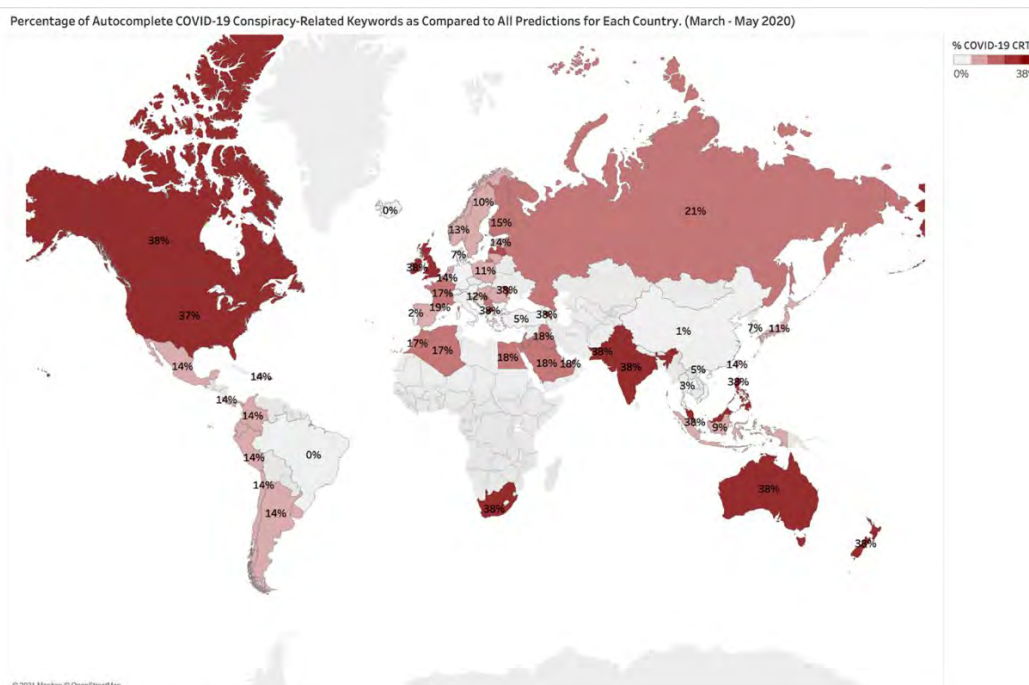


Figure 5. Percent of COVID-19 Conspiracy-Related Keywords Compared to All Predictions Per Country

Overall, Great Britain, Ireland, Australia, the United States, India, and South Africa and some of the surrounding areas showed higher percentages of COVID-19 CRT predictions as compared to all predictions within these countries. Multiple countries in South America showed COVID-19 CRT predictions returned at 14%, also indicating that these countries returned the same predictions. Unlike other countries in South America, Brazil returned 0% of the predictions, as did Iceland, Germany, and Italy and several other countries (note that Figure 5 does not display all 0% values). Google Transparency Report does not give insight into why these countries returned 0% of predictions. One can get a glimpse of the challenges faced by the country officials, as seen in Figure 6, which displays one of Google's Transparency Reports for India (January 2020 - June 2020), sending multiple requests for the removal of content which includes conspiracy theories related to COVID-19 along with "news reports and criticism of the authorities' handling of the pandemic."

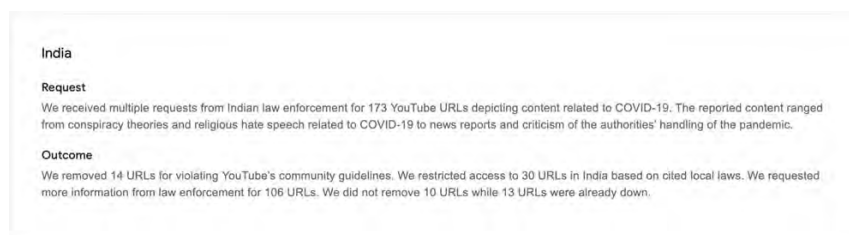


Figure 6. Jan 2020 - Jun 2020 Google Transparency Report India

https://transparencyreport.google.com/government-removals/by-country/IN?hl=en&country_breakdown=period:Y2020H1;country:IN&lu=country_request_explore&country_request_explore=period::authority:IN;p:2 (Retrieved on 4/12/21)

As previously mentioned, Google refers users to consult Google Trends (see Figure 2, above) to understand what is trending or popular in a given location and period. The authors referenced Google Trends to validate a subset of the above findings. In Figure 7, Google Trends displays the top three COVID-19 CRT-related percentages of predictions found in this study; "COVID-19 is man-made," "COVID-19 is not bad," "COVID-19 is a weapon." Since multiple countries could not be specified, the scope of the Google Trends search was worldwide.

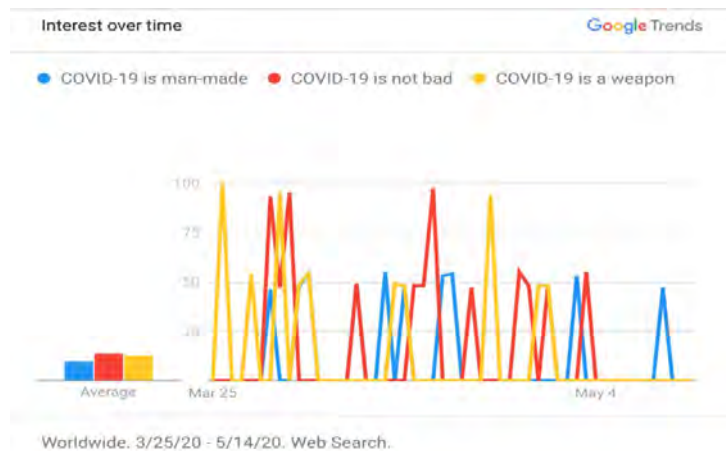


Figure 7. World-Wide Google Trends view from March – May 2020

<https://trends.google.com/trends/explore?date=2020-03-25%202020-05-14&q=COVID-19%20is%20man-made,COVID-19%20is%20not%20bad,COVID-19%20is%20a%20weapon> (Retrieved on 1/5/21)

The results displayed in Figure 7 for Google Trends differ slightly from what was reported in the authors' analysis. Google's scale represents the peak of each search term's popularity ranging from 0% to 100%. At different times "COVID-19 is a weapon" and "COVID-19 is not bad" approached that number. Interestingly, "COVID-19 is man-made" hovered around the 50% area. Results from ASLT showed "COVID-19 is man-made" was the highest average over the 76 countries. This difference can be due to Google Trends' result being worldwide and thus more encompassing than results from the 76 countries selected for this study. Alternatively, this can result from Google's statement that trending data is only one factor in considering GA prediction results. In any case, these results from Google Trends support this study's findings that these COVID-19 CRT-related phrases, and especially the two larger categories identified in the author's analysis, were popular or trending during this timeframe.

LIMITATIONS

This study has several limitations. As noted above, the authors have chosen to characterize GA as both a social process and an algorithm (Roy & Alayon, 2020) in applying social cognition theory to aid our understanding of results. Additionally, although the study does give perspective over multiple countries worldwide, studying 76 countries limits a full worldview. The frequency of collection may have potentially impacted the percentages as the data was collected over a three-month timeframe, sampling a total of 35 days, running at various times of the day and on different days of the week. However, the duration from the May to March timeframe appears appropriate as mentioned previously as after this period Google is actively seeking to "safeguard" from threats such as conspiracy theories (Pichai, 2020).

For transparency, ASLT collected data from the same AWS (server) location (US East 1/N. Virginia). However, this server was not logged into a google account. The API used by ASLT, which allows a point-to-point connection from AWS to Google, searched for dynamic content (GA predictions). Additionally, the URL specified the country code (i.e., FR = France), thereby "spoofing" the search location, as it was not possible to travel to different locations to conduct the searches during the pandemic. For these reasons, to the authors' knowledge, client-side caching, remembering previous searches for search predictions, was not a factor. As noted above, there is also the limitation that results for 13 countries had the same number of predictions and keywords (38%) which cannot be attributed to mere chance, so that interpreting the data for these countries is limited and Google has not provided full information about their algorithms.

As Mazieres and Huron (2013) noted, although English appears to be a prevalent and fitting language to use while studying GA, this limits data collected from non-western, non-English speaking countries. Although Google is the most used search engine globally, it has below 40% market share in China, Japan, and Russia (Mazieres & Huron, 2013). Therefore, it is recognized that Google search is limited in these countries and does not entirely reflect all of the population's interests.

DISCUSSION

The analysis of keywords from ASLT regarding predictions identified two main categories. One of these, Man-Made Biological Weapon (42%, $n=2,111$) resonates with Stephen's (2020) finding that one third of Americans believe some variant of the theory that COVID-19 is constructed as a bioweapon. Similarly, in Great Britain, almost half of surveyed individuals "endorsed" a statement that the coronavirus was a bioweapon developed by China to abolish the West (Freeman, et al., 2020). Results regarding GA predictions also coincide with popular stories

indicating that the virus was a side-effect of the 5G network (Shahsavari, et al., 2020), building upon the narrative regarding the perceived negative environmental and health effects resulting from the 5G rollout (Bruns, Harrington, & Hurcombe, 2020). The second major category, Questioning Reality/Severity of COVID-19 (44%, n=2,224) is in line with Fuchs (2020), who asserts that a downplay or denial of the seriousness of COVID-19 is an ideological dimension of these CRT. During analysis the authors observed some similarities, differences, and contradictions in the COVID-19 CRT GA predictions. Even if one believed that COVID-19 CRT had some factual components, a level of misinformation within these predictions was evident. For instance, COVID-19 cannot be a "bio-weapon," yet at the same time, "not real." Consequently, being presented with misinformation from GA predictions can threaten public health by confusing individuals about factual information (Roozenbeek et al., 2020), thereby further dividing society members, especially in today's political climate (Mian & Khan, 2020). Belief in pandemic denial CRT have potentially harmful consequences that may result in spreading the disease (e.g., reduction of social distancing, see Bierwiazzonek, et al., 2020).

Regarding RQ1, this study explored how GA can be a useful methodological tool to trace searching behavior and to mirror societal perceptions and beliefs on a particular subject as asserted by Roy and Ayalon (2020). Knowledge of these beliefs and perceptions is critical to understanding what COVID-19 CRT exist worldwide and how they are spread. As previously mentioned, studying social media, such as Twitter or Facebook, provides venues for researchers to examine CRT. However, research using GA can also be beneficial in at least two different ways. The first is that GA is a more subtle, less obvious way to reflect users' search behavior, especially regarding what is classified as misinformation or "fake news." For the mainstream public COVID-19 CRT would fall within this category. Social media companies, such as Facebook, use their News Feed Algorithm to counter what they determine to be fake news (Andersen & S  , 2020). This is different than GA, which Google has affirmed is user generated and as such, it is the user's responsibility to report inappropriate content, not Google's. The second is that using a software program such as ASLT combined with data analysis software such as Tableau enables researchers to get a geospatial perspective of GA predictions during a particular point in time. One may consider using Google Trends for this type of analysis, although the user must specify the keyword (i.e., "COVID-19 is not real"), so existing GA predictions are not always revealed to the researcher. Additionally, RQ 1 focused attention on the ways that GA predictions contribute to the spread of COVID-19 CRT among Google users.

Related to RQ2, results indicated that individuals from many of the 76 countries did receive GA COVID-19 CRT predictions when searching Google during these three months with many similar keyword themes across the multiple countries. The distribution was demonstrated in Figure 5. Although COVID-19 CRT must have originated from one or more specific locations, as indicated by the spread of this information worldwide, it is difficult to determine where these CRT originated. Nevertheless, as the data shows, the highest prediction percentages are in countries where there may be less data suppression (e.g., The United States, England, and Australia), similar to Stephens' (2020) CRT Twitter analysis findings. If there is less data suppression, then the data can be perpetuated by users clicking through GA predictions, thereby making them trend, which these results suggest.

RQ3 asked how the application of social contagion theory could help to explain the spread of COVID-19 CRT through GA. Previous research focused on social contagion being extensively studied across social media, centering on spreading messages such as misinformation and "fake news" (Alshaabi et al., 2020) and on networked communities (e.g., Scherer and Cho, 2003). To understand how social contagion theory can help to explain the behavior of GA, the authors examined how it was used in a somewhat similar domain, such as social media. Social contagion typically rests on the behavior or property of influential relationships at the micro-social level affecting the macro-social level (Berndt, Rodermund, & Timm, 2018). For instance, an example of social contagion as bonding can be 'sharing' or 'liking' a post on Facebook (Harrigan, Achananuparp, & Lim, 2012). Further, influential figures on social media can act as a "hub of social contagion," allowing researchers to study the diffusion of information across networks (Alshaabi et al., 2020). Social contagion theory is appropriate to apply to the current study of GA, since, according to Scherer and Cho (2003) "The idea of social contagion suggests that individuals adopt the attitudes or behaviors of others in the social network with whom they communicate. The theory does not require that there is intent to influence, or even an awareness of influence, only that communication takes place" (p. 262). So, although the direct nature of social interaction is not present in GA, the dynamics of social contagion can be shown to be present when one considers GA as a type of network setting. Although the user interacts with a "machine" to perform a search query, the GA predictions contain trending data that ties the user to a network of popular beliefs within the user's community or region and directly helps to amplify these beliefs. For even the most skeptical Google users, this search engine is still influential and its algorithms can therefore act as a hub for social contagion in accordance with the theory.

In utilizing ASLT, results suggest that the predictions presented by GA unobtrusively at the time of search helped to spread COVID-19 CRT information. As consistent with social contagion theory, these CRT represent a nonpermanent event that develops over time and space through social networking dynamics (Scherr, 2020). Social

contagion theory assists in our understanding of the phenomena occurring in GA and how they influence the search behavior of Google users. These users are actively seeking information (in this case, regarding COVID-19) but then through GAs are "discovering" CRT-related predictions and further propagating these when they click on the prediction (including amplification through Google Trends). As a result, the user is unconsciously, yet actively, contributing to a social contagion hub perpetuating COVID-19 CRT information, misinformation, and disinformation or "fake news." Rather than depending on deliberate human intention, the algorithm-driven spread of information found in GA (Hodas & Lerman, 2014) may be more determinantal as users who may not believe or support the information are unknowingly amplifying it (see also Allum, 2020).

CONCLUSION

Knowledge of how stories (such as COVID-19 CRT) spread and persist within groups is fundamental to understanding social phenomena (Alshaabi et al., 2020). This study explored using ASLT to determine and capture COVID-19 conspiracy-related predictions during the early stages of the worldwide pandemic. This software application enabled the authors to describe and visualize these predictions worldwide. Although more conventional avenues for researching the digital spread of COVID-19 CRT exist (e.g., Twitter, Facebook, YouTube, and Reddit), autocomplete is a less obvious, yet equally or potentially more valuable data source. For academics, a large part of digital research relies on sources provided by a monopoly composed of a few Big Tech companies who may keep critically important proprietary user data confidential. Newer, unconventional methods and data sources must be explored as possible sites to gain previously unknowable understanding of both user behavior and proprietary system algorithms.

The authors found that tracking GA predictions provided a snapshot across three months during the pandemic to discover insights into the spread of COVID-19 CRT information. However, unfortunately, for COVID-19 CRT this door is closing, as Google is actively removing pandemic CRT-related data. A recent preliminary test of running ASLT after this study was conducted indicated that GA returned no COVID-19 CRT across the 76 countries. The authors are in agreement with Miller and Record (2017), "First, speech should be protected on the Internet. Censorship is bad. We agree. But omitting autosuggestions is not censoring search results. The distinction is between finding information one is seeking and being involuntarily informed that certain information exists" (p. 1957). However, as one door closes another one opens and there are ample and newly forming CRT-related topics of current interest that still could be explored using GA, including those related to vaccine-related queries, QAnon (LaFrance, 2020) and more. The authors also look forward to seeing GA as a more normative exploration tool when exploring and capturing societal data and search behavior.

This research is among the first to apply social contagion theory to a study of autocomplete applications, and results demonstrate that this framework can be successfully extended to consideration of GA results world-wide or focused on particular countries. This theoretical framework could also be used for future research seeking to explain (and perhaps mitigate) the exponential spread of CRT which may well be dangerous during a pandemic and other times of global crisis. Although Google has taken action to stop the flow of COVID-19 -related CRT, this research shows that before these actions were taken, CRTs had already spread rapidly and dramatically around the globe, growing in contagion, partially due to GA, alongside of the pandemic itself.

ACKNOWLEDGMENTS

The authors would like to thank Ishaan Singh, Raj Inamdar and Gautam Sikka for volunteering to assist with the initial creation of the ASLT GA API. The authors gratefully acknowledge support from Vivek K. Singh's National Science Foundation grant CNS-2027784: RAPID: Countering Language Biases in COVID-19 Search Auto-Completes.

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The Reproducible Data Reuse (ReDaR) Framework to Capture and Assess Multiple Data Streams

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ABSTRACT

Much of the literature in knowledge discovery from data (KDD) focuses on algorithms that are faster and more accurate at capturing patterns in a given data set. However, answering a research question is fundamentally connected with how well the data is aligned with the questions being asked. Thus, data selection is one of the most important steps to ensure that models produced from the KDD process are useful in practice. A lack of documentation about the data selection rationale and the transformations needed to semantically align the data streams prevents others from reproducing the research and obfuscates development of best practices in data integration. Our goal in this paper is to provide KDD practitioners with a framework that brings together theories in provenance, information quality, and contextual reasoning, to enable researchers to achieve a semantically aligned dataset with data selection, description, and documentation based on an application-focused assessment.

KEYWORDS

Semantic alignment; fitness assessment; data selection; reused data; data practices.

INTRODUCTION

Knowledge discovery from databases (KDD) is a multi-step process for pattern identification and classification in data that includes data selection, preprocessing, and transformation steps to prepare data for later modeling and interpretation (Fayyad et al., 1996; Mariscal et al., 2010). KDD applications focused on data- and model-based research, however, are dependent on the semantic alignment and selection of data that are relevant to the application goals. There is a lack of documentation and discussion over best practices for the alignment and selection of data from multiple data streams in modeling and knowledge-based research.

Researchers in the Earth sciences often analyze and model subsurface geologic systems through the integration of multiple data streams that are conceptually heterogeneous, and syntactically and semantically ambiguous (Gil et al., 2018; Howard et al., 2009; Nickel et al., 2011). Research on global climate change requires integration of regional and global data sets, where semantic ambiguity can mistakenly encourage the comparison of semantically distinct data streams (Faghmous and Kumar, 2014; Ford, et al., 2016; Hassani et al., 2019). In health care, there are moves to compile vast distributed datasets to support ‘learning health systems’ (Etheredge, 2007; Friedman, et al., 2015; Delaney, et al., 2015). In these environments, and others, the fidelity of data mining results and utility of model-based insights is dependent on the semantic alignment of complex data streams and on the identification and selection of relevant data. And, as recently noted by the National Academies of Sciences, Engineering and Medicine in evaluating the data requirements for reliable, repeatable toxic risk assessments, “Without a clear definition of evidence streams or documented approaches to evidence synthesis, within each evidence stream, it is difficult to assess and reproduce the results of evidence synthesis.” (NASEM, 2021).

The use of explicit statements that capture the database, search string, and inclusionary and exclusionary criterion are the defining features of a systematic review (Higgins et al., 2019). We posit that similarly making the semantic alignment and data selection strategies explicit are equally important for KDD. However, because in many domains the application questions and contexts can vary by investigator, it is impossible to anticipate and document all provenance and contextual attributes that might be relevant for each data stream. A semantic alignment method is needed, for use with multiple data streams, to enable reliable alignment, conceptual modeling, and data selection in a way that supports application-specific modeling and knowledge discovery. A suitable approach also would assess the available provenance information with domain knowledge on data generation practices to capture the underlying concepts for every data stream, integrate insight on biases and random errors that result from the generation or processing methods, assess the fitness of each data stream for the application goals, and combine this captured information in the generation of an aligned conceptual model. To that end, we echo the importance of provenance that has been recognized by Tilmes, Yesha, and Halem (2010), and extend more traditional thoughts of provenance (Herschel, Diestelkämper, and Lahmar (2017) by building off work by Fox, McGuinness, and Da Silva (2008), and

Zednik, Fox, and McGuinness (2010) that recognizes the need to consider more information about data than typical process provenance to determine data fitness.

We propose a solution that integrates theories in provenance, information quality, and conceptual modeling to align data concepts, assess data fitness, and ensure reproducible data reuse. This **Reproducible Data Reuse (ReDaR)** framework utilizes robust provenance and data generation descriptions and a de-contextualization/re-contextualization of the data streams. It accommodates reuse-application explicating to assess data fitness using perspectives obtained from communities of practice. This framework also uses conceptual modeling to clarify alignment and attribution that can be used to support downstream modeling.

The ReDaR framework enables a KDD practitioner to document their alignment, assessment, and selection strategies used with multiple data streams, so that a reader can evaluate how well suited the data is to address the research question asked. The framework allows the practitioner to make the critical conceptual and process characteristics that are associated with each data stream explicit and provide ample opportunity for documentation of data characteristics to help ensure reproducibility and guard against misuse of data sets and misunderstanding of the models produced. The insights into the value of each data stream can also be used to determine when new data should be collected.

The rest of this paper begins with an outline of the general structure of the framework and a description of the use case in geology that is used to demonstrate the concepts presented here. The first step in the framework is a provenance and domain knowledge analysis of each data stream, followed by a contextual assessment and de-contextualization. Insights from these steps are used to frame the development of a semantically aligned conceptual model. A quality-based fit-for-purpose assessment follows. This paper ends with a brief discussion of the insights gained from applying this framework, some conclusions as to its ability to address general assessment and alignment needs, and finally, with a short discussion of potential contributions of this work.

A GENERAL FRAMEWORK FOR ALIGNMENT AND SELECTION

The ReDaR framework provides KDD practitioners with a way to document how provenance, domain knowledge and a contextual analysis to support alignment, aid data selection, and provide a robustly attributed schema and conceptual model that can support complex reasoning and pattern evaluation (Figure 1).

The ReDaR framework includes four steps:

1. A provenance and domain knowledge analysis of each data stream that compiles thorough data-generation information with initial cleaning and processing provenance, specifically including details about information concepts and quality based on consideration of the reuse application goals.
2. A contextual assessment, including a de-contextualization of each data stream and a re-contextualization focused on the reuse-application information needs.
3. Representation and attribution of data streams into an aligned conceptual model. Information from the provenance and domain knowledge analysis and the relevant contextual attributes are represented within an Extended Entity-Relation model using entities and attributes to disambiguate and semantically align each data stream. Conceptual modeling is used to formalize and visualize the aligned schema.
4. A data quality-based fitness assessment for the aligned data streams. Information from the provenance analysis, contextual assessment, and reuse goals are used to identify potential data quality problems within the aligned data streams. These problems represent data quality dimensions that need to be considered to reliably use the aligned data, and they are used to evaluate whether the data are suitable for preservation and use within the reuse application. Data that are identified as being too poor quality to use are deleted from the schema and conceptual model. Data fitness attributes can be added to the conceptual model at this point, representing the major quality dimensions identified for each data stream.

Use Case

To demonstrate the application of this semantic alignment framework, we compiled a dataset of five data streams that were used in a glacial sediment mapping project in northeastern Illinois (Thomason and Keefer, 2013). This dataset was selected for the use case because the development of this alignment framework is part of a larger research program into issues related to reasoning with multiple uncertain geologic data streams, and glacial sediment data streams are the primary use case for that larger program. The goals of the northeastern Illinois mapping project included interpreting the distribution of potential sand and gravel aquifers from the observational data streams, where potential sand and gravel aquifers were identified as any sandy or gravelly deposit greater than 1.5 meters in thickness. The five data streams include: core sample descriptions, water well driller's logs, natural gamma wireline logs, electrical resistivity wireline logs, and electrical resistivity tomography (ERT) profiles. The properties observed within these data streams vary significantly, and include, respectively: detailed description of the materials

recovered in core samples; generalized descriptions of the aquifer and non-aquifer materials encountered during drilling; counts of natural gamma particles detected in sampled boreholes; the electrical resistivity of the materials surrounding sampled boreholes; and the modeled electrical resistivity of subsurface materials calculated from field measurements made along a transect.

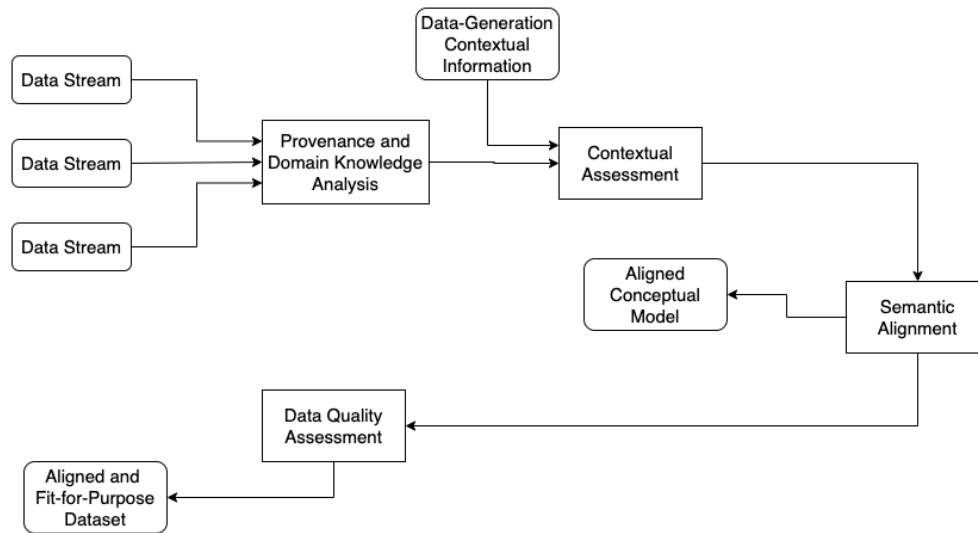


Figure 1. Activity diagram for ReDaR Framework. Round-cornered rectangles are artifacts. Square-cornered rectangles are processes.

Throughout this proposal, the term ‘observation set’ refers to the set of individual observations collected for a specific data stream at a single borehole or transect. All the core sample descriptions reported from a single borehole constitute one observation set. If a core sample set, natural gamma log, and electrical resistivity wireline log are all collected for a single borehole, each one represents a different observation set. Also, according to geologic convention, each observation set from every borehole is represented as a vertical array of data called a ‘log’. Each log consists of a succession of ‘log units’, which represent discrete intervals of sediment or rock in a log that are specifically demarcated and described by the geologist.

PROVENANCE AND DOMAIN KNOWLEDGE ANALYSIS

Using the ReDaR framework, the KDD practitioner starts with documenting known provenance and domain knowledge around the data collection, data cleaning, and initial processing information. As with other domains (Twidale, Blake, Souden, Stelmack, and Kim, 2019), the data generation characteristics of these five data streams may only be known by subdomain specialists, or those who collected the data, and are rarely documented in metadata. The data generating characteristics that are targeted in this analysis are those that describe the physical and conceptual nature of the data, and that identify attributes that are particularly subject to both random and systematic errors – characteristics that provide insight on the consistency, reliability, and representativeness of the data values. Domain specialists or the data curators may be needed to assist in this part of the documentation effort. While this additional input may seem onerous, this information is necessary to identify potential data biases that are critical for the reliable alignment and subsequent modeling, as well as for the model-interpretation stage of the KDD process.

To demonstrate, the rationale for collecting the use case data streams are captured, along with a description of common sources and magnitudes of error that may be introduced from data collection and initial processing activities. Often, common sources of error are well known among subdomain experts, but detailed knowledge of these errors might only support qualitative rankings or the identification of max-min values. In the use-case data streams, the remotely-sensed nature of the observations and the difficulty in observing error occurrence make it impossible to quantitatively describe the error distributions. The heterogeneities and hierarchical complexities of geologic systems also severely limit the transferability of any distribution estimates between different studies. For this paper, we will only highlight this provenance and documentation analysis for two of the five streams: core sample logs, and ERT profiles.

Core samples are physical samples of in situ geologic materials obtained during borehole-drilling efforts and are collected either when a reliable description or a physical sample of subsurface materials is needed (Figure 2). These core sample descriptions are generated by professional geologists or engineers, include standardized, written

observations of the recovered core sample materials that delineate distinct geologic units that are identifiable within the samples (Figure 3). The use of standard terms by professionals ensures that most of the errors in core sample descriptions are small and relatively infrequent. These errors typically include variations in the terms used to describe specific sediments, measurement errors associated with the vertical location of a described deposit, or a failure to consistently record a specific property (e.g., reactivity to acid). The most common error in core sample descriptions is a gap in material descriptions over some interval, due to the incomplete recovery of sampled material. This error is somewhat systematic in nature and is dependent on the sampling equipment, drilling method, type of materials being sampled, and skills of the drilling crew. Importantly, incomplete recovery of samples can be a significant source of error. The core samples collected for the use case dataset recovered an average of only 36% of the material encountered



Figure 2. Core sample of glacial sediments collected from a location in Illinois. The core box is 2 feet long, holding a maximum of 10 feet of core length. The top depth of the recovered interval is 10 ft while the bottom depth of the recovered interval is 37.5 ft, indicating 27.5 ft of unrecovered core material.

38.0 - 39.0	Brown (7.5YR 5/2), loam diamicton as above with abundant inclusions of strong brown (7.5YR 5/6) coarse-grained sand; calcareous
39.0 - 40.0	Yellowish brown (10YR 5/6) moderately well-sorted very coarse-grained sand to medium gravel; calcareous
40.0 - 42.0	Very poorly sorted sand and gravel; largest clast is 0.15 ft. across
42.0 - 43.0	Core loss. Geophysical log indicates lithology as above.

Figure 3. Excerpt from a detailed core description from a continuous coring effort (Curry, 1995). Left column contains the depth, in feet, of top and bottom contacts for each unit. Right column contains detailed descriptions of core sample within the specified depth range.

while drilling (Dr. J.F. Thomason, personal communication, 2019). Many core sample descriptions undergo an early processing step where adjacent detailed descriptions are aggregated to represent a single deposit with a more generalized description. Typically, these aggregated deposits are grouped because they have been interpreted as being deposited within the same depositional environment and associated with the same ice event. This aggregation results in a predictable amount of information loss, but the accuracy of representing the aggregated core descriptions using a more-generalized classification is largely unaffected.

Electrical resistivity tomography (ERT) profiles are 2-D models of electrical resistivity of the materials below a measurement transect along land surface. Completed ERT profiles are generated from measurements of apparent resistivity of the earth materials. The apparent resistivity measurements are processed using standard algorithms and create one or more 2-D models of electrical resistivity (i.e., ERT profiles) (Figure 4). ERT profiles are typically collected to estimate the distribution of resistivity values in the sampled subsurface and are valued because they provide a single characterization of sediments in both vertical and horizontal directions – horizontal

characterizations are unavailable from any borehole-based observations. Certain patterns in the spatial distribution of resistivity values within the real-world, measured sediments (e.g., low values over high values) are known to influence (i.e., bias) the modeled patterns of resistivity value. Even when considering these biases, the resistivity models are viewed as representations of the most-likely, or average, distribution of point values of resistivity. Because these profiles represent most likely values, they provide smoothed distributions – they cannot be used to estimate the actual variability and spatial distribution of resistivity values in the observed materials. The relationship between resistivity and sediment type is non-unique, but it is generally considered reliable enough to support use of the resistivity profiles as estimates of sediment-type distribution. The use of standard methods for collection and processing, together with the stable physics of the measurements, ensure that the ERT profiles provide reliable, repeatable measurements. However, ERT profiles do have some known errors. In terms of representativeness, each resistivity model is partially determined by parameters in the across a model, preventing abrupt changes in resistivity that often better reflect the natural changes that occur in the sediment type distributions. These different biases also result more mid-range resistivity values – with a corresponding truncation of both low and high values – relative to the actual resistivity distribution within the measured materials. In terms of other errors, ERT measurements are particularly vulnerable to electrical interference (i.e., power lines) or objects that are highly conductive (i.e., metal drainage conduits). Measurements near these types of features are inaccurate and are removed during data cleaning – prior to modeling efforts. Once a profile has been generated by the inversion algorithm, the profiles are used to interpret the distribution of generalized sediment texture from the modeled resistivity values. The resulting texture-classified 2-D profiles can be further processed by conceptually disaggregating them, representing them as a series of vertical 1-D texture arrays. These 1-D arrays are used with and compared to the other data streams; this step is discussed in more depth within the section discussing the aligned conceptual model.

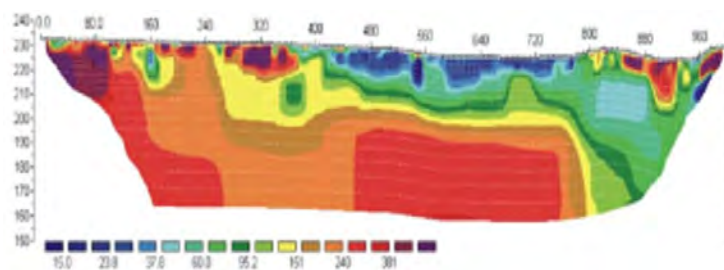


Figure 4. Modeled resistivity distribution from an electrical resistivity tomography (ERT) profile from McHenry County, Illinois. Warm colors represent high resistivity values and often correspond to coarser-grained, low clay-content sediments, dry sediments, cemented sediments, or limestone bedrock. Cool colors represent low resistivity values and typically correspond to finer-grained, high clay-content sediments, sediments with saline pore water, or shaley bedrock.

By conducting this provenance analysis on each data stream, we then evaluated all streams for characteristics that helped define the conceptual nature of the observations (Table 1). These eleven characteristics also were found to be important for evaluating the reliability of the data, and will be used in the fit-for-purpose assessment later in the framework. The data-stream characteristics for core sample descriptions note the high conceptual relevance and observation reliability, while also noting the potentially significant level of bias, primarily from the incomplete recovery of sample materials. The water well driller's logs, in contrast, are (1-D data arrays collected from borehole drilling) highly suspect in terms of accuracy but have a good conceptual relevance and are helpful in addressing the primary mapping goal. Geophysical wireline logs (1-D data arrays collected within boreholes) provide a high level of consistency in the methods generating the data, but the dependence of the reported values on uncontrollable factors makes the reported values somewhat less reliable. These methods also have less conceptual relevance, as they measure indirect properties that must be transformed to the generalized texture classification. While the natural gamma logs have less bias than the electrical resistivity logs, the correlation to texture is not as strong, so the transformed standard texture classifications will be less reliable for identifying sand and gravel aquifers. The ERT data are collected with methods that have a high level of consistency, but the method measures a much larger volume of material and has a larger number of potential sources of error. Given these potential limitations, it is noteworthy that it is the 2-dimensional nature of this data stream that increases the likelihood of both modeled resistivity and transformed general texture classifications meeting the mapping goals (i.e., identification of sand and gravel aquifers) and increases the net reliability of ERT profiles, relative to the other data streams.

Data Stream Characteristics	Core Sample Descriptions	Water Well Driller's Logs	Natural Gamma Wireline Log	Electrical Resistivity Wireline Log	ERT Profile
Property type observed	sediment lithology	sediment texture	gamma particle detections	electrical resistivity	apparent resistivity
Reliability of transformation to texture	high	high	moderate	moderate	moderate
Spatial dimension of sample set	1D	1D	1D	1D	2D
Approximate volume of each observation	0.9 L	20	70 L	140 L	3000 L
Consistency of observation method	high	moderate	high	high	high
Consistency of reported observations	high	low	moderate	moderate	moderate
Frequency of random errors	low	moderate	low	low	low
Significance of random errors	low	high	moderate	moderate	moderate
Frequency of biases	moderate-high	high	low	moderate	moderate
Significance of biases	moderate-high	high	low	moderate	moderate
Reliability for addressing application goals	moderate	moderate	moderate	moderate-high	moderate-high

Table 1. Data stream characteristics for the case study dataset.

CONTEXTUAL ASSESSMENT

The second step in the ReDaR framework is a contextual assessment that identifies implicit and explicit contextual attributes of each data stream and then de-contextualizes the data stream by making contextual attributes explicit for later use. The data streams are then re-contextualized by making the de-contextual attributes explicit when they differ from the context of the reuse application. This assessment can use information from the provenance and domain knowledge analysis as well as other available documentation or metadata. The information collected in this assessment can also help identify data that may be suitable in downstream modeling, to guide representation choices within the conceptual modeling, and to support identification of data quality problems within the later fit-for-purpose assessment. The contextual attributes preserved from this assessment should be useful to these goals and should help disambiguate data streams by clarifying conceptual distinctions.

CREATING A SEMANTICALLY ALIGNED CONCEPTUAL MODEL

The third step in the ReDaR framework is the development of a semantically aligned conceptual model. This step uses information collected from the earlier steps to identify concepts and determine their appropriate representations for the aligned schema. The aligned entities and relationships are formalized and clarified, and information described in earlier steps (e.g., contextual assessment) can be embedded using attributes assigned to the appropriate entities.

For the use case dataset, an Extended Entity-Relation (EER) model (Elmasri and Navathe, 2007) was developed for the conceptual model. Figure 5 highlights the overall structure and the relationships between the entities associated with each data stream.

Attributes of entities within the EER model represent important concepts, including concepts used in the fitness assessment. For the use case dataset, attributes associated with each entity in the EER model serve one of four purposes: 1.) they locate the observations in space; 2.) they document observation values; 3.) they document semantically-aligned concepts associated with of the observations; or, 4.) they document properties of each observation or observation set that can help evaluate data quality or to assist in interpretation of each observation for reuse-application purposes. (Specific attributes describing data-quality dimension are added during the fourth step in the framework, the fit-for-purpose assessment.)

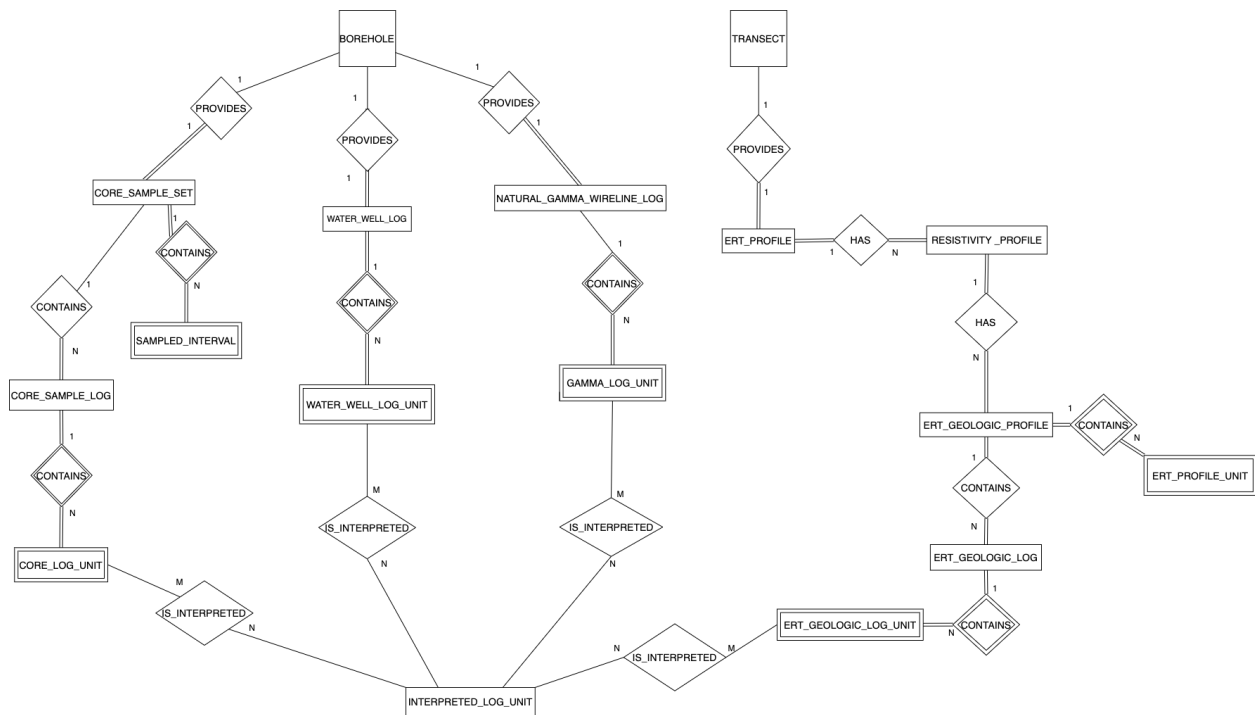


Figure 5. Extended entity-relationship model for entities and relationships in the geologic mapping dataset. The left tree represents the four borehole-based data streams. The right tree represents the transect-based data stream. Rectangles signify entities, diamonds signify relationships.

For the BOREHOLE entity (Figure 6), several attributes are used to locate the borehole and associated observation sets by providing information on the location, land surface elevation, and measurement units. Attributes, ‘Nominal Borehole Diameter’ and ‘Total Depth’ are included for later analysis, and the remaining attributes are included to support later evaluation of the fitness of log-unit descriptions. The attributes associated with the CORE-SAMPLE SET and SAMPLED INTERVAL (Figure 7) entities are all provided to support reasoning about each observation. The CORE-SAMPLE LOG entity (Figure 7) provides only an ID and the name of the person who described the samples, a piece of provenance that may be used in evaluating the fitness of the associated core description. The CORE LOG UNIT entity contains the ‘Generalized Core Description’ (Figure 8), attributes that describe the observation (i.e., Sorting, Grading, Layering, and Weathering), together with depth and thickness attributes that provide information for reasoning, and attributes supporting the quality and fitness evaluation.

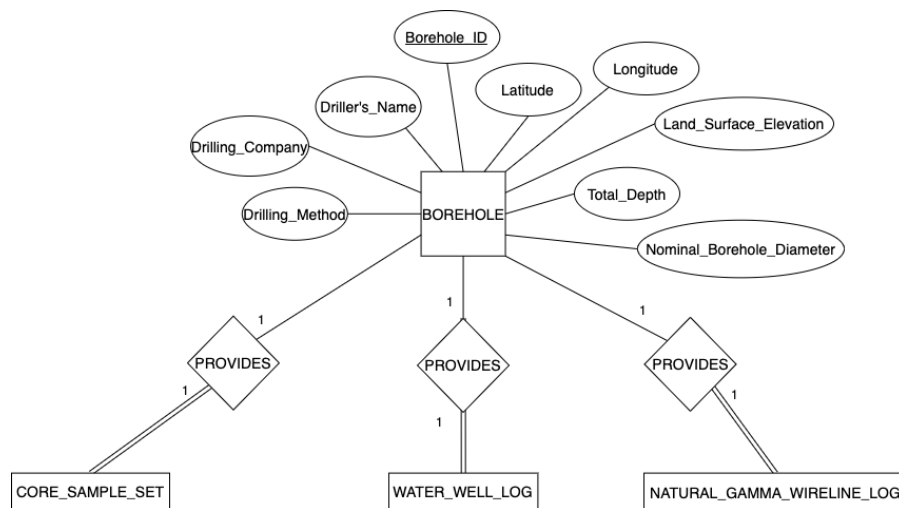


Figure 6. A portion of the EER model, showing attributes for the BOREHOLE entity, within the geologic mapping dataset.

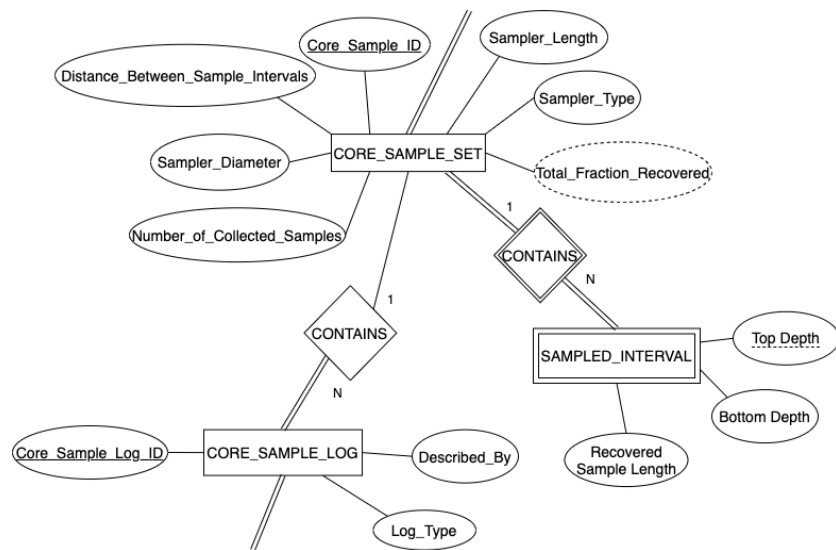


Figure 7. A portion of the EER model, showing attributes for the CORE-SAMPLE SET, SAMPLED INTERVAL, and CORE-SAMPLE LOG entities, within the geologic mapping dataset.

FIT-FOR-PURPOSE ASSESSMENT

Step four in the ReDaR framework is a fit-for-purpose assessment based on an evaluation of the data quality and comparison to the reuse application goals. Insights gained from the provenance analyses (Table 1) are used to identify a list of potential data quality problems or dimensions; identification of quality problems was inspired by Stivilia, Gasser, Twidale, & Smith (2007). Only the dominant data quality problems for a given data stream are identified – minor problems are ignored. For example in an ERT profile, the inconsistency of converting resistivity to lithologic texture is a major problem, while the potential random error in location of the measurements is expected to be within 3.0m (9.8ft), which is too small to be of significance to the data. The remaining dominant quality problems are re-conceptualized as quality dimensions and added to the conceptual model as attributes to the appropriate entity. In general, if community practices for evaluating fitness-for-purpose are available, they can be used to help identify either specific data quality problems or existing community-supported methods for using these quality problems to identify the dominant data quality attributes.

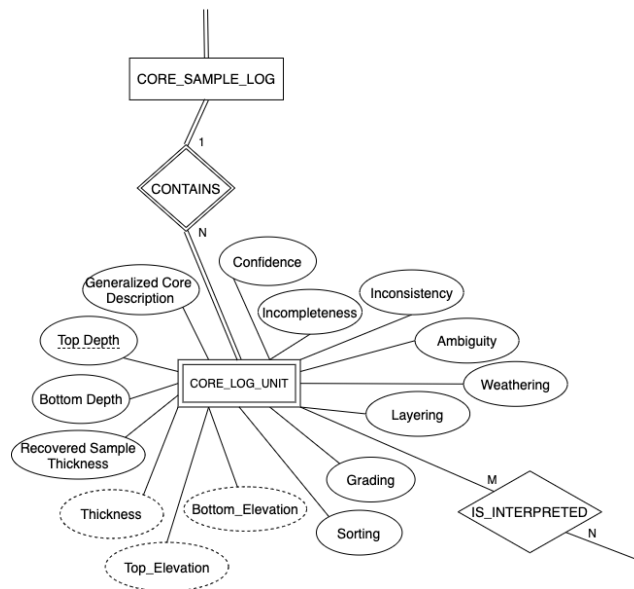


Figure 8. A portion of the EER model, showing attributes for the CORE-LOG UNIT weak entity, within the geologic mapping dataset.

To identify the data-quality problems and evaluate the fitness of the use case data for the mapping (i.e., reuse-application) goals, we used the data stream characteristics from Table 1 and considered additional attributes that

geologists often use to evaluate the fitness of these data streams for geologic mapping goals. The earlier provenance analysis documented that each data stream observes a different sediment property and that the volume of the observations between streams vary significantly. Even with the use of a generalized classification for mapping units, several of the data streams contain significant amounts of ambiguity. A similar consideration was made for each of the random and systematic errors identified within the provenance analysis, and an analysis was made of the significance that these errors can have on reliably identifying sand and gravel aquifers. After completion, this process identified ambiguity, inaccuracy, inconsistency, unreliability, and incompleteness as the dominant quality dimensions that can affect the fitness-for-purpose of all five data streams in meeting the geologic mapping goals (Table 2). These quality dimensions were then used as attributes added to each of the log-unit entities within the conceptual model (e.g., Figure 2.9).

Data Stream	Ambiguity	Inaccuracy	Inconsistency	Unreliability	Incompleteness
Core Sample Descriptions					X
Water Well Driller's Logs	X	X	X	X	X
Natural Gamma Wireline Logs	X	X	X		
Electrical Resistivity Wireline Logs	X	X	X		
ERT Profiles	X	X	X		X

Table 2. Data quality dimensions identified as potentially affecting the fitness-for-purpose of the use case data streams in meeting the geologic mapping goals.

DISCUSSION AND CONCLUSION

Although fast and accurate computational models are important for decision making, the relevance and reliability of selected data are critical for determining the value of the model results. The ReDaR framework provides KDD practitioners with a structured way to document their data alignment, selection, and fitness assessment decisions, and can help ensure the dataset is suitable to address a given research question.

The use case examples demonstrate how the ReDaR framework could be used to document data collection, cleaning, and initial processing activities in a geoscience setting, and how this documentation could provide insights into systematic biases and random errors that were generated during these activities. This information is typically not preserved in metadata (Tilmes, Yesha, and Halem, 2010; Zednik, Fox, and McGuinness, 2010), but as shown here, these insights can be used to document record- and attribute-level ambiguities.

The ReDaR framework provides a structured means for identifying and including relevant data descriptors in a dataset. As demonstrated these descriptors are added as attributes within the conceptual model, intended to support data-quality assessment, future analyses, and modeling efforts. Alternatively, any of the descriptors, or other discovered generation and processing information, could be added to the metadata. Regardless of the specific application needs, this framework provides information that can be used to better support data curation, either locally or within a relevant repository (Baker and Yarmey, 2009; Hanson et al., 2011). We echo Borgman's (2012) warning that for data reuse to be realized, "researchers who produce those data must share them, and do so in such a way that the data are interpretable and reusable by others." Semantic alignment and robust data description are critical not only for improving analysis and modeling, but in making research data interpretable and reusable by others.

The use case examples demonstrate how a fit-for-purpose assessment based on a semantically-aligned and robustly-documented merged schema can: facilitate the use of multiple community-based heuristics to evaluate data stream reliability; support a consistent evaluation of the data, the deliberate analysis and comparison of underlying data concepts, and the identification of dominant data-quality dimensions; and, utilize attribution within each data stream to support fitness-based data selection – all within a consistent consideration of the information needs of the targeted application.

The ReDaR framework extends fitness assessments from Strong, Lee, and Wang (1997), Stvilia, Gasser, Twidale, and Smith (2007), and Wang and Strong (1996), to include the additional characteristics of reliability and representativeness (Zednik et al., 2010). The framework enables a data stream characterization and a de-contextualization to provide support for semantic alignment, and a quality-based assessment of aligned entities to be used to better identify data that supports research goals.

During the fitness assessment of the use case dataset, the reliability limitations within the water well driller's logs, the unresolvable ambiguities within the transformed geophysical data (i.e., wireline logs and ERT profiles), and the incompleteness and ambiguities of the core sample descriptions were easily identified. While other applications might have found the water well driller's logs too unreliable for use, the information provided by the ReDaR framework enabled a consistent approach for making this evaluation based on the needs of the targeted mapping application.

As infrastructure supporting data collection and sharing continue to advance, more attention is given to big data problems that involve the integration of data streams from multiple repositories. We posit that the key challenges in this approach are not the underlying data structures or networking speed, but rather the ability to semantically align multiple datasets that were created by different systems, at different times, for different purposes. In the same way that a systematic review uses explicit databases and (inclusionary or exclusionary) query semantics to ensure the consistent and repeatable identification of relevant publications, we envision the ReDaR framework as an explicit method to ensure a KDD effort is based on a dataset that is reliably integrated and described to answer specific research questions. Models developed using data that has been carefully documented, semantically aligned, and intentionally selected to address a research question are less likely to suffer from unidentified bias and more likely to identify patterns that are consistent with the expected semantics of the problem.

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Information as Meaningful Experience

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ABSTRACT

Leisure is seen as important in the settlement and acculturation experiences of immigrant and refugee populations as well as helping them in maintaining their cultural identity and ties to their homeland. The study covered by this paper looks at a virtual small world, converging around a leisure activity of fanfiction reading and writing from a gender and diaspora perspective, with an aim to understanding what is experienced as information within that context. Adopting a theoretical lens drawing on information and document experience literature, information was found to be experienced as everyday, as social ties, as awareness and as memories leading to a broad conceptualization of information as meaningful experience. The study also highlighted the important role played by the social context in these experiences of information, while underscoring the usefulness in adopting an experience approach, going beyond what has been the norm in the form of information seeking and problematic situations.

KEYWORDS

Leisure; information experience; document experience, diaspora.

INTRODUCTION

Commonly understood as free time, most definitions of leisure view it as something that is indulged in when one is not productively occupied and includes hobbies. Even if it is personally cherished and socially important, Hartel (2005) notes that it is most often seen as insignificant, nebulous and without any structure (p. 313). Savolainen (1995) noted that difficulties lie in studying non-work information seeking as it could be seen as ambiguous and residual by nature. But there could also be overlap between work and non-work information seeking wherein a particular need could serve in both contexts and these could also share features like the principle of least effort. The adoption of the concept of everyday life information seeking helps legitimize non-work contexts. But this should also not be seen as an effort towards creating a false dichotomy between work and non-work contexts because they complement each other. Fulton and Vondracek (2009) argued that the impact of leisure on our everyday lives needs greater attention and this includes information behavior, the use of technology in leisure activities and the social outcome of interactions by way of leisure activities. The focus of information behavior studies have mostly been on information seeking in formal, work related contexts, but there has been an increase in studies looking at everyday contexts, including leisure. The word immigration refers to the movement of certain ethnic groups across borders, whereas, diaspora points to the dispersion of various ethnic populations globally. In other words, while immigration focuses specifically on the lived experience of certain ethnic communities in a host or adopted land, diaspora focuses on the global spread of a population transcending national boundaries. In the postmodern world, with the changes wrought by transnational capitalism and the resultant movement of capital, goods and people, the term diaspora has shed some of its past connotations of forceful dispersion and living in exile. The dispersal in today's times are due to the forces of globalization and is often voluntary. Studies looking at immigrants and refugees from an information perspective have mostly been place based and focused on their settlement and acculturation experiences, with a particular emphasis on information seeking activities within that context. Migration studies have noted the role played by media in the acculturation of immigrants along with the importance of consumption of ethnic media in helping immigrants maintain their cultural identity as well as ties with their home country. For example, the importance of leisure activities in the settlement experiences of new comers into Canada was noted by Quirke (2015). While Quirke and Howarth (2018) found that information shared in a leisure setting, through traditional story telling led to the creation of social and bridging capital. Srinivasan and Pyati (2007) argued that immigrant information behavior should be studied "within the dynamic contexts of globalization and diaspora" (p. 1734). The authors noted that online diasporic environments are equally important as their information environments tend to be more global. Pyati (2010) noted that diaspora communities are often part of a rich global information network. Adopting a gender, diaspora and leisure perspective, this paper covers a research study that looked at women belonging to the Indian diaspora, who are part of an online community converging around a shared love of reading and writing fan fiction.

Migration can be seen as gendered journeys, but the experiences and perspectives of women along with their increasing role and significance remain underexplored and underestimated due to the problematic assumption that migration is overwhelmingly male (Kim, 2013; Suman, 2018). Along with the prevalence of information studies

looking at work and formal contexts, Kim (2016) noted the absence of interest in the personal lives of women. Due to the gendered nature of migration and the legal aspects of immigration (visa rules which prohibit dependent spouses from working), a population of what is known as ‘trailing spouses’, most notably women, are common in South Asian diasporas. These women take up activities such as writing, with Suman (2018) noting the popularity of the romance genre, underlining a fact often missed by critics of this genre, that writing and reading romance is a way of subverting patriarchy. Hegde (2016) found that by means of the activity of food blogging, the South Asian diasporic women, through individual recollections of their home and homeland and the comforts afforded by home cooked meals, end up disrupting earlier notions of diasporic insularity and alienation by establishing connections with various others in the diaspora. In this manner they also create digital repositories of culinary knowledge. The blogs themselves act as a “cultural form that works within a circulatory matrix where new configurations of cosmopolitan sociality are being constituted” (p. 89). Studies of fans and fandom have noted the essentially feminine nature of the spaces occupied by such communities. Reiterating the gendered nature of fan communities, Jamison (2013) states that a majority of these self-published and not for profit works are created by women, which Busse (2017) describes as artistic works as well as cultural documents. Hill and Pecoskie (2017), who examined the information activities of a fanfiction community as serious leisure, describes fanfiction as a “subset, or type, of self-published cultural product” (p. 843). Long (2003), writing on women’s book clubs, notes the need to look at reading as a social practice and how adopting a reader-centered model leads to a view of reading as a form of cultural practice and behavior that carries out “complex personal and social functions for those who engage in it” (p. 22). Through reading and talking, women support each other in collectively working out the relationship they have with the “contemporary historical moment and the particular social conditions that characterize it” (p. 22). Reading groups may embody the concept of a deliberative space, a “counterhegemonic publics” (Fraser, 1989, p. 167), riding the boundary between public and private sphere. These sorts of spaces may be needed by women as a place where their concerns can be vocalized, and to chronicle the peculiarities of their lives. As highlighted by Hegde (2016) the gendered nature of food blogs helps to shed light on an aspect of the everyday life of women belonging to the South Asian diaspora and it also underlines the transnational nature of diaspora spaces on the Web. Adopting this approach of looking at the “digital and gendered diasporic ways of being” (p. 91), a purpose of the research study was to understand how the gendered diasporic environments of fanfiction blogs termed “virtual zenanas” for the study, which can be seen as “privately public and publicly private” (Papacharissi, 2010, p. 142), are experienced in the everyday life of women belonging to the Indian diaspora. Further these spaces can also be viewed as small worlds, as it coalesces around a shared leisure interest. Experiences of the everyday, including leisure tend to be neglected by perceiving it as familiar, unremarkable and common. Further Pollak (2015) notes that very little is known about non-documentary and experience based information found in informal contexts. Keeping in mind Kari and Hartel’s (2007) call for looking at that which is pleasurable and profound, the everyday (Ocepek, 2018), the informal, including leisure contexts (Pollak, 2015), the study further aimed at understanding “the red thread of information in the social texture of people’s lives” (Bates, 1999, p. 1048) by placing it in the overall context of diaspora and leisure. It was also felt that by ignoring things as trivial and ordinary, as well as focusing on problem oriented contexts we are missing out on understanding that which contributes to individual as well as societal wellbeing, while enabling us to “learn from each other in very organic ways” (Pollak, 2015, p. 5). The focus on problematic contexts and explicitly sought and shared information, prevents us from seeing how information could be experienced in more holistic ways. The broad research question was: What does experiential information look like in the diaspora small world? (Kizhakkethil, 2020a).

Experiencing leisure

Hartel (2003) introduced serious leisure to LIS and it can be defined as a “constellation of insights about the activities that happen within leisure time” (Hartel, 2005, p. 313). It can be viewed as useful in studying information behavior with respect to the leisure part of everyday life. ‘Serious leisure’ was coined by Robert Stebbins in 1982. As a sociologist Stebbins viewed serious leisure as interdisciplinary because it draws from almost all social sciences (Hartel, 2005). According to Hartel (2005) the word “serious” in serious leisure means the presence of dedication and concentration in such activities while been fun. One of the reasons given for the usefulness of the concept in information behavior research is the necessity for acquiring skill and knowledge in pursuing serious leisure. There are three forms found within serious leisure: hobbies, voluntarism and amateurism. Hartel (2005) argued that hobbies are a good starting point for information behavior research due to their prevalence. Some of the studies in LIS which have used the serious leisure perspective have looked at gourmet cooking (Hartel, 2006, 2010), amateur photography (Cox, Clough, & Marlow, 2008), food blogging (Cox and Blake, 2011), hobbyist collectors (Lee and Trace, 2009), quilting (Gainor, 2013), music record collectors (Margree, MacFarlane & Prie, 2014), motor sport enthusiasts (Joseph, 2016), fan fiction community (Hill & Pecoskie, 2017; Price, 2017), among others.

Gallant, Arai and Smale (2013) noted that the serious leisure theory as put forward by Stebbins has remained unchallenged and unchanged to a large extent, pointing to the durability of the concept. At the same time, it “reflects its somewhat intractable links to its past and the intellectual context from which the theory emerged” (p. 92). They

pointed out three aspects of the concept which impose certain limitations. Firstly, the assumption that if one is participating in a certain activity, it is presumed to be a participation in serious leisure with its resultant benefits. In the second case, the psychological aspects of individual leisure has not been fully grasped. Pollak (2014) noted that socially constructed and unacknowledged dichotomies limit the study and interpretation of serious leisure, like situating work and leisure in a positive/negative dichotomy. In the third instance, the social context in which leisure activities occur has been neglected along with the potential such activities can have in fostering social ties and identity building. With these limitations in mind, Gallant et al., (2013) argued for an “expanded view of experiences of leisure in general, and serious leisure more specifically, particularly the gendered and commodified nature of these experiences, as well as the potential for diversity and innovation” (p. 94). Adopting this view, Pollak (2015) looked at experience in general in a small rural context across the life, work, and leisure spectrum to come to an understanding of experiential information. Following this approach for this study, leisure is viewed as an experience, without further classifying it as serious or not (Kizhakkethil, 2020a).

THEORETICAL FRAMEWORK

To understand the social context, it was felt that a re-imagination of the idea of a small world was required, even though the concept is good to encapsulate a social world coalescing around a shared leisure interest. Based on literature review and the author’s observations of the world under study, a preliminary model of a virtual small world was drawn up and was defined as having sites of activity, supported by mediated practices and characterized by the presence of social ties, a sense of community and a world view (Kizhakkethil & Burnett, 2019; Kizhakkethil, 2020b). Sköld (2013) studied virtual gaming communities by adopting a document and documentation approach, and argued for putting the analytical focus on documents rather than on their latent information. This helps to bring to light the important role played by these documents, in the socio-cultural life of virtual communities. These virtual spaces are characterized by the pervasiveness of mediated practices through the use of new media technologies, and requires viewing both the virtual spaces and the mediated practices as documents. Enabled by the new media ecology, documentary practices like blog posts, tweets, comments etc., flourish, and hence viewing them as documents “accentuates new media as infrastructures that do not solely carry informative traces of the activities of virtual communities, but in effect are an active and formative part of them” (p. 11). Adopting this approach of Sköld’s (2013), the blogs on which fan fiction is hosted and the mediated practices supported by these virtual spaces like posting comments, replying to comments, posting various media etc., were viewed as documents. According to Bruce, Davis, Hughes, Partridge and Stoodley (2014), information experience can be understood as a “complex, multi-dimensional engagement with information” (p. 4) in real world contexts, and “integrates all information related-actions, thoughts, feelings and has social and cultural dimensions” (p. 34). Davis (2015) holds there are three dimensions to information experience. This comprises people with their backgrounds, world views, feelings, emotions and thoughts; the myriad forms of information; and the context in which the experience occurs, whether virtual or physical. Document experience is information experience from a document perspective. As a phenomenological approach, document experience “seeks a holistic, multidimensional account of how humans engage with documents, to include cognitive, affective, temporal and corporeal dimensions, among others” (Gorichanaz, 2016, p. 2). Most definitions of documents implies the presence and activity of at least one human actor. It is through the presence of a human actor that a document can be “observed, consulted or studied” (Gorichanaz, 2015, p. 3). This also implies that without a human actor there will be no one to whom a document can be presented, or who can reconstitute or handle it. Any information object remains a potential document by itself and it is through human activity that a document is created. If we were to conceptualize documents as co-created, then the human actor is inextricable from it. Both the information object and the human actor contribute towards the formation of a document and this occurs in a transaction; “a moment that can only exist by the fusion of the person at that moment with the object in that place” (Latham, 2014, p. 549). Drawing on the work of John Dewey and Louise Rosenblatt, Latham (2014) holds that document experience can fall in a continuum which ranges from the efferent to the aesthetic. On the efferent end of the continuum, a person looks to take away something, like information from reading a newspaper. Whereas at the aesthetic end of the continuum, the transaction “involves deciphering images and concepts of words that lead to an interpretation of the text aroused through one’s feelings, associations, attitudes and ideas” (p. 546). Gorichanaz (2018) states that documentation is an experience viewed from the first person and his model was developed looking at self-portraiture as an act of documentation, working from earlier work which looked at lived experience of document work through a case study of a gardener. This experiential time sensitive framework consists of foundation, process and challenges bringing together or synthesizing earlier models from Lund (2010), Gorichanaz and Latham (2016) and Gorichanaz (2016). Viewing leisure as an experience, the theoretical framework consisted of the preliminary model of a virtual small world, information experience as a concept, Latham’s (2014) model of document experience (from a user/reader perspective), and Gorichanaz’s (2018) first person model of documentation (creator/writer perspective).

RESEARCH SETTING AND METHODOLOGY

The population looked at for the study were Indian women belonging to the diaspora who are also fans of an Indian television show titled “Iss Pyaar Ko Kya Naam Doon”. Fanfiction based on the show is very popular in the community and the spaces like blogs where it is hosted tend to become “Addas” or hangouts. Data was collected through semi-structured interviews and through the collection of comments posted on fanfiction blogs. Five blogs based on popularity and access at the time of collection, hosted on wordpress.com were identified, and comments posted on them were collected using the screen clipper feature of OneNote. A total of 1255 comments were collected. A purposive sampling approach was followed for the recruitment of interview participants, with a total of 15 participants recruited, a mix of writers and readers. In qualitative research a participant needs to be a person who has experienced or is experiencing the particular phenomenon under study and is willing to contemplate and provide a detailed experiential account of the experience to the researcher (Morse, 1991) and as such this sampling approach was adopted. One participant withdrew citing health issues. Eight (8) of the participants were located in the US, three (3) in the UK, and one each in Canada, United Arab Emirates, and Australia. The participants were given the option of doing email or audio interviews, eight (8) participants opted for email and six (6) opted for audio interviews. The audio interviews were conducted using Zoom. Three of the participants had written or were writing novel length stories at the time of recruitment and were classified as writers. A qualitative research approach along the lines of one used by Ocepek (2016) was employed for the study. Ocepek (2016) used a methodology inspired by institutional ethnography and that was “designed to explore the social relationships that construct the context around a given phenomenon through the descriptive analysis of the localized lived experience of research participants” (p. 15). She affirms that Dorothy Smith’s (1987) reinvention of methodologies in sociology can prove to be an inspiration to create our own methods, especially in the arena of everyday life information behavior studies with a focus on the lived experience of individuals. Institutional ethnography was developed by Dorothy Smith as a feminist methodology for showing the “social organization of patriarchy” (Townsend, 1996, p. 179), it can be viewed as a qualitative research approach grounded in critical social science and feminism. Thematic analysis which is a method for the systematic identification, organization and offering of insight into “patterns of meaning (themes) across a data set” (Braun and Clarke, 2012, p. 57) was employed for the study. Both deductive and inductive approaches were combined in the data analysis. A deductive approach is a top down approach, where the coding is driven by certain concepts, topics or ideas that the researcher brings to the process. The initial analysis was guided mainly by the theoretical framework employed for the study, while keeping oneself open to the themes the data brings up apart from it, which is what an inductive approach is like; a bottom up approach which is driven by what is present in the data. Member checking was carried at two stages; in the case of audio interviews the participants were given the transcripts of the interview for their perusal and asked to make any changes they would like. In the second instance, the individual analyzed interviews were given to the participants to verify if their voices and views are reflected in the analysis. Post this, the participants were also provided with a model (see Figure 1) and asked what they considered information, which nine participants chose to answer.

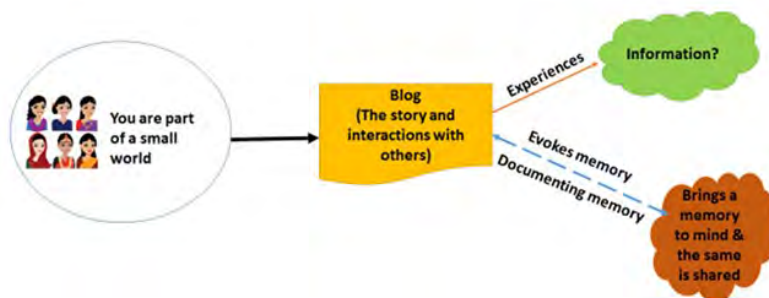


Figure 1. Model shared with participants

FINDINGS

This section covers the relevant findings. The quotes from the interview data have been edited in some cases for purposes of clarity and brevity.

Small world

Themes relating to the small world social context, social ties and sense of community were seen to be supported in both the interview and comments data. Social ties and the importance of the same is a theme that came up in all the interviews, with most participants holding it as one of the key takeaways from their experience of reading and writing fan fiction. It was also seen to play a part in their reading and commenting, and in the case of writers as feedback and motivation. For example Participant 1 said “more than story and characters I am enjoying rapport shared between readers or writers or readers and writers”. For Participant 7 “the biggest draw from the experience is

that it has enabled me to meet new people and form strong friendships". The social context added to the sense of enjoyment derived out of the document experience. A 'sense of commonality' and 'being comfortable' are themes that came up in the interview data. This theme, along with the importance of social ties, points to a sense of community. Participant 4 touched on feeling comfortable and having commonalities, in sharing things like even a piece of music:

First and foremost, the very fact that I'm willing to share it, kind of, oh, hey, I can always say, hey, I like this song, you know, like a random pop song that nobody likes, the very fact that you're comfortable sharing a song that not many people would like itself shows a level of comfort, which you wouldn't feel comfortable sharing or telling people with whom you meet, like, face to face, maybe because you're worried about how they would think so, like, like I said, that itself shows because I think in my mind I know that I wouldn't be judged.

Participant 2, a writer, talked about the encouragement she received from social ties based on the comments she used to post for the story known popularly as the 'river', which in turn became motivation for her to write her own story:

I took it really seriously when I was writing a comment, I really took it seriously and then when people responded to it, saying like, especially Appu, like she'll say oh you've written really well, this is so good. I'm like, really?..... and then people are saying you can write, you can write

Document experience

A main theme that came up in the interview data was "learning experience". All the participants described their experience as a learning one or enriching one. By learning they meant things like how to be more positive towards life, or discovering and nurturing a talent/skill especially in the case of writers. They also spoke about becoming more 'active readers'. Participant 2 who took a foray into writing after becoming a part of this fandom, said her experience of reading fanfiction made her into a more a 'active reader', the interpretive skill so acquired is carried on to the consumption of other media as well.

This FF reading, has also helped me in being a more appreciative and selective reader in other fiction. It is like I got a new perspective with which I read, and appreciate the writing and motivations of characters. I now like to delve into the sub-texts (even when watching movies), without being a passive reader (or viewer).

Participant 1 gave examples of what she considered positive behavior and went on to say, "I don't read fiction because I want to learn, but, I can learn while reading". For Participant 7, the different perspectives she was exposed to through reading the comments of other readers not only provided a glimpse into the mind of the person posting the comment, but also helped with her own thought process. She said:

There have been times when a one specific scene has garnered like six or seven different responses..... you're thrown because you get like these many perspectives out of one given situation and you know you can form an opinion about, not opinion that's a strong word, but you can get a glimpse into the head of person who's writing it right, so you can learn. Oh yeh sa bhi soch sakta hai (you can think like that too).

While talking about interacting with others, Participant 3 said, "it feels nice to talk about general stuff or even learn more about different cultures, in some cases". Asked to elaborate she gave an example of her experience reading a story titled 'sea mist', to say "we spoke about festivals, various places, or discussed about sarees". About her document experience, Participant 15 said, "learning is the key. The interactions help you to learn more about the culture and the background related to it". We can say the document experience here includes not just the reading of the story but also the interactions that takes place via the mediated practices supported by the blog. For the participants classified as writers, the process of writing involved looking up information apart from drawing on one's own existing knowledge, experiences as well as memories. Though Google was the go to place for information, Participant 2 also spoke about speaking to a social tie who is a doctor about a medical condition, further highlighting the role of social ties in the experience:

I actually asked Meenu once because when I wrote, I wanted the mother to fall sick and come to this house.... that's when I think like when I wrote about the accident of her kneecap and she had to get a surgery and physiotherapy so that piece I wanted to make sure that it was logical, I didn't want to write some stupid story.

Participant 4 on the other hand spoke about finding information about a place she had not visited for use in her story, including things like flight timings if one were to travel there by saying "I took a look at the amount of time it would take for her to go, to reach and the kind of flights they have and things like that". In the comments data a major theme apart from the concepts associated with the small world, was 'sharing', which also includes information sharing. Experiences associated with reading, memories and personal anecdotes apart from information (directly sought and provided) were seen to be shared. Examples are used in the discussion section.

What is information?

A sample of the answers to the question of what they perceived as information based on the model provided in Figure 1 is provided below. This further supported the interpretation of what was experienced as information in the comment data.

Participant 1: Information about real places mentioned, medical issues and terminology used or legal issues and terminology used or English words or acronyms or IT issues and terminology used. I also take information which lets me have a better outlook on life.

Participant 8: I think the biggest takeaway I have had from the ff blog space are not the stories but the comments of fellow readers. Their life experiences which are reflected in the comments. In everyday life my association are with likeminded folks, similar background etc. So this has been an eye opener. One would think it should not be a surprise but it is/was. On a personal front made me realize (what I had taken as given) that I have a lot to thank my parents and family.

Participant 9: I think information in the literal sense would be physical places written about in the story and mentioned in interactions with readers. Another thing is a better understanding of general life issues and differing outlooks of people in different parts of the world. Also, more information about popular culture.

Participant 10: Some authors have a penchant for describing the places as vivid as one can imagine. It is their way of bringing visuals of a place to the readers. I thoroughly enjoy such journeys. And then, there is so much you can learn about a certain profession (J**s does so well with describing medicos) or certain life-style culturally or geographically (be it in a specific city in India or a different country). Readers chime-in with their experiences too. That, again, is information. I remember while reading River, several of us shared our first experience stepping on a foreign land (similar to the protagonist Khushi's).

Participant 14: Information is the setting like where the scene takes places, the authors have a wonderful way of describing even a common room to something extraordinary. What I take away is to look for beautiful things around you. Professions and understanding of various skills from the story. For instance when I read a story about an NFL player, you learn a lot about the game, a story about a vivid photographer, there is lot you learn about the profession. The authors taking time to make the story more real with facts.

DISCUSSION

To address the research question covered by this paper, the interviews were used as the primary data source, and the main theme that became apparent was the participants terming their experience as a “learning experience”. The participants were asked to talk about their experience of the small world, especially the sites of activity which in this case are the blogs hosted on WordPress, with an emphasis on their reading experience. They were also asked to talk about their leisure interests and how that has changed over the course of migration. What has been made clear from the study is the importance of social context in the document experience of the participants. Apart from seeing social ties as an important takeaway, the participants described their experience as an enriching or learning one. Apart from this, the writers were also asked to describe their experience of documentation, in other words the writing of a story. The role of information and what constitutes information in this process were also examined. The nine participants who chose to answer the question as to what they considered information based on the shared model (See Figure 1) gave a wide variety of perspectives on what they considered information starting from what is generally understood or termed as information, to even culturally driven differences. When it comes to looking at the document experience from a creator side, apart from information seeking in the form of research that is done, the support provided by the social ties, in the form of motivation, peer support, and validation, is seen to play a big role not only in the process of documentation but also in the journey to it becoming a personally meaningful activity. Based on the analysis of the information and document experiences, along with the analysis of the comment data, information can be seen as:

- As everyday
- As social ties
 - As interaction
 - As motivation
- As awareness
- As memories

Information as everyday

Information as everyday encompasses things like learning about different places, different cultures, different professions and its allied aspects, popular culture, sharing other things like information about restaurants, hotels, books, movies, etc. For example, Participants 1, 9, 10 and 14 talked about the places mentioned in stories as something that they have taken away from their experience. Participant 3, in the course of her interview, had talked

about learning about different cultures in her interactions with others as part of her document experience. Participants 1 and 10 talked about learning about things related to professions like medicine and law, while Participant 7 mentioned learning about business consultants and their work. This is reiterated when they were directly asked what they saw as information. For example, Participant 14 says that “information is the setting like where the scene takes places, the authors have a wonderful way of describing even a common room to something extraordinary”. Everyday can also be talking about things like parenting as part of social interaction. This falls in line with what is known as everyday life information behavior where the emphasis is on non-work related activities. And, in line with the idea of information ground, the information is exchanged as part of social interactions, where the primary purpose is not information seeking or sharing.

Information as social ties

Social ties is one of the biggest takeaways for all the participants from their experience of the small world. The impact of interacting with others and sharing their reading experiences is seen to be a big part of their document experience which adds to what they refer to as a learning experience. Information as social ties has been further categorized into information as interaction and information as motivation.

Information as interaction

Interactions with social ties plays a big role in the document experience. All the participants highlighted what role that interacting with others played in how they interpreted what they were reading and what they gained from the experience. Here interactions mean exposure to other perspectives, learning about other people, and also getting exposed to information that one didn't have before. Participants spoke about how this turned them into more active readers, how they learned to look at and understand other perspectives. For example, Participant 8's answer to the question of what she considered information in the small world context was “Information: I think the biggest takeaway I have had from the ff blog space are not the stories but the comments of fellow readers. Their life experiences which are reflected in the comments.” Similarly, Participant 6 had this to say about her experience:

There were things that I would realize really after reading some comments or hey, this, this is another way of looking at it, right. You know we are so set in our own ways of thinking, right, that we do not think (of) another perspective. And so reading gives you different perspectives of how different people think how they come up with, you know, their theories, an insight into that person as well.

Participant 10's answer to what she saw as information included “readers chime-in with their experiences too. That, again, is information.” Figure 2 shows a conversation between two women, where one is sharing what she thought a situation touched upon in the story and the other woman (writer) is sharing an article she had found on the subject.

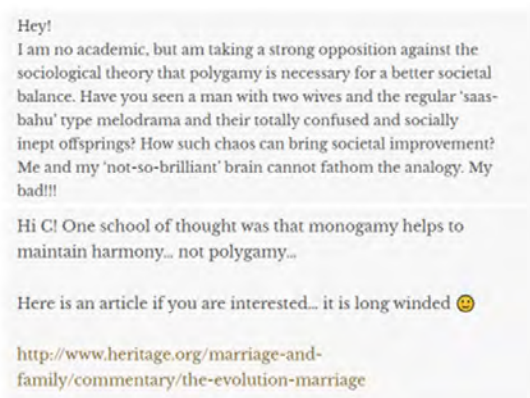


Figure 2. Example of information sharing

Information as motivation

For the participants who are writers, the motivation received from their social ties played a role in them writing as well as helping them in the process by way of peer support. For Participants 2 and 7, the encouragement and goading from social ties played a big role in them starting to write. For all three, reader document experience expressed by way of comments played a big role in motivating and helping them in overcoming challenges. The reader experiences act as information about what is working or not working as far as their story is concerned, and played a part in the learning process associated with writing. It also takes the form of peer support from social ties, who act as beta readers as well as helping in other things like setting up the blog. Participants also spoke about how appreciation for comments made them feel good as well as helping out others in mediated practices like posting

videos, gifs, images, etc. In both situations above there is exchange of information involved whether by way of support or in actual terms like providing opinions or help. Figure 3 below has a note posted by a writer on her blog thanking a set of her regular readers for their presence and interactions on her blog.

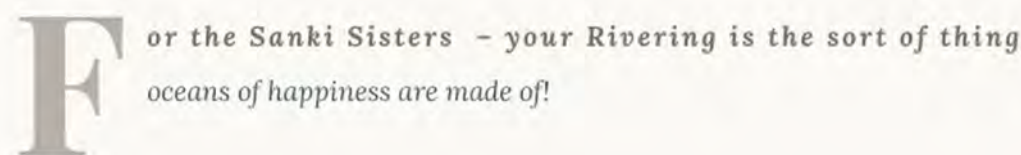


Figure 3. Social ties

Information as awareness

Participants described becoming aware of facets to their own self, or even the sharpening of a skill set that they already had as a result of their document experience. This can be conceptualized as a kind of information that is experienced. For participants who are writers' awareness or discovery of a side to themselves through the process of writing and sharing the same is seen as very enriching. Awareness about self can also be in relation to others or one's life experiences. For example, Participant 4 in her answer to the question of what is information for her talked about the difference in way of thinking that she perceived between those living outside of India and those who live in India, irrespective of education. She said "it made me wonder whether irrespective of the level of formal education women receive if we are all just products of our upbringing and/or consequences of the society we inhabit?" In a similar vein, Participant 8 said the interactions she had with people in the small world "made me realize (what I had taken as given) that I have a lot to thank my parents and family." This was brought about by her interactions with those who were unlike her, whose life experiences were different to her own.

Information as memories

Memories are evoked as part of document experience and are used in making meaning, and as information in the interpretive activity. Participant 4 spoke about her experience of reading the story titled "odyssey" and how it triggered memories of her hometown.

Another scene from another fan fiction that brought my school days to mind, was a scene from ***u's Odyssey*. Though I gave up the story mid-way, it made such an impact on me especially the initial chapters mainly because the story was set in Chennai, from my part of Chennai to be precise. I have spent so many countless evenings meeting friends at the beach after school. My house was close enough to the beach that I could see the ocean from the balcony. The smell of the sea in the air as she describes it brought it all so vividly to mind. Yup, this was another story that had me feeling so nostalgic.

In the document phenomenology framework, Gorichanaz and Latham (2016) states that four kinds of information come together in document becoming. Two come from the object and two from the person perceiving it. Adtrinsic information comes from a person and is the "personal historical information that comes to the fore through memory associations during a document transaction" (p. 1121). Such information can be either personal or social and these are often intertwined. Individual experiences are socially processed while social encounters could be individually experienced. Memories evoked by individual document experience is socially processed through the documenting that takes place through mediated practices, and this leads to a sort of collective memory making by way of social interactions surrounding such experiences. Memories as adtrinsic information also feeds into the creative process as noted by Gorichanaz (2019a) in his first person model of documentation. Memory as adtrinsic information is seen to be well supported in the data. Similarly memories evoked fall within the ambit of the themes 'object link' and 'being transported' of Latham's (2014) document experience model.

Information as meaningful experience

Anything can be experienced as information. Like beauty, information lies in the eyes of the beholder (Lupton, 2014). According to Bruce (2008), information is anything that is experienced as informing. It does not always have to be a visible object, it can be a physical action or an emotion, and it can also be embodied (Harlan, 2014). Information experience from a document perspective is known as document experience. A purpose behind the study was to understand the document experiences both from a reader and writer perspective situating it within the large context of diaspora and leisure. Through this, an attempt was also made to understand what is experienced as information. The main theme that came up in the interview data was the participants describing their experience, both reading and been being part of the small world as a learning or enriching one. One of the main themes in the comment data was sharing, which included everyday life including anecdotes, memories, and also information. In

addition, the participants were also asked what they perceived as information. Taking all this together into consideration information was seen to be experienced as every day, interaction, motivation, awareness, and memories. These results are in line with the results of Harlan (2014)'s study of teen content creators. For her participants, information experience was closely aligned with learning. Harlan noted that when it comes to content creation and content sharing, information is experienced in multiple ways, and that it cannot be conceptualized in just one way. Information was experienced as participation, inspiration, process, artifact and collaboration. This finds support here also in that information is seen to be experienced as interaction and motivation which plays a part in what the participants described as a learning experience.

Silverman (1995), drawing on Dervin (1981), posits that information as well as meaning can be referred to as a process of negotiation between two parties wherein meaning and information are not transmitted but rather created. Meaning can be said to be "in the eyes, head and heart of the particular beholder" (p. 161). In relating this to visitor meaning-making in museums, Silverman (1995) highlighted the active role of a visitor in creating meaning out of her museum experience through the context that she brings along, and is also influenced by the presence of companions, leisure motivations and self-identity. Similar ideas have informed the work of Latham (2014) and in which she views document experience as a person-document transaction. According to her, an aesthetic person-document transaction is the "coming together of the person – living, breathing, with memories, knowledge, feelings, moods, environment, etc. – with the document, a complex representation of some reality or realities" (p. 551). Within the ambit of document phenomenology, which is a part of Gorichanaz's (2018) document experience model, it is the coming together of four kinds of information; two from the document and two from the person encountering the document resulting in the document meaning. Silverman (1995) sees meaning making as a "constant process of remembering and connecting" (p. 162). Learning and perception depend on how we accommodate newly gained information in our existing mental frameworks and structures. Speaking of museums, she states that people place what they encounter, whether object, text, perspective or a fact, within the background of their own experiences. In addition there are motivations behind a museum visit and the same has an impact on meaning making. Similarly one's identity as well as one's social context in the form of companions play a role in how meaning is made.

Latham (2014) drew on the work of John Dewy and Louise Rosenblatt in developing her model of document experience. Document experiences in the form of a transaction falls in a continuum ranging from the efferent to the aesthetic and the stance taken by the person has an impact on it. A person is considered to be inseparable from their lifeworld, and as such the infrastructural context of a document along with its lifeworld should be seen as having a bearing on the document experience (Wood & Latham, 2014; Carter, 2016; Gorichanaz, 2016). We see similarities between Silverman's ideas on meaning making and Latham's document experience framework drawing on Rosenblatt's transactional theory of reading. For this study, combining Silverman's work to with Latham's document experience model helps to better explain the results of how information is experienced as discussed above. Silverman's motivations can be seen as Rosenblatt's stance. Where it can add to Latham's work is bringing the role of the social context, the presence of others and their role in meaning making, to how we understand document and information experience. This could be seen as the infrastructural context of a document and its life world along with the person's lifeworld. Transaction for this study would not be just the transaction with the document (the story by itself) but transaction with others by way of their comments. This transaction can also fall in a continuum between efferent and aesthetic; efferent when there is information sharing (information as every day) and aesthetic when information is by way of say motivation or awareness. Silverman (1995) notes that visitors to museums often learn new things through the knowledge and past experience of companions. Similar to other realms of one's life, people make meaning in museums "through the filter of their interpersonal relationships" (p. 163). This can be seen to be supported here by the importance placed on social ties by all the participants and the role they mentioned it played in their individual document experiences.

Silverman (1995) states that meaning making strategies are common behaviors that are basic to all humans. In a similar vein, Harlan (2016) views learning as a daily activity that is rooted in our life world. In the process one encounters information which requires us to "make connections between new information and existing knowledge. Therefore, learning is, in a word—, connected. When we engage with information we connect to ourselves, our understandings, our experiences, as well as with others and to the world around us" (p. 110). This is in line with what Silverman (1995) says about making of meaning involving remembering and connecting. This idea of learning goes with what is understood as 'learning experience' for the participants and the conceptualizations of information that came from it. For Harlan (2014), information for her participants was not only transformation and subjective, pointing to information being something experienced as informing. She states that the same had elements of Buckland's (1991) classification of information as an object, as a process and as knowledge, with an element of simultaneity. Based on the results of the study and taking into account the literature discussed above, it is held that information should be viewed as a meaningful experience, which encapsulates within it Buckland's (1991) classification of information as an object, as a process and as knowledge. Here information as object is the document

itself (including the mediated practices which are viewed as documents), as a process which is the meaning making that happens in the person-object transaction including information as motivation and awareness and finally as knowledge which are the changes that happens as a result of the meaning making in one's existing knowledge structure. This broad conceptualization of information frees us from the narrow idea of information as something that helps us in solving a problem, addressing a gap, or as something that is sought (considering the overwhelming number of information seeking studies) or, drawing on Rosenblatt's work, that which falls only in the efferent side of the continuum. As a meaningful experience, it can cover the whole spectrum of information experiences and the activities associated with them. Adopting the document approach, where the analytical focus is on the document rather than its latent information (Sköld, 2013, 2015), also helps bring to light a more holistic experience of information. Doty and Broussard (2017) called for the viewing of fiction as informative, and doing so helps better address problems in information science theory like the "frustrated attempts to define *information*, the (generally hidden) gendered character of information science and information behavior research, the misguided conduit metaphor and an overemphasis on cognition at the expense of practice, documents and materiality" (p. 61). Viewing fiction as informative also helps in better understanding of information behavior. This study is seen as an attempt in this direction, adding to the studies that have looked at activities that are found to be meaningful, without being constricted by any clearly stated goal.

CONCLUSION

There have not been many information studies that have taken a diaspora perspective and this study is an attempt to fill that gap in the literature that takes into account the transnational nature of diaspora populations. There has been a steady increase in studies that have looked at leisure within information science, and this study is an addition to the same. Kari and Hartel (2007) called for the study of that which is pleasurable and profound and along the same lines Gorichanaz (2019b) called for information studies into personally meaningful activities. He defines personally meaningful information activities as those carried out by a person "freely and for their own purposes, and which reinforce the person's senses of efficacy, value, and self-worth" (p. 1304). The results of this study show that fan fiction reading and writing can be seen as a personally meaningful leisure activity, in which information is experienced in a multitude of ways. In addition, viewing leisure as an experience also provides a fresh perspective in how informal, everyday contexts can be studied. It is believed that adopting a document approach as symbolized in the document experience models would help us to better understand what is experienced as information in a holistic way unlike the traditional approach of looking mostly at problematic situations and explicit information seeking. This study further refines and adds to the extant document experience models. Taking this further, the plan is to look at activities like vlogging, to understand what would be information in such contexts as well as the role of the social context in such experiences. Though the study has several limitations like the small sample size, the focus on a particular cultural context and technology platform, it is hoped it will contribute towards further conceptual and theoretical work in the information and document experience arena.

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From Information to Knowledge Creation in the Archive: Observing Humanities Researchers' Information Activities

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ABSTRACT

As primary sources, archival records are a unique information source at the very heart of humanities research. However, how humanities researchers move from information to knowledge creation by making meaning from archival records has not been the focus of previous empirical research. This is surprising, as creating new knowledge through (re)interpretation of records is a core motivation and outcome of humanities research; as representations of historical and social occurrences, archival records rely on researchers' interpretation of content, context, and structure to establish an 'archival' meaning of the record, before applying this meaning within their own work. Therefore, constructing knowledge from archival materials necessitates a dual process of knowledge creation to create novel insights from a hybrid interpretation of archival meaning and the researcher's own interests. This paper presents findings from a naturalistic empirical observation of 11 humanities researchers engaging in research at a national archive, centring on key information activities that facilitate knowledge creation from archival records: *Scanning, Relating, Capturing* and *Organising*. Through these activities, scholars integrate their research aims and objectives with archival meaning to generate new insights. Deeper understanding of the nature of knowledge creation in archives can benefit archivists, archive users and systems designers alike.

KEYWORDS

Archives; Human Information Interaction; information use; knowledge creation.

INTRODUCTION

Archives are an essential information source for humanities researchers, for whom original insights into primary material drives new interpretations of historical or social "*occurrences*" (Yeo, 2007, 2008). For these researchers, interpreting information to drive the generation of novel ideas is both a core motivation and outcome of information interaction. However, while there have been some existing user studies of Human Information Interaction within archives, these studies have focused primarily on understanding information-seeking activities (Rhee, 2015; Sundqvist, 2015) and not on information use to facilitate knowledge creation.

Archival records are a unique information source: to reliably interpret them as evidence of events or processes that took place requires not only an understanding of their content, but also their context and structure (Millar, 2018, p.9). For humanities researchers, this means undertaking a dual process of knowledge creation that requires the researcher to first interpret the record within the archival context—to invoke an 'archival' meaning of the record (Ketelaar, 2012, p.23)—before using this meaning to drive novel insights into historical or social occurrences.

No previous studies, to our knowledge, have focused on understanding key activities that support knowledge creation from information found in archives, such as close reading, capturing records through self-digitisation methods and organising and reorganising materials to support connection-making. While such activities have been studied in relation to humanities scholars' research practices in general, the unique qualities of the archive as an information environment and the centrality of interpreting primary sources to humanities research makes this a specific context worthy of in-depth examination. We report a naturalistic observation of 11 humanities researchers engaging in research with archival records within a large national archive. We identify and elucidate two core research practices, comprising four associated information activities that facilitate both interpretation of the 'archival' meaning and creation of new knowledge from historical records. These are *Reading* (with associated

information activities of *Scanning* and *Relating*) and *Collecting* (with associated activities of *Capturing* and *Organising*). Through elaboration of these activities, tensions between establishing an archival meaning and generating novel insights are examined. This aims to provide a richer understanding of the nature of knowledge creation in archives that can benefit archivists, archive users, and systems designers alike.

The rest of this paper is organised as follows: first, related literature on knowledge creation in archives and humanities scholars' information activities is synthesised. The naturalistic observation method followed is explained and justified, followed by findings, focusing on the four identified information activities of Scanning, Relating, Capturing and Organising. Next, the importance of these findings for understanding the nature of knowledge creation in archives is discussed, followed by conclusions and future work.

RELATED LITERATURE

Knowledge Creation in the Archive

Archival records serve as important sources of historical evidence, as 'witnesses' to events or processes that took place in the past (Yeo, 2007, 2008). They are also somewhat unique as information sources, as it is not only a critical understanding of their content, but also of their structure and context that is required to reliably interpret them (Millar, 2018, p.9). As such, the content of a record usually consists of a description or some other representation of an event or activity it purports to represent. Structure describes the "*physical and intellectual characteristics that define how a piece of evidence was created and maintained*" (Millar, 2018 pp.12-13), while context refers to the "*functional, organizational and personal circumstances*" surrounding the creation of the record (ibid). Collectively, these characteristics allow the record to be considered a representation of a particular event or activity and thus support the interpretation of an 'archival' meaning of the record (Ketelaar, 2012, p.23). While multiple meanings can be interpreted, each should be supported by evidence from within and beyond the record.

To use archival information effectively (and without straying far from the evidence), researchers must establish the record in relation to these elements in addition to being able to apply relevant information to their own work. Thus, archival records require a dual process of knowledge creation: establishing the 'archival' meaning—the record in relation to the activity or event it purports to evidence—while also reinterpreting this meaning in relation to their own research aims and objectives to generate new ideas and insight.

There are very few studies of information activities in archives and most of these focus on information-seeking (e.g. Daniels & Yakel, 2010; Duff, Craig, & Cherry, 2004; Duff & Johnson, 2002, 2003; Johnson & Duff, 2005). The only study on information interactions in the archive that explicitly aimed to understand 'archival meaning-making' focused on how the navigation of records transitions to interpretation of the records themselves (Duff, Monks-Leeson & Galey, 2012). Studying students' experiences of using finding aids – descriptive tools that help to highlight physical and conceptual links between items within archival collections – Duff et al. (2012) found that building both contextual knowledge and a holistic overview of the collection as a whole supported the students' interpretation of the archival records. This reflects the assertion made by Millar (2018, p.9) that it is not only the content, but also the context and structure of records that comprise a record's meaning.

Though the evidence is very limited, other studies of information seeking (Duff & Johnson, 2002, 2003; Johnson & Duff, 2005) also highlight the significance of context to finding relevant information in the archive. In particular, the importance of building contextual knowledge during the course of information seeking in archives has also been pointed out (Duff & Johnson, 2002). While 'contextual knowledge' can relate to building an understanding of the circumstances in which records were created (Duff & Johnson, 2002; Duff et al., 2012), it can also refer to the expectation of historical researchers "*doing their homework*" before entering the archive (Johnson & Duff, 2005, p.127). The same expectation has also been noted of other humanities researchers, such as genealogists (Duff & Johnson, 2003; Yakel, 2004). This suggests a secondary type of 'contextual knowledge', formed by the framing the researcher themselves wishes to apply to a topic of enquiry. Indeed, Duff et al. (2012, p.84) note that students found it easier to navigate the archive if they had a predetermined framing for their research before they entered the archive. This points to the existence of dual knowledge creation processes: interpreting the 'archival' meaning and the utilisation of this interpretation within the humanities researchers own work. The broad scope of these processes means that knowledge creation should not be regarded purely as an outcome of humanities research, but as a continual and active process of interpretation and application that occurs as a by-product of multiple information activities throughout the research process. It is these activities that are investigated in this research.

Humanities Scholars' Information Activities

While the information needs, seeking and use activities of humanities scholars have been extensively studied (e.g. Brockman et al., 2001; Stone, 1982; Toms & O'Brien, 2008; Watson-Boone, 1994), few of these studies elaborate on how these activities relate to knowledge creation. Furthermore, as explained, archival records are somewhat different to other types of primary sources and so an examination of how these studies of humanities researchers' information activities relate to archives is necessary.

Information activities are often presented as subsets of broader research practices. For example, searching, reading, and writing are all research practices that recur frequently (Brockman et al., 2001; Palmer & Neumann, 2002; Palmer, Teffeu & Pirmann, 2009). As digital technologies have had an increasing impact on humanities research, some studies have also identified personal information management as another significant research practice (Given & Willson, 2018; Kamposiori, Mahoney & Warwick, 2019; Trace & Karadkar, 2017; Antonijević & Cahoy, 2018).

Information activities related to search have been the most closely examined, with browsing and chaining identified as particularly significant to humanities scholars (Brockman et al., 2001; Toms & O'Brien, 2008; Stone, 1982). As noted above, during search humanities researchers build contextual knowledge of archival collections (Duff & Johnson, 2002). This may explain humanities researchers' preference for browsing over searching and, when searching, for recall over precision in search results (Dalton & Charnigo, 2004). In digital information environments, a preference for browsing may also reflect an awareness of digital selectivity and concern that they are not seeing everything on a topic (Coburn, 2020; Sinn & Soares, 2014).

While there has been extensive research attention on how humanities scholars find information, including how they serendipitously encounter it rather than actively seek it (Martin & Quan-Haase, 2017), less attention has been given to research practices reflecting the interpretation and use (as opposed to acquisition) of information such as reading and writing, despite their centrality to the analytic process in the humanities. Palmer & Neumann (2002) identify three types of reading particular to humanities research: scanning, rereading, and reading for writing. Though scanning is largely related to the identification of relevant material, rereading and reading for writing are recognised as at least partly interpretive processes (2002, pp.99-100). Palmer & Neumann (2002) are careful to note that activities such as note-taking and annotation often accompany reading and therefore may support knowledge creation work carried out in the archive itself.

Like many disciplines, humanities research has adapted to incorporate digital technologies, often where it supports existing practices (Bulger et al., 2011). Though some scholars have pointed to digital technologies altering reading practices, with an increase in the use of e-texts (Given & Willson, 2018; Sukovic, 2008; Talja & Maula, 2003; Toms & O'Brien, 2008), such findings are less relevant to archives as the most recent data suggests that the majority of physical archival holdings are not digitised (Poll, 2010). Furthermore, Gooding's (2016) study of webometric data from Welsh Newspapers Online also found that users' behaviours in an online environment were more indicative of changes to search than to reading.

Where digital technologies have most impacted archival research is through the ability to self-digitise large volumes of material using cameras, smartphones and tablets (Cox, 2007; Given & Willson, 2018; Rutner & Schonfeld, 2012; Trace & Karadkar, 2017). This has given rise to the increasing importance of understanding personal information management activities such as collecting and organising due to their increasing importance in humanities research (Antonijević & Cahoy, 2018; Given & Willson, 2018; Kamposiori et al., 2019; Trace & Karadkar, 2017). This importance is reflected in a significant shift in archival research since the widespread use of self-digitisation technologies, from largely interpretive activities to a greater emphasis on gathering materials for later analysis. This suggests personal information management activities, such as collecting and organising materials, should also be considered as activities that support knowledge creation from archival information.

While existing studies of humanities researchers' information activities can guide us towards those activities that may support knowledge creation in archives, they are insufficient for understanding how researchers generate novel insights from archival materials. Primary sources can vary significantly in the type and format of information they contain. Archives are no exception and it cannot be assumed that interpretation and knowledge creation occur the same way in archives as they do with other primary research materials. As archival use is central to humanities research, understanding the nature of knowledge creation in archives can enrich our understanding of humanities research more broadly.

METHOD

To identify the information activities carried out in archives that are key to knowledge creation, along with how and why they are carried out and how this supports knowledge creation, in-person observations inspired by a Contextual Inquiry approach (Holtzblatt & Beyer, 2017) were conducted with 11 humanities researchers at the main public site of a national archives. A Contextual Inquiry-inspired approach to observation (Holtzblatt & Beyer, 2017, pp.72-73) was chosen because knowledge creation is inherently difficult to observe and would therefore require probing, through question asking and answering, to understand. As such, we felt an approach that allowed for greater researcher intervention, as a curious 'research apprentice' rather than passive observer could provide greater insight into information activities that incorporate or give rise to knowledge creation. It was also likely to provide greater insight into motivations behind the participants' activities (Boren & Ramey, 2000). Though researcher questioning poses a potential disruption to observation that is 'as natural as possible', this risk was mitigated by ensuring interventions were limited to where we believed this would provide greater insight and would not influence the

participant's actions. Both these mitigations had resulted in useful data in a previous observation study conducted by the researchers (Makri, Blandford & Cox, 2011).

In this section, the participant recruitment approach is discussed, including key ethical considerations, and data collection and analysis approaches explained and justified. The study received ethical approval from our departmental Research Ethics Committee.

Participant Recruitment

Participants were approached on the basis that they were currently conducting research within the archive, which contained historical records covering a period of 1000 years. Participants were recruited either in advance (through the archive's research newsletter and social media channels) or in-person, at the archive itself, pre-pandemic. All except one were recruited ad-hoc on the day; this was the most successful recruitment approach. They were asked if they would like to be observed and, if so, to confirm that they would be conducting research using the archive that day and to explain the topic of their research, to ensure a breadth of humanities research. The topic of the advance recruit was also documented. Participants were professional historians, academics, research assistants, PhD students, and genealogists. They were a mix of newer and seasoned researchers. Their research topics ranged from Anglo-German relationships under Henry IV, to land and housing policy in Malaysia; genealogy and family history, to the nuclearization of British society under Margaret Thatcher. Most were collecting materials for further detailed analysis, though several could be better characterised as 'fact-finding', e.g. whether an individual was awarded a posthumous medal in WWII (P08).

The study was naturalistic in the sense that none of the topics were prescribed: they were what the humanities researchers had already planned to research within the archive. Participants were also asked whether they would be working with physical or digital archives (or both) that day, to ensure findings were not restricted to a particular materiality of the record. During the study, 6 of 11 worked exclusively with physical records and 5 exclusively with digital records, though this solely comprised digitised rather than born digital material. Data collection took place over 6 weeks, from October-December 2019. Rather than determining sample size in advance, the principle of 'information power' (Malterud, Siersma & Guassora, 2016) – where sampling continues until a (subjectively) rich insight is gained to address the research aims – was adhered to. Although participants were recruited from a single archive, which mostly contained textual documents, the nature of the information activities identified does not appear to be archive-specific. However, we only make limited claims of generalisability to archives with predominantly non-textual (i.e. image, video, or audio) materials.

Data Collection

Before the observation, participants were told that the total session, including obtaining informed consent and any follow-up questions, would last around an hour (mean = 52 min., 7 secs.; s.d. = 8 min., 2 secs.) and that they would be notified as the end of the session approached. As well as describe their task, participants were asked to provide background context to their research. The archive advised users to order material prior to visiting, so all participants had a predefined task in mind. During the observation, participants were asked to carry out their chosen research task. These included but were not limited to: consulting online databases only accessible within the physical archive; creating conceptual links between existing research materials and new information found; and making personal copies of documents. It was stressed to participants that the study was interested in understanding the routine research activities of humanities researchers in archives and that they should carry out their research as they normally would. After the observation, follow-up questions were asked to expand on or clarify participant actions and test researcher assumptions. Participants were also asked to explain how the research activities observed fit into their wider research process. No fixed questions were asked, allowing the researcher to follow-up on intriguing or seemingly important comments or actions made by the participant.

Data was audio recorded, de-identified prior to transcription by assigning participant numbers, and transcribed in full. Any identifying details from transcripts were also removed, such as references to personal names where participants were carrying out genealogical research. Video data was not collected, due to data collection happening in public areas of the archive and the need to protect the privacy of non-participants. Brief notes were taken to contextualise participants actions, e.g. "*P07 has drawn boxes around the individual images to highlight which sections of the volume will be of interest to them.*" These were not included for coding during data analysis.

Data Analysis

Transcription was supported by Otter.ai, a GDPR-compliant, automated transcription tool. The transcripts were not stored on Otter's server, but on the researcher's encrypted and password-protected computer. We did not grant Otter permission to use the transcripts for machine learning purposes. The analysis itself was supported by NVivo. Analytic coding was partially inspired by Thematic Analysis (TA) (Braun & Clarke, 2013). Early stages of coding followed TA closely: an initial total coding of activities was carried out primarily inductively, through which codes relating to information activities were identified, with codes compared for similarity and some being merged or

further split accordingly. For example, “*there is a particular case in here, which I think is directly comparable*” (P08) was coded as ‘*Relating to other records*’; this was later grouped with other codes referring to a relational style of reading, such as ‘*Relating to existing information*’ and ‘*Reading things through*’. During analysis, comparison was made with existing classifications of information activities (e.g. the classification by Palmer et al., 2009) and a hierarchical approach to classifying the information activities was adopted at this stage, with the activity of Relating grouped with Scanning under Reading. Excerpts related to each activity were extracted from NVivo and re-ordered to construct a narrative explaining what the practices involved, how and why they were carried out and how they facilitated knowledge creation as a by-product. Inter-rater reliability was not sought as this is less appropriate for assessing the validity of highly interpretive and inductive research than for deductive research (Braun & Clarke, 2013, p.279; Yardley, 2008, p.237).

FINDINGS

The findings highlighted that humanities researchers undertake a dual process of knowledge creation to create novel but evidence-based insights from the archive. This involves making an integrated interpretation of archival meaning and the researcher’s own interests. As such, the archival meaning and researcher’s interpretation become entangled through the researchers’ information activities, resulting in the making of a hybridised meaning from information found in the archive.

Reading	<i>Scanning</i>	Scanning both involved looking for cues relating to a project or area of interest (Palmer & Neumann, 2002, p.99) and constructing an initial, tentative meaning of the record by interpreting these in the context of the researcher’s own project.
	<i>Relating</i>	A more in-depth style of reading than Scanning, Relating included an interpretive element that involved constructing the meaning of the record in relation to the wider archival context and the user’s evolving knowledge base. It included both in-depth reading of a single document and working through a collection of records stored in a file to gain a holistic understanding.
Collecting	<i>Capturing</i>	Capturing materials, primarily through photography on a phone, tablet or digital camera, to work on them elsewhere. Capturing was undertaken as other means of access were not possible; browsing from archives is generally not permitted and this material had not yet been digitised.
	<i>Organising</i>	(Re)arranging materials in a purposeful order to support interpretation or creation of meaning. Participants drew on the hierarchal structure of the archive (series→file→item) in their organisation of personal copies of archival material. Some indicated they would later break with this structure when moving to a later stage of analysis in their research.

Table 1. Description of Archival Information Activities to Support Knowledge Creation

Reading

Reading is a key way in which archival users assign meanings to records (Ketelaar, 2012, p.25) and our findings reflect this. The practice of Reading to support knowledge creation is examined through discussion of two distinct information activities: Scanning and Relating. Scanning a record involved finding information and determining its significance in relation to the user’s own research interests. This builds on Palmer & Neumann’s (2002) definition of identifying cues “*that intersect with their line of inquiry*” (p.99), going beyond this to incorporate constructing an initial, tentative meaning of the record through an interpretation of these cues in the context of the researcher’s own project. Relating is used to describe a type of reading that was particular to the archival interactions observed here. It is based on descriptions of “*reading through*” (P04), which were used by several participants to refer to a more interpretive style of Reading that relied on constructing the meaning of the record in relation to both the wider archival context and the user’s evolving knowledge base. This went beyond merely relating the information found to that already known, to making an integrated interpretation of archival meaning and how this meaning relates to the researcher’s aims and objectives.

Scanning

Due to pressures involved in visiting the archive, such as time, distance, and cost, several users spent the majority of their visit scanning material, aiming to maximise efficiency by covering as much material as possible and reducing their potential number of visits to the archive. Scanning served not only as a relevance check (to determine the potential importance of the document to the researcher), but also began to align the record to participants’ own research interests – a conceptual ‘shaping’ that went beyond merely reading what was written, to engaging with what was written and what was already known.

All participants arrived at the archive with some level of existing knowledge on their topic, though this varied widely in formality from detailed research guides that determined “*exactly what to be looking out for*” (P05) to “*a*

few different subject areas” (P06) to be explored. Through the activity of Scanning, participants simultaneously brought this information to bear on the record while bringing the record within their own specific framing of a research topic. For example, P04 was at the archive to scope information on the topic of WWII spies. Attempting to confirm her “*growing hypothesis that a lot of these people who were bilingual acted as spies, as well*” she scanned the record for any possible clues that might confirm this. She picks out “*two clues*”, the first relating to the content: “*the person here is talking about what might happen, if she is questioned by the Russians, and... what she might say to them*”. The second clue is the context in which the record was produced, “*I understand that the captain who is writing the letter is trying to report almost verbatim the conversation, so I would assume that this is what she herself said, her ‘very special work’ which would be an understatement of what it really was*”. The details that P04 picks out fit the original framing or hypothesis that she had developed through reading before she entered the archive, though the precise details come from the record itself. Chosen from the wider context of the document precisely because they suit her framing, she shapes the record according to her own particular interests. This was described as a process of “*hunting, searching for clues*” (P02). This comparative practice goes beyond a simple relevance check to actively create a particular meaning of the record that aligns the record to the users’ own research interests by defining the record in relation to those interests. It follows that this process is also selective, in that the user does not pick up on everything from the record: “*It’s basically you know, maybe someone might read it and not really see it and someone else might kind of notice it*” (P11). Through this initial interaction, P04 defines the way the record is read and how it relates to her interests.

Relating

A second style of Reading within the archive was identified through several participants’ references to “*working my way through*” (P08) or “*reading through the file*” (P04). Such phrasing could refer either to the level of the record, where participants stopped to read through the record to interpret an intriguing piece of information in more detail, or to the level of the file, skimming through the file and gaining an impression of the whole. We use the term ‘Relating’ to refer to this activity, as participants related information found to the context of the record, to information found elsewhere (i.e. outside of the archive), or to other records within the archival file.

When slowing down to read a record in depth, participants frequently compared it with other records they had recently read within the same file, whether mentally recalling these, or physically skipping back through the file. P04 often referred to information read in previous documents, reflecting a growing understanding of the context the records were produced in as she progressed through the file. Information found in the record was also compared to that which the participant had found before entering the archive, as in the case of P03. After finding a newspaper announcement for “*twenty-three substantial brick dwelling houses*”, he invoked his wider knowledge of the period, that, “*at this particular time, that area was going down so they’re obviously pointing this out because anybody reading the advertisement might assume because they were in that area, they weren’t any good.*” Such an assertion is rooted in the details provided by the record itself. Yet it gains a deeper significance for P03 when it is brought into contact with information previously found or known. The meaning of the record is thus created by P03’s recontextualisation of the information within his own framing. This goes beyond situating or scaffolding the information found within prior knowledge, which involves comparison or incremental knowledge-building; the information found *only* gains important meaning when understood in the context of prior knowledge. Through the practice of reading, the record can be framed by the context provided by other records within the archive. Alternatively, context may also be provided by the researcher’s own evolving and active knowledge of the topic. The interpretation of archival meaning is thus never solely ‘archival’ but a hybrid, shaped by the researcher themselves, and provides a basis for knowledge creation.

Participants also engaged in Relating as they sought to interpret the potential significance of the file structure, providing an understanding of the file greater than the sum of its parts (the individual records). P08 had initially approached the files he was working with as a fact-finding task: to determine whether the person he was researching had received a posthumous award. While the record did not provide evidence of this, reading the file as a whole suggested an unanticipated relationship between the records within the file. As he put it, the file provided him with “*evidence I hadn’t expected to find, and hadn’t even thought about*”, providing him with “*a clearer idea of the decision-making process*” for the award. Through the act of interpreting connections between the records in the file, P08 gained a very different understanding than that suggested by his own expectations of what information the file would hold. This holistic reading can be seen as a reading of the archival structure particular to P08: combining his own particular interest in the file with the significance of the archival structure.

Collecting

The research practice of Collecting comprises the information activities of Organising and Capturing (Palmer et al., 2009). While Palmer et al. (2009) refer to ‘Gathering’ rather than Capturing, a narrower term has been used here to reflect that participants primarily sought to create surrogates or copies of archival material, often through digital

photography but also occasionally through note-taking (where no interpretation was involved and text was copied verbatim).

The archival meaning of the record, as inferred through its content, context, and structure, partly relies on arrangement to preserve the meaning of the record. Archival classification is largely based on provenance, meaning that records from different creators should not be mixed and the original order of records preserved wherever possible (Meehan, 2014, pp.65-68). When Collecting, participants chose to what extent they preserved this archival arrangement. Sometimes they chose to closely replicate it in their own organisation of materials so that they could read the archive in the same manner later. Other times, they opted to rearrange materials in a way that better facilitated interpretation, to support the creation of new insights.

Capturing

Amassing personal copies of archival records is not new (Cox, 2007; Orbach, 1991). However, capturing data to work on outside the archival reading room is becoming more prevalent over other forms of interaction in the archive and occurring at a much larger scale, due to facilitation through digital technology (Bulger et al., 2011; Rutner & Schonfeld, 2012; Trace & Karadkar, 2017). This was reflected in the findings, with almost all participants capturing information to work on outside of the physical archive.

Participants' careful preservation of the record and its order and grouping within the wider file demonstrates awareness of both context and structure that is provided by archival practices, and how they support creation of a particular interpretation of the record. In retaining this, participants sought to maintain connections between the record and its form, as well as between records, to allow them to fully and faithfully interpret the record outside of the physical archive. Though Capturing approaches varied widely, most participants sought to capture at some level *"the context it's found within"* (P11) and several, such as P09, suggested *"normally if it's not too big, [...] I just take the whole thing"*, thus preserving the structure of the individual record. Occasionally, participants collected more than one document to preserve the relational nature of the relevant information: its meaning in its wider context. P07 used personal letters as an example to demonstrate how meaning is often spread over more than one document. The variety in participants' Capturing suggests that each held an individual conception of what was necessary or relevant to perform the same meaning of the record derived within the archive at a later date and in a different location. Such decisions and personal views subtly shape the meaning rendered by the record, presenting a hybrid between the framing that the record's structure and the archival context provide for the record's content, and that provided by the user themselves.

A few participants demonstrated awareness of these subtle shifts in meaning and attempted to mitigate potential risks by capturing further details beyond the digital copy. For example, P05 used note-taking to supplement photography when capturing archival materials, to allow her to reconstruct a more thorough interpretation of context. She wrote *"a brief description of what the folder as a whole contained"*, stored in a spreadsheet. Motivated by the belief it would be *"good to get it read as much as possible, in one go"*, her written summary provided an immediate impression of the file as a whole, based on her subjective experience of examining it while in the archive. Although this impression remains subject to her selectivity in reading, the textual summary enabled her to preserve a point of reference for the whole collection, upon which future interpretations could be based.

Organising

Some participants expressed frustration with how the archive was arranged: P05 noted that it *"messes up the ideas in my head"*, while P11 said she *"might've organised it differently because of my interests"*. This reflects an incongruence between the personalised meaning researchers wished to create, and the provenance-based classification system employed by the archive to preserve the context and structure of the records. Nonetheless, it was not often practical to rearrange materials when working in the archive. For those accessing physical documents, only one bound volume or three files could be brought to the reading room table at a time. This limited participants' ability to reorganise material and restricted direct comparison of materials housed in different files while the user remained within the physical archive building.

Despite having difficulties in navigating the archival arrangement at times, the same participants also saw value in preserving this arrangement in the organisation of their own research materials. At the most basic level, record numbers were used to maintain the archival arrangement of materials. P06 ensured she viewed and photographed materials in order of record number so they could be retrieved in the same order, while P05 used record number to document files in a spreadsheet, likewise preserving the arrangement of records as they appeared in the archive. Though P11 was not observed setting up her organisational approach during the session, she too claimed that, *"my initial, let's say categorisation is very much based on the categorisation I find them in, here, and actually, it's quite sensible because a lot of times it's easier to read things, how they've been categorised"*. The example P11 discusses here involves her attempts to uncover information on an architect involved in several colonial building projects. For her, the fact that *"I found [his] resume, found here within these documents"*—i.e. government documents—was

significant as “*it tells you a larger story*” about the use of the records. Conversely, it might be imagined that if this record were found among his family archive or personal affects, it would not hold the same meaning. As such, we see how it becomes important to P11 to preserve not only the record’s content, but also its context to support the generation of a specific insight that the provenance-based archival classification preserved.

Some participants also suggested that their organisational methods would later change to reflect different research stages. Interestingly, this process often took place after participants had established an interpretation of the record as suggested by the archival arrangement: P11 described how she would rearrange the records “*once I have all the documents, and I know what’s in each one*”, having initially stored them in a manner very similar to the archival arrangement. Likewise, P07 envisioned sorting out material thematically later, as “*the sampling frame for that would be different I think*.” Once the record’s meaning within the archival context was established, P11 described how she sought to reorganise any notes and images collected and “*would copy paste into a separate folder that’s about...a specific part that I’m looking at*”. Other participants hinted at a similar process of re-organising information to fit the evolving research task: P03 initially stored his notes according to “*different physical locations*” where he had accessed records, before subsequently copying them into “*whatever the topic is that I’m writing at that time*”. This relocation of the record and other information further highlights the importance of the context in which materials are stored. While initially preserving the archival arrangement – and thus the contextual interpretation afforded by this through their Organising, subsequent rearrangement allows the researcher to break with the archival structure to support them in using this information to shape their research. This suggests that some participants may perceive the initial interpretation of the record as separate to applying archival information within their own research. Using the document as part of their own broader argument is seen here as a later stage of research and possibly supports a distinction between interpretation of the record and later knowledge creation.

DISCUSSION

The findings provide a rich insight into how knowledge creation occurs within (and beyond) the physical archive, through the enactment of four information activities – Scanning, Relating, Capturing and Organising. These activities are not new. Indeed, they have been identified and discussed in relation to several disciplines, including the humanities (e.g. Palmer et al., 2009; Meho & Tibbo, 2003). What is new, however, is an understanding of how and why they are undertaken in the archive: a unique primary information source at the heart of humanities research. While existing empirical research has focused on understanding information acquisition in archives, this naturalistic observation study focused not on understanding how information is found, but how it is leveraged to create original insights. In that respect, this research regards information acquisition as a means to an end; as a facilitator of knowledge creation.

The findings affirm that creating new knowledge through the (re)interpretation of records is a core motivation and outcome of humanities research; in line with Millar (2018), humanities researchers were found to use not only the content of archival records, but also their context and structure to establish an ‘archival’ meaning of the record, then apply this meaning within their own work. Therefore, constructing knowledge from archival materials was found to necessitate a dual process of knowledge creation to create novel insights from a hybrid interpretation of archival meaning and the researcher’s own interests. This involved striking a simultaneous balance between interpreting an ‘archival’ meaning of the record through gaining an understanding of its content, context and structure and considering the relationship between information found within and outside the archive to construct new knowledge.

Most of the information activities discussed here revolve around an ‘ex situ’ mode of archival research (Trace & Karadkar, 2017, p.500): researchers primarily sought to gather large amounts of archival material to interpret it offsite. While Trace & Karadkar (2017) define this in opposition to an ‘in situ’ mode, the information activities we examined suggest a blurring of the archive’s boundaries and reflect a more continuous interpretive process, occurring both on and off site. The effect of this blurring is to illustrate a tighter integration between the two knowledge creation processes discussed in this paper: interpretation of an ‘archival meaning’ (Ketelaar, 2012, p.23) and generation of new insights through knowledge creation.

The information activities identified in this study were undertaken uniquely in an archival context; Scanning an archival document does not merely involve extracting potentially relevant information to the research task at hand (Palmer & Neumann, 2002, p.99), but re-interpreting the text through the lens of the research topic and other information acquired from within and outside the archive. Likewise Relating does not simply involve making mental connections to prior knowledge or previous information acquired (Kuhlthau, 1991), but actively shaping the information found based on the content, context and structure of the archive. While Relating might usually be considered an activity that operates on informational content, it was found to be strongly influenced by the record’s structure and context: as with P08’s experience of the file as a whole lending a different interpretation than that provided by the individual records.

Capturing does not only involve taking snapshots of potentially useful information as a workaround to physical access constraints and to minimise visits to the physical archive. It also involves deliberately preserving (and forsaking) some of the archival context and structure to support the creation of new knowledge outside of the physical archive. However, while participants regarded themselves as interpreting the record once they had left the archive, decisions made about what information to capture was found to shape their subsequent ability to reconstruct the content, context and structure of the record. This can be seen in the significant variety in the ways that participants tried to preserve these characteristics of archival information. At the most basic level, participants ensured that items were captured in order, allowing associated items from the same file to be browsed together. Others, such as P05, had more complex systems of Capturing and Organising that allowed them to reconstruct the archival structure at the level of both series and file. This suggests each user has a different conception of what is necessary to recreate the record and allow for interpretation outside the physical archive, making this always a partial and unique enactment of potential meanings from the archival record. This should not be seen as indicative that working 'ex situ' will result in an inaccurate creation of archival meaning, but as highlighting how such interpretations are always generated at the intersection of the connections the archive seeks to preserve and the original insight the user is trying to create.

Finally, Organising archival materials does not solely involve creating and re-arranging personal classification systems, but deliberately emulating (and eventually breaking away from) the original archival system to generate new insights from beyond the archive's physical borders. While emulating the archive's (somewhat arbitrary) structure might at first seem counter-intuitive, considering this action in the context of preserving structure to support knowledge creation helps us understand how it can be useful. Similarly, breaking away from a structure that has helped spur insight may seem strange on the face of it. However, when considered as a transition to a new form of knowledge creation support best suited to later research stages, the rationale becomes clearer.

What is abundantly clear is whether Scanning and Relating within the physical archive or Capturing and Organising materials to consult offsite, participants wanted to work with the totality of the record: not only its content but also its context and structure. It was embracing the totality of the record that helped support the generation of original knowledge: knowledge not solely derived based on content. It was not, however, only the sum of content, context and structure that resulted in the creation of new insight; the research aims and objectives, prior knowledge held by the researcher and previous information found within and outside the archive played a combined role. This highlights the entangled nature of 'archival meaning,' researcher interests, prior knowledge and knowledge creation. Nonetheless, some participants believed knowledge creation took place in a later stage of research, such as analysis or writing, rather than being seeded throughout the information acquisition activities they were observed undertaking. This suggests that humanities researchers may seek to first establish an 'archival' interpretation of a document before applying it to their own research.

These findings highlight the complex nature of knowledge creation in archives, explaining how it can be facilitated through seemingly mundane information activities such as Scanning, Relating, Capturing and Organising. They expand our existing understanding of archival information activities, by moving beyond seeking and towards knowledge creation. Though we can trace the origins of knowledge creation to these activities, it is possible most knowledge creation does occur in later stages of research. As such, a follow-up study is proposed that will examine humanities researchers' information activities once they have left the physical archive. It is hoped that this study will complement the current findings by offering a holistic view of archive-based information activities related to knowledge creation; it is also anticipated that further information activities may be identified through this second study. A rich understanding of information activities and their interconnection can help to inform the design of the next-generation of digital archives by encouraging a shift in thinking and approach, away from merely preserving and providing access to information and towards enhancing opportunities for knowledge creation both within the archive and beyond.

CONCLUSION

This paper presented an observational study of humanities researchers conducting research in a national archive, focusing on elucidating the information activities key to knowledge creation, how and why they are carried out and how this supports knowledge creation. These activities comprised Scanning, Relating, Capturing and Organising and were identified as part of the wider research practices of Reading and Collecting. These activities were highly influential in supporting knowledge creation, both in establishing the meaning of an archival record in relation to its content, structure, and context as well as in relation to researchers' prior knowledge gained from information previously found in and outside the archive. These two areas of knowledge creation were found to be strongly intertwined, with the researcher's framing of the research aims and objectives and the seeking of original insight tightly integrated within the process of understanding the evidential value of the archival records. An enriched understanding of the nature of knowledge creation in archives can benefit archivists, archive users and archive designers alike; reflecting on these findings can support archivists in labelling and structuring archives to better

support knowledge creation, users in enhancing their knowledge creation practices and archive designers in more explicitly supporting knowledge creation in archives.

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Is Interdisciplinary Collaboration Research More Disruptive Than Monodisciplinary Research?

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ABSTRACT

As an important pattern of scientific research, interdisciplinary collaboration is universally encouraged by science and technology policy makers. However, it remains a question whether interdisciplinary collaboration research is more disruptive than monodisciplinary research. To address this research question in this study, interdisciplinary collaboration is measured as whether the authors of a paper are from at least two disciplines, and the degree of "disruptive" is measured by the Disruption index proposed by Funk & Owen-Smith (2017). By using articles published in six journals from 1978 to 2019 in the Microsoft Academic Graph (MAG) database, we constructed an OLS regression model with journal fixed effect and time fixed effect to analyze the influence of interdisciplinary collaboration on the Disruption values with different citation windows. The findings show that interdisciplinary collaboration research is less disruptive than monodisciplinary research.

KEYWORDS

Interdisciplinary collaboration, Disruption, Regression analysis.

INTRODUCTION

Interdisciplinary collaboration is being widely practised in various fields. It provides new solutions under the situation that monodisciplinary research cannot solve increasingly complex social and scientific problems. An application-based knowledge production model has gradually replaced the traditional discipline-based knowledge production model, and interdisciplinarity is typical of the latter (Agassi, 1997; Chen, Arsenault, & Lariviere, 2015; Gibbons et al., 1994). Studies show that scientific research is gradually becoming interdisciplinary (Porter & Rafols, 2009; Van Noorden, 2015). Interdisciplinary research and multidisciplinary research are both referred to as scientists from two or more disciplines working together to solve a scientific problem. However, different from multidisciplinary research, interdisciplinary collaboration research emphasizes the integration of knowledge. It integrates mutually independent knowledge spaces to generate new methodologies, knowledge, and even new disciplines that can address complex problems in modern science (D'Este, Llopis, Rentocchini, & Yegros, 2019; Klein, 2008). Interdisciplinary collaboration overturns the inherent boundaries and barriers between disciplines and provides a broader perspective on problem-solving. Many studies have confirmed that interdisciplinary research has a special impact on scientific impact (Yegros-Yegros, Rafols, & D'Este, 2015) and that collaboration in more distant disciplines can lead to greater success (Lariviere, Haustein, & Boerner, 2015).

Scientific innovation can be divided into two categories, disruptive and developing work. Disruptive innovation represents a departure from previous knowledge while developing work confirms and develops previous theories (Andersen, 2013; Funk & Owen-Smith, 2017; Wu, Wang, & Evans, 2019). Innovation and creative thinking are the key factors that promote scientific breakthroughs (Xu et al., 2018). Comments about the relationship between interdisciplinary research and innovation are that interdisciplinary research is a catalyst for innovation. Some evidence of the development history of modern science indicates that major scientific breakthroughs, new growth points, and even the emergence of new disciplines are often realized in intersecting and infiltrating different disciplines, such as the discovery of the double helix structure of DNA molecules, etc. Interdisciplinary collaboration can bring about the diversity of knowledge and make research output more novel. (Fontana, Iori, Montobbio, & Sinatra, 2020; Lee, Walsh, & Wang, 2015). The interdisciplinary collaboration reflects heterogeneous knowledge, which is an important manifestation of the innovation process ((Karakowsky & McBey, 2001)). The

exchange and generation of ideas among academic team members, even to the point of disagreement and conflict, is considered to lead to creativity and innovation. (Leahey, Beckman, & Stanko, 2017).

Recently, science and technology policy makers are vigorously promoting interdisciplinary collaboration, and scientists are also actively seeking interdisciplinary collaboration opportunities. The influence of interdisciplinary collaboration on scientific impact and team creativity has been demonstrated. However, there is still a lack of more empirical evidence on the value and effectiveness of interdisciplinary research. We hence propose the following research question in this study,

Is interdisciplinary collaboration research more disruptive than monodisciplinary research?

LITERATURE REVIEW AND HYPOTHESIS

There are two opposing views in existing theories to interpret the relationship between interdisciplinary collaboration and disruption, based on which, we propose two competitive hypotheses.

Proponents of interdisciplinary research assume that disciplines represent silos that are separate from each other and that these silos hinder innovation and prevent the exploration of topics beyond the narrow scope of each discipline (Jacobs & Frickel, 2009). They believe that interdisciplinarity can facilitate disruptive innovation by breaking down barriers to knowledge dissemination and pre-existing knowledge frameworks according to the burden of knowledge mechanism and Kuhn's paradigm theory.

The burden of knowledge mechanism suggests that knowledge innovation is a continuous process of accumulation. Subsequent innovators need a large stock of knowledge than their predecessors to reach the frontier, which leads to a greater knowledge burden on them (Jones, 2009). The burden of knowledge accumulation drives scientists to focus on their own fields. In this case, individual's knowledge is narrowed to a specific topic or field. Therefore, forming a research team of scientists from different disciplines to collaborate with each other becomes an effective method for solving a complex problem, in which scientists from different fields will contribute knowledge from their respective areas of expertise. Interdisciplinary research increases the diversity of knowledge and thus counteracts the increasing problem of specialization in various fields (Cedrini & Fontana, 2017).

The formation of disciplinary systems leads to the dependence of scientists on the existing research paradigms. According to Kuhn's paradigm theory, innovation is an important factor in the growth of scientific knowledge, and theoretical innovation is the process by which a new theoretical paradigm replaces an old one (Kuhn, 1962). However, on the one hand, there is a certain "resilience" mechanism in theory itself, which can motivate people to adjust the anomalous results until they are non-anomalous. On the other hand, there is an element of inertia in people's social psychology, which makes them more inclined to defend knowledge that they are already familiar with and that most people agree on and accept (Kuhn, 1962). With these two factors, the anomalies in the study are usually dissipated. Mono-disciplinary communities of highly specialized experts will remain isolated, making it difficult to achieve innovation. When scientists with different knowledge background collaborate, some divergent ideas can lead to radical innovations (Andersen, 2013). It has been confirmed that scientific breakthroughs usually occur when another discipline unexpectedly solves a problem in one discipline at a greater disparity (Shi & Evans, 2019).

The risks and reliance on existing research paradigms lead to a tendency to segment knowledge (Abramo, D'Angelo, & Di Costa, 2018). Scientists confined to specialized discipline are often unable to break out of their inherent knowledge framework. By contrast, interdisciplinary research provides a channel for the collision and convergence of multiple knowledge and fully breaks down the boundaries between disciplines by integrating knowledge. In this way, it is more likely to produce new knowledge that overturns traditional research. Therefore, we propose the following hypothesis:

H1: Interdisciplinary collaboration research is more disruptive than monodisciplinary research.

However, Proponents of monodisciplinary research argue that disruption is based on a deep understanding of knowledge in a specialized discipline. Based on Kuhn's paradigm theory, monodisciplinary research focuses on problems within the field of expertise, and such sustained work is far more productive than interdisciplinary collaboration and more likely to uncover deeper problems in the field, thus breaking with tradition (Kuhn, 1969). Interdisciplinary collaboration is only a product of modern knowledge moving to the edge, which is just a catalyst to assist knowledge production. Its knowledge structure is constructed hastily and is not solid. With the differentiation and refinement of disciplines, deepen the study of things are necessary. So it is difficult to produce disruptive output if scientific research has not accumulated to a certain extent.

From the perspective of social identity theory, scholars argue that disciplinary heterogeneity gives rise to a process of social categorization (Judge & Ferris, 1993). The existence of disciplinary heterogeneity in interdisciplinary collaboration makes team members less cohesive, even increases the likelihood of conflict and inhibits team

performance. Various obstacles have greatly increased the coordination cost of interdisciplinary collaboration (Cummings & Kiesler, 2005). Heterogeneity will impede information sharing and knowledge dissemination among team members, with adverse consequences for innovation in research teams (Auh & Menguc, 2005). Based on these theories, we propose a competitive hypothesis relative to H1:

H2: Interdisciplinary collaboration research is less disruptive than monodisciplinary research.

DATA AND METHODOLOGY

Data collection

Interdisciplinary collaboration is usually proxied by interdisciplinary co-authorship in academic articles. In this study, we collected papers from the Microsoft Academic Graph (MAG) database. To explore the causal effect between interdisciplinary collaboration and disruption of an article, other influencing factors need to be controlled as much as possible. Due to the interdisciplinary nature of many journals, the research fields and research topics of the papers published in them can be diverse. Since the citations to articles are only comparable in the same research fields, journals focusing on only one specific research topic were sampled. By consulting experts in both natural sciences and humanities & social sciences, six academic journals were finally selected, including *Late Imperial China* (focusing on the studies of the history of China's Qing dynasty), *Scientometrics* (focusing on scientometric studies), *Biomaterials* (focusing on the studies of biomaterials), *Autophagy* (focusing on the studies of autophagy), *Journal of Informetrics* (focusing on informetric studies) and *Neuron* (focusing on the studies of neuron). The bibliographic information of the papers in these journals with a time span of 1978-2019 was obtained from MAG.

Measurement of interdisciplinary collaboration

Scientists have made a lot of explorations on quantifying interdisciplinary collaboration, which can be measured by the output of research, projects or proposals (Wang et al., 2017). The discipline to which the participant belongs is the main way of judging interdisciplinary collaboration. In a sense, the author's subject area can be considered as their knowledge sharing among the project (Giovanni Abramo, 2018). The problem of this type of measurement methods is how to map the authors to the corresponding disciplines. The commonly used way is based on the institution to which he or she belongs (Schummer, 2004; Abramo, D'Angelo, & Di Costa, 2017).

Interdisciplinary collaboration can be conducted by combining scientists from different disciplinary backgrounds. In this study, whether the authors of the article belong to the same discipline was used to judge whether the collaboration is interdisciplinary. In the university or research institution system, department, school, or college levels are usually the smallest units of academic operation. The author's discipline is judged based on the secondary institution (schools or departments) with which the author is affiliated with. Therefore, extracting the name of the second unit from the attribution unit of the author in the bibliographic information is required. After removing articles with single authors and the missing values, a total of 11,469 articles were obtained.

Measurement of Disruption

We adopted the Disruption Index (D-index) to measure knowledge innovation (Wu, Wang, & Evans, 2019). D-index was first proposed by Funk & Owen-Smith (2017) and applied to patents. Wu et al. (2019) extended this index to papers and computer software and proposed D-index, which is based on citation networks, to measure whether research develops or disrupts the existing research. The measurement idea of the D-index is dividing the cited papers into three categories. The first type of research (i) is to cite only the focal paper, the second type of research (j) is to cite both the focal paper and its references, and the third type of research (k) is to cite only references of the focal paper. Figure1 illustrates three types of research. The ratio of the difference between the number of the second type of literature and the number of the first type of literature to the total number of references is used to measure whether the paper is disruptive. The formula for calculating D-index of the focal paper is as follows:

$$D = \frac{n_i - n_j}{n_i + n_j + n_k}$$

where n_i , n_j and n_k represent the number of i, j, and k, respectively. The values of D range from -1 and 1, which indicates that the focal paper develops ($D < 0$) or disrupts ($D > 0$) the current knowledge or remains neutral ($D = 0$). The larger the value of D is, the more disruptive the focal paper is.

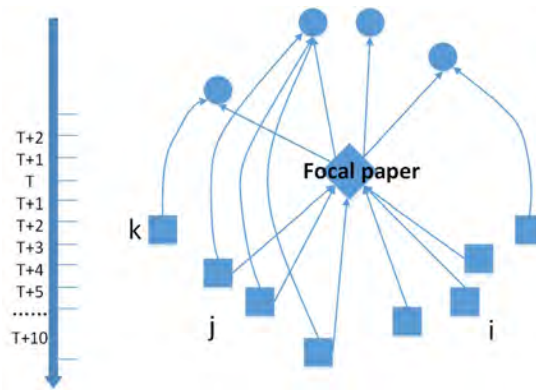


Figure1. Illustration of the disruption index

It should be noted that some studies have found that the size of the D-index is related to the length of the citation window, and they recommend a citation window of at least three years (Bornmann & Tekles, 2019). Therefore, we explored three lengths of citation windows: D5, five-year citation window; D10, ten-year citation window; and Dn, citation window from publication to present. D-index under these types of citation windows were calculated for each sampled article.

Variable operationalization and models

The purpose of our study is to analyze the relationship between interdisciplinary collaboration and disruption. The dependent variable is the D-index calculated by the three lengths of citation windows. We define whether the publication is interdisciplinary collaboration as an independent variable. Obviously, the independent variable is binary. If the authors of an article belong to different secondary institutions, it is classified as interdisciplinary collaboration research; if it belongs to the same secondary institution, it is monodisciplinary research. All variables that affect the dependent variable should be controlled in the model. According to previous studies, we selected the following variables as control variables: the number of authors in the paper, the length of the paper title, and the number of references. Since the value of D-index is calculated by the citations, we try to cover the factors related to citations as much as possible based on the existing data. Below interprets these variables and the reasons why we chose them.

Number of references: The number of references is correlated with citations. Articles that cite more references are in turn cited more (Bornmann & Leydesdorff, 2015; Webster, Jonason, & Schember, 2009)

Length of title: Many studies have explored the impact of title length on citations that papers received. Although these studies do not reach an agreement, some believe that there is a positive correlation between the two (Habibzadeh & Yadollahie, 2010), and some believe that there is no obvious correlation or has a negative correlation between the two (Rostami, Mohammadpoorasl, & Hajizadeh, 2014).

Number of authors: The number of authors reflects the size of the team. There is a difference in the D-index between large teams and small teams (Wu et al., 2019), and the correlation between the two is negative (Lyu, et al., 2021).

Tables 1 and 2 summarize the results of the descriptive statistics of each variable in a total of 11,469 papers and the correlation between the variables. Correlation between the independent variables indicates that there is a moderate risk of multicollinearity. Therefore, we further tested the variance inflation factor (VIF) of each variable. The results show that the VIF factors of all quantitative variables are far less than ten, and their tolerances are greater than 0.2, so the multicollinearity problem between independent variables can be ignored here.

<i>Variable</i>	Mean	Std. Dev.	Min	Max
<i>D5</i>	.017	.148	-.29	1
<i>D10</i>	.018	.148	-.25	1
<i>Dn</i>	.02	.148	-.25	1
<i>Interdisciplinary</i>	.497	.5	0	1
<i>Title_{len}</i>	95.573	30.115	13	236
<i>Team_{size}</i>	4.89	2.919	2	34
<i>Reference</i>	43.925	33.191	0	752

Table 1. Descriptive statistics of the variables

Variable	D ₅	D ₁₀	D _n	Interdisciplinary	Title _{len}	Team _{size}	Reference
D ₅	1						
D ₁₀	0.998***	1					
D _n	0.995***	0.998***	1				
Interdisciplinary	-0.028***	-0.030***	-0.034***	1			
Title _{len}	-0.034***	-0.036***	-0.038***	0.170***	1		
Team _{size}	-0.070***	-0.073***	-0.077***	0.482***	0.266***	1	
Reference	-0.186***	-0.190***	-0.194***	0.022**	-0.017*	0.070***	1

*** p<0.01, ** p<0.05, * p<0.1

Table 2. Correlation coefficient of the variables

The ordinary least squares model was adopted for analyzing the causal effects between explanatory variables and explained variables. Since the citations of an article are affected by the journal's reputation, and the scientific impact of articles in different journals is different. In order to eliminate the quality differences between different articles, we learned from previous research and considered the fixed effect of journals. Fixed effects model is suitable for panel data, which uses dummy variables to find differences of several categories of a specific variable. We conducted a Hausman specification test on the data, and the results show that journal fixed effects are more effective than random-effects models in estimating the impact of interdisciplinary collaboration research on disruption. Besides, the volume and number of journals are fixed in the model to overcome time interference.

To verify the hypothesis, we constructed an OLS equation containing all the above variables. We consider both the fixed effect of the journal and the fixed effect of the publication time, and the regression model is shown below.

$$D = \alpha_0 + \alpha_1 treat + \alpha_2 title_{len} + \alpha_3 team_{size} + \alpha_4 reference + \alpha_5 journal + \alpha_6 vol_{number} + \varepsilon. (1)$$

RESULTS

Statistical description

The number of articles from interdisciplinary collaboration research and monodisciplinary research is not much different in the sample dataset. There are differences in the quantity distribution of interdisciplinary collaboration in different fields. It can be seen from Figure 1 that journals in the field of humanities and social sciences, such as *Late Imperial China* and *Scientometrics*, has more monodisciplinary papers. However, journals in natural sciences, such as *Biomaterial* and *Autophagy*, have more interdisciplinary papers.

Besides, the distributions of 3 types of D-index in interdisciplinary collaboration and monodisciplinary research are reported in Figure 3. It can be observed that, regardless of whether it is an interdisciplinary or disciplinary paper, most of the D-index value are around 0. But compared to interdisciplinary papers, monodisciplinary papers are more inclined to the distribution in the range of D-index value greater than 0.

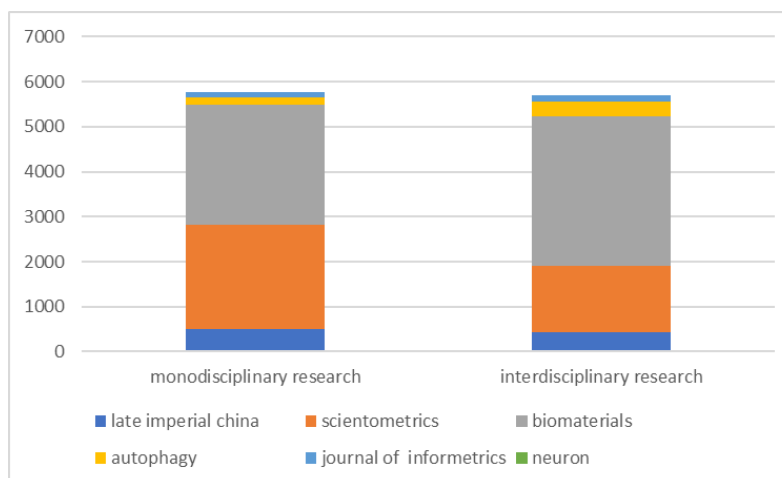


Figure 2. The number of interdisciplinary and monodisciplinary articles in six journals

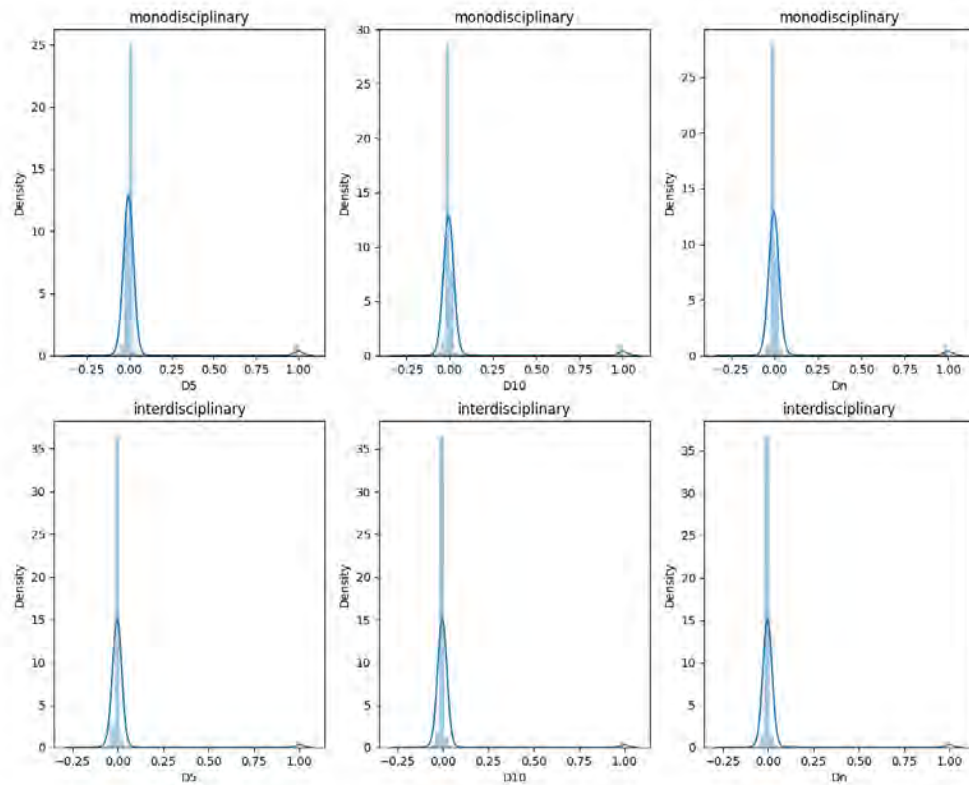


Figure 3. The distribution of three types of disruption index

Regression results

Table 3 displays the estimations of the fixed effect regression models. Models (1)-(3) use the D-index in different citation windows as the dependent variables. The results show that the effect of the independent variable on the dependent variable is significant under either of the citation windows. Among them, the coefficient of the independent variable is $\alpha = -0.00402$ ($p < 0.1$) for the 5-year citation window, $\alpha = -0.0042$ ($p < 0.1$) for the 10-year citation window, and $\alpha = -0.00452$ ($p < 0.05$) for citation window from publication to present. This indicates that interdisciplinary collaboration research is less disruptive, while monodisciplinary research is more disruptive.

	Model (1)	Model (2)	Model (3)
<i>Variables</i>	<i>D₅</i>	<i>D₁₀</i>	<i>D_n</i>
<i>Interdisciplinary</i>	-0.00404* (0.00224)	-0.00420* (0.00224)	-0.00452** (0.00224)
<i>Title_len</i>	-0.000134*** (4.32e-05)	-0.000142*** (4.32e-05)	-0.000151*** (4.32e-05)
<i>Team_size</i>	-0.00435*** (0.000489)	-0.00435*** (0.000489)	-0.00433*** (0.000489)
<i>Ref</i>	-0.000564*** (4.90e-05)	-0.000569*** (4.90e-05)	-0.000573*** (4.92e-05)
<i>Constant</i>	0.0414*** (0.00421)	0.0398*** (0.00422)	0.0436*** (0.00422)
<i>Observations</i>	11,469	11,469	11,469
<i>R-squared</i>	0.489	0.489	0.489
FE journal	YES	YES	YES
FE time	YES	YES	YES

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 3. Results of fixed effects regression models

DISCUSSION AND CONCLUSIONS

In general, we investigated the relationships between interdisciplinary collaboration and the disruption index of articles by using OLS regressions with fixed effects. Articles in the sample are divided into two groups: interdisciplinary collaborative research and monodisciplinary research. Factors that have a potential relationship with the independent variable and the dependent variables are included as much as possible in the model, and we controlled journal and publication time effect.

$H1$ is rejected and $H2$ is accepted, in terms of the empirical analysis results of this study. It shows that interdisciplinary collaboration research is less disruptive than monodisciplinary research. Since this model has stricter control of variables compared with simple regression analysis, it can explain the causal effect of interdisciplinary on disruption to a certain extent. In other words, interdisciplinary collaboration produces less disruptive research. The result seems contrary to the widespread perception that interdisciplinary collaboration research can lead to more disruptive scientific output. But it indeed provides factual evidence for $H2$. Because of the lack of in-depth professional domain knowledge, interdisciplinary collaboration is difficult to make fundamental breakthrough innovations. Besides, the results show that there is a negative correlation between team size and disruption values, which also confirms the view that small teams are often more disruptive than big team (Wu et al., 2019; Lyu, Gong, Ruan, Cheng, & Li, 2021). There is also a negative correlation between the number of references and the length of the paper title and disruption values.

Our findings emphasize that in the current situation of blindly advancing interdisciplinary collaboration, we should realize that the interdisciplinary paradigm is not beneficial to all research and teams (Jin & Sun, 2010). The study sheds lights on the mechanism of interdisciplinary collaboration. It is undeniable that interdisciplinary collaboration has indeed brought new ideas and methods to solve complex problems and promoted the development of scientific research. Achieving good interdisciplinary collaboration in actual scientific research to produce knowledge with real innovative value is a question worth pondering. Undoubtedly, the excellent output of interdisciplinary is also inseparable from the support of the external environment, for example, a complete discipline evaluation system is needed (Bromham, Dinnage, & Hua, 2016).

There are unavoidable limitations in this study. First, we only used the paper data of six journals to analyze the relationship between interdisciplinary and disruptive innovation. Whether the results apply to other journals needs further investigation. Second, the interdisciplinary collaboration is measured by whether the authors are from different secondary institutions. We do not consider that even if it is the same secondary institution, different primary institutions and different countries may have differences in subject positioning. Last but not least, in order to achieve a more stringent causal inference effect, more indicators related to citations and D-index should be included in the regression model. For example, scientists' knowledge background and personality which potentially affect both the preference of interdisciplinary collaboration and their citations, are not controlled in our regression model. These issues will be considered in future work.

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Using Symptoms and Healthcare Encounters to Capture a Rare Disease: A Study of Clinical Notes of the Alpha-Gal Meat Allergy

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ABSTRACT

This paper examines clinical notes to identify reported symptoms and investigate patient-provider communication processes in alpha-gal syndrome (AGS). Clinical notes appear to be a credible and stable source of research where the researcher can find information regarding both symptoms and environmental factors of AGS. Compilation of notes could be used for a checklist to aid in diagnosis. This study analyzed clinicians' notes in patient records retrieved from the Electronic Medical Record Search Engine (EMERSE). The most reported symptoms fell into four general categories: skin (42%), inflammation (17%), gastrointestinal (20%), and anaphylaxis (21%). Environmental triggers were also commonly reported. This in-depth analysis of clinical notes of AGS can serve as a basis for future automation of rare disease analysis; moreover, it provides a basic understanding of the granularity of information that an electronic health record (EHR) may provide for rare disease identification.

KEYWORDS

Alpha-Gal meat allergy, clinician-patient relationship, clinical notes.

INTRODUCTION

Alpha-gal syndrome (AGS), a novel and often severe food allergy to mammalian meat, is a relatively newly discovered medical condition. Since its first report in the medical literature approximately a decade ago, the syndrome has been found in patients in North America, Europe, Asia, Australia, and Africa (Steinke et al., 2015). Its unusual clinical presentation and range of symptoms often produce diagnostic challenges. The prevalence of AGS is currently unknown (U.S. Department of Health and Human Services, Office of Assistant Secretary for Health, Alpha-Gal Syndrome Subcommittee, 2020). Time from exposure to onset of symptoms is variable, often delayed (from ~3-8 hours); and symptoms can range from itching and hives to gastrointestinal distress to anaphylaxis (American Academy of Allergy Asthma and Immunology, 2020). While it is not completely known what triggers AGS, evidence points to tick bites as the causative agent (Commings et al., 2011). The test for AGS has been available now for almost ten years (Siles & Hsieh, 2011). There is no treatment for AGS, other than avoidance of meat and meat products, and in some cases, avoidance additionally of dairy and gelatin. Recent estimates of AGS cases now exceed 5,000, and in a southeastern registry of patients the syndrome was identified as the leading cause of anaphylaxis (Pattanaik et al., 2018; Office of Assistant Secretary for Health, Alpha-Gal Syndrome Subcommittee, 2020). Given its rarity, in many situations, clinicians face similar challenges as their patients: a lack of information and inability to identify and diagnose the allergy.

Rare diseases can pose a challenging situation for all parties, including the patient, the doctor, and caregivers (Lopes et al., 2018). The psychological experiences of people with rare diseases can be highly associated with a sense of uncertainty for various reasons, including the disease prospect, treatment, and the tension from interactions with healthcare providers (Lippe et al., 2017). Research has recognized, in the case of rare diseases that having access to reliable sources of information can be important for effective health care, and information professionals may play a role by directing patients with rare diseases to reliable health information portals (Ladd, 2015).

Informational research can aid in understanding rare disease, specifically the mapping of terminologies (Rance et al., 2013). When it comes to rare diseases, patients can become the experts (Lippe et al., 2017) due to insufficient knowledge of healthcare providers; in addition, patients and physicians are challenged to learn to fulfill new roles (Budyk et al., 2012). In this context the communication process becomes patient-driven, with shared decision-making necessary (Braddock, 2010).

For diseases like AGS, a clear-cut diagnosis can be challenging (Pollack et al., 2019), especially considering the broad range of symptoms and uneven results of lab tests among patients, and how the health condition of the patient can be dynamic and fast changing. Even when providers have knowledge and experience with AGS, a shared decision-making and diagnosis perspective is needed, as they rely heavily on patient input because the lab test (the

Immunoglobulin E (IgE) test) for AGS has weak predictive power (Fischer, et al, 2020). Patient input provides important information regarding potential symptoms of AGS, which providers rely upon to make differential judgments or diagnostic decisions.

So, the clinical interaction of a potential AGS patient and their doctor can be considered as a situation where these two come to supplement each other's understanding via information communication. For health information researchers, a primary goal is to enable more effective connection between patients and providers. In the case of AGS, such facilitation can be highly beneficial; especially considering the syndrome can be life-threatening in extreme cases.

This study aimed to examine the physician-patient communication process as documented through clinical notes of patients' health care visits, with the premise that the two parties of communication are equipped with differing levels of information and knowledge. We sought to develop an informational tool that could help with the communication process to better convey the key information regarding the description and diagnosis of AGS. This study explored the following questions. First, how do possible AGS patients communicate with their doctors during clinical visits, including how did patients describe their related symptoms? Second, what were the most frequently mentioned symptoms or factors discussed during their appointment? And thirdly, how closely are these most common terms associated with a clinical determination of AGS. This paper provides a demonstration of how information scientists are uniquely situated when researching electronic health records. In addition, it also reveals the challenging and interdisciplinary nature of health information research. This paper emphasizes the reliance on human interpretation when working with the limited amount of clinical texts of one rare disease, AGS. Meanwhile, this paper also provides a basic understanding that future work can leverage to design computer assisted ways of working with clinical natural language of AGS. Specifically, this paper is structured as follows: in the next section, we review some of the existing research including the variability of symptoms of AGS, and the importance of considering environmental factors. Then we introduce the processes undertaken to identify the most relevant clinical notes of AGS, and report on observations based on analysis of these clinical notes.

LITERATURE REVIEW

Existing medical research has provided some fundamental understandings of AGS including the characteristics of its symptoms and the disease's association with environmental factors (Commins et al, 2009; Wolver et al, 2013). Previous studies have presented broad, high-level summaries of the major symptoms of the condition (Cabezas-Cruz et al, 2019; Donaldson & Le, 2019; Wilson et al, 2019). Specifically, some of the most common symptoms include: urticaria, pruritus, angioedema, and anaphylaxis; in addition, the symptoms that patients experience can vary significantly, so it is possible that patients do not exhibit these typical clinical symptoms, while some patients also have symptoms such as nausea, diarrhea, indigestion, or abdominal pain; the variability of symptoms of AGS is referred to as the "idiosyncratic nature of AGS" (Cabezas-Cruz et al, 2019).

Considering the idiosyncratic nature of AGS, a related line of research has examined differentiating diseases of AGS. Specifically, food allergies and chronic urticaria appear to be two of the most common differentiating cases. While differentiation with other food allergies can be easier to determine due to delay of symptom onset with AGS (Cabezas-Cruz et al, 2019), the delayed reaction to meat can also become a confounding factor to prevent easy differentiation with chronic urticaria, not to mention that AGS and chronic urticaria can co-exist and some even postulate a possible causal relation between the two (Pollack et al., 2019).

Given α -gal sensitization is associated with tick bites, and that the predisposition of individuals to AGS remains unclear (U.S. Department of Health and Human Services, Office of Assistant Secretary for Health, Alpha-Gal Syndrome Subcommittee, 2020), it has been recognized that environmental factors are also crucial for understanding the condition. In particular, environmental factors include the status of the tick population and ecological conditions (e.g. temperature, humidity) that impact tick distribution; environmental factors could also include related human activities and living conditions, such as outdoor employment, pet ownership, hunting, etc. (Cabezas-Cruz et al., 2019; Levin et al., 2019).

From an information research perspective, existing work has investigated AGS patients' information practices. Specifically, research has found the diagnosis of this disease is largely patient driven (Flaherty et al., 2017); namely, it is common that during clinical visits it is patients who brought up the possibility of the alpha-gal allergy with their physicians. Moreover, interaction between healthcare providers (HCPs) and patients can be challenging when patients realize their HCPs have little knowledge of the disease (Flaherty et al., 2020). This line of research is particularly valuable and timely for understanding AGS, given that independent health information seeking is one of the characteristics for patients with rare diseases. Patients' information seeking can be necessary and crucial, especially when considering that HCPs may lack information and awareness of sources of information about rare diseases (Katavić, 2019; Vandeborne, et al., 2019).

To summarize, this brief review suggests that existing research forms a multi-dimensional research landscape for understanding AGS. In addition to the idiosyncratic nature of the clinical symptoms, and the limited specificity of the laboratory test, research has emphasized the importance of understanding environmental factors, as well as potential communication challenges that both providers and patients face during clinical interactions. Given this understanding of AGS, this study employed a clinical textual analysis for understanding the symptoms and environmental factors of AGS. Electronic clinical notes have been used to help understand medical symptoms (Koleck et al., 2020), and to help with the diagnosis of rare disease with some assistance of computer algorithms (Colbaugh et al., 2018; Dong et al., 2021; Sheikhalishahi et al., 2019). However, researching clinical notes of AGS can present a unique challenge because: first, manually going through clinical notes is possible and necessary due to the limited amount of clinical notes available; in addition, medical research is also at an early stage of gaining a full picture of the diagnosis of this disease. Manually going through the clinical notes of AGS could help with diagnosis by focusing on distinguishing patients who are confirmed or possible cases of AGS and provide a snapshot of communication between patients and their HCPs.

DATA & METHOD

This study leveraged the EMERSE (Electronic Medical Record Search Engine), a database initially developed at the University of Michigan in 2005; it was launched at the University of North Carolina at Chapel Hill (UNC) in 2017. EMERSE contains clinical notes from the UNC Health Care system, though it does not provide access to patients' electronic health records. The study protocol was approved by the UNC Institutional Review Board (September 27, 2019; Study #19-2259).

A free text search was performed in EMERSE (in January 2020) using the exact match of the keyword phrase “meat allergy.” This search returned a total of 788 patients. The keyword “meat allergy” was used as a first filtering step because the researchers believed that compared to more clinical terms such as “alpha-gal”, the more familiar term might result in higher search return rates.

For the list of the original 788 patients, each patient could have multiple records in the system. To narrow down the number of records for manual processing, a further filtering search was performed to return only those patient records that contained either “hives” OR “urticaria”. The “hives” OR “urticaria” search criteria were used because these two have been reported in previous research as the most common symptoms of AGS; research has found that 93% of the patients among a total number of 261 AGS patients surveyed had experienced hives (Wilson et al, 2019). Moreover, the OR Boolean search maximized our retrieval of possible AGS patients.

The further filter criteria was assumed to have narrowed down the returned results to those that were about potential patients or patients with AGS, by ruling out, for example, those cases where “meat allergy” was only mentioned as background information. And for each patient with records that contained “hives” OR “urticaria”, only one record was kept for later analysis. In other words, only one record (typically the oldest record chronologically) was retrieved for any one patient. The choice of the earliest record was based on the assumption that the earliest records were more likely to contain the clinical visits where the disease was first suspected or diagnosed, where later ones were more likely to be follow-up encounters.

Finally, for each of the patient's records that matched these searching criteria, the two researchers reviewed the records manually, and recorded all the symptoms and environmental factors that were reported in the clinical notes. This manual review process also served to cull out the AGS-related cases that were not relevant for our research purposes. For instance, where α -gal was only mentioned in cases of cancer treatment. This yielded 300 in total records. The researchers reviewed the first 49% of these, resulting in a spreadsheet of symptoms and environmental factors that included 149 patient records (namely, 149 patients, each patient with one record).

The core text this study worked with consisted of a spreadsheet that further delineated symptoms and environmental keywords that were recorded in the text of clinical notes during the patient-doctor health care encounter. For cases where a symptom term was mentioned multiple times in the original clinical text, we only recorded it once.

Additionally, we marked each patient's clinical note as either “historical (H)” or “possible (P)”:

The first scenario of historical cases (or “H”) was where it was clear the patient had already been diagnosed with AGS, and the notes contained relatively detailed information about the patient's AGS condition. For example, these notes contained text like “...was diagnosed with Alpha-Gal Allergy...”, or “... follow up of alpha gal food allergy”, or “... with a history of alpha gal meat allergy ...”

The second scenario of possible cases (or “P”) was where the clinician appeared to be actively suspecting the patient had AGS, or where the clinician was in the process of differentiating AGS from other possibilities. This category of records was indicated by text such as “... a new patient for evaluation of a possible alpha gal food allergy,” and

“with possible alpha-gal syndrome (AGS) despite negative IgE testing,” or “... she gave us a clinical story that was very convincing for alpha gal food allergy. However, blood testing revealed no alpha gal IgE.”

Both the historical (H) and possible (P) scenarios were considered valuable for understanding AGS with slightly different foci. For historical cases, they could provide a source and confirmation of the most signaling symptoms of AGS. For possible cases, they could provide an opportunity for understanding the difficulty of communication, specifically, the source of confusion. Among the 149 records, there were 56 H cases, and 93 P cases. The complete data searching and narrowing processes are summarized in Figure 1.

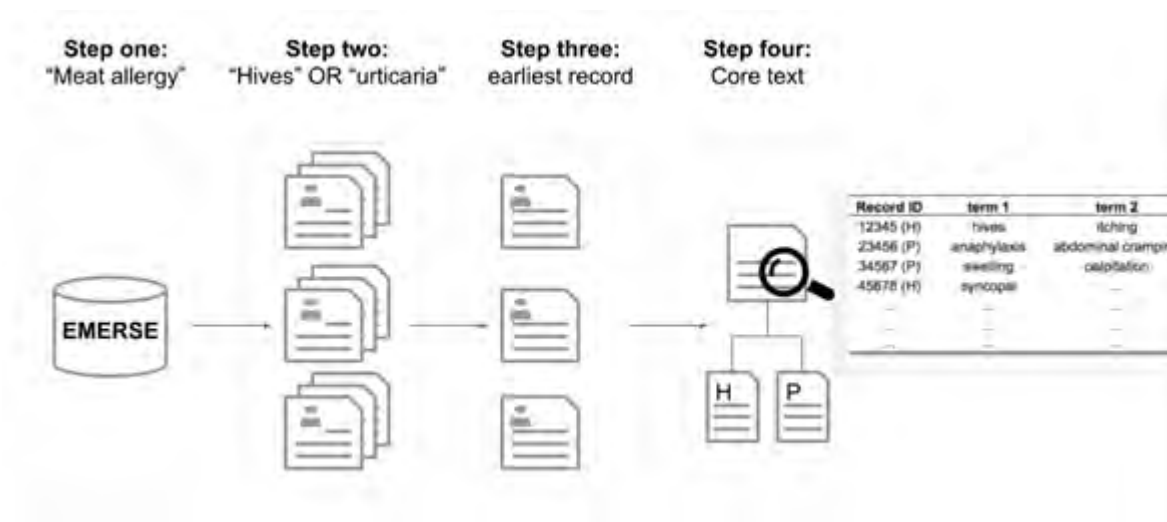


Figure 1. A diagram of text processing steps

In order to understand the degree to which filtering for hives or urticaria missed AGS cases, we took a further step where we examined a random sample of 80 records (10% of total, 20% of those not filtered) and assessed their characteristics. Within these records, we differentiated by indications they did not have AGS (categories 1-3 in Table 3. below); indications they did have AGS (categories 4-8 in Table 3. below); and indications of the terms for which we had filtered. This allowed us to estimate the prevalence of AGS in those records not captured by our filter terms, hives or urticaria.

ANALYSIS & FINDINGS

One goal of analysis was to identify how symptoms and environmental factors appeared in the clinical notes. In order to have a more systematic description, the researchers coded the terms based on the below schema, where the symptoms were put into four broad categories, and the environmental terms were also put into four categories. Both symptomatic and environmental factors are important, as many times these two were intertwined during the communication process, and we could tell from the clinical notes that clinicians considered both, for example, "... female who is seen as a new patient for evaluation of possible α -gal food allergy. ... Hence, even if she tests positive for alpha gal (which she might given that she has common environmental exposures with her husband who does have this allergy), we have to entertain the possibility that she does not have the disease."

The coding process was iterative. The researchers first read through the spreadsheet and categorized terms as they were encountered. As most of the terms converged on a limited number of categorizations, the categorization below was created to guide further coding. The coding schema is presented below:

Symptom terms categorization:

- 1) Skin reactions – included terms such as hives, urticaria, rash, pruritus, itching
- 2) Inflammation – included terms such as swelling, edema, angioedema, swollen
- 3) Gastrointestinal – included terms such as diarrhea, emesis, abdominal pain, vomiting, reflux
- 4) Anaphylaxis – included the spectrum of related symptoms such as syncope, difficulty breathing, hypotension, chest tightness

Environmental terms categorization:

- 1) Tick exposure/history: indicated by terms like tick bite/exposure
- 2) Delay of symptom onset: indicated by the word hour

- 3) Symptom onset during nighttime: primarily indicated by the word night
- 4) Living environment: indicated by terms like wooded, rural, farm

For each of the broad categorizations, the researchers enumerated all the related terms, and then counted the occurrence of each of the terms, and then calculated the occurrence of each of the broad categorizations. By counting, we mean counting the presence of symptom terms, rather than the actual times the word per se appears in the note. The occurrences of these broad categorizations are summarized in Table 1. and Table 2. A detailed documentation of all terms and their occurrences can be found in the Appendix.

<i>(N = 528 terms)</i>	All cases	Historical cases	Possible cases
Skin reactions	41.64%	44.51%	40.27%
Inflammation	17.29%	19.08%	16.44%
Gastrointestinal	20.45%	17.92%	21.64%
Anaphylaxis	20.63%	18.50%	21.64%

Table 1. Presence of symptoms in clinical notes

<i>(N = 264 terms)</i>	All cases	Historical cases	Possible cases
night time onset of symptoms	17.42%	8.11%	21.05%
delay of symptoms	25.00%	24.32%	25.26%
rural/wooded environment	11.36%	8.11%	12.63%
tick exposure	46.21%	59.46%	41.05%

Note: An observation of clinical notes of 149 historical and possible α -gal meat allergy patients

Table 2. Presence of environmental factors in clinical notes

Skin reactions, which included hives, urticaria, etc., turned out to be the most frequently reported symptom across the two scenarios (historical and possible) of analysis. This is likely not only due to initial search structure, but also because manifestations of skin symptoms vary significantly, so that people use more varied vocabularies to describe their skin reactions. Existing work has also reported a high prevalence of abdominal reactions in rural black Africans (Levin et al., 2019; Mabelane et al., 2018). So, our initial observation of the prevalence of the skin reaction record will need to be further checked with demographic information. In addition, note that among the 149 patients' records analyzed, close to 70% (69.13%) of all patient records reported environmental factors, among which tick exposure was the leading factor reported in clinical notes.

As discussed in the methods section, we also examined a random sample of 80 records to assess the efficiency of our filter terms for studying AGS. Of those 80, 55 (69%) possibly had AGS (categories 4-8 in Table 3. below); 47 of whom (59%) were highly likely or confirmed to have AGS (categories 4-7). In addition, 10% (category 8), did have hives or urticaria in the record, but were not included in the 149 records that were reviewed. Thus, while filtering by hives or urticaria was initially undertaken to allow for identification of AGS cases more efficiently and did allow us to compare symptoms, it was by no means ideal, given its exclusion of pertinent records.

Category No.	1	2	3	4	5	6	7	8
Category Description	No AGS	Suspect AGS, negative test	Ruling out AGS	Has AGS Visit for advice	Has AGS Visit for different reason	AGS No record of skin symptoms	AGS With skin symptoms (e.g. "rash"); no mention of hives or urticaria	AGS Visit for test; urticaria or hives in record
No. of Patient records	4	2	19	7	30	4	6	8

Table 3. Categorization of a random sample of 80 records

While the Possible cases in the first assessment of 149 patients contained some wording that did not fall into Table 3, the Historical cases are similar to 4-8 in Table 3. Of note, only Skin Reactions and Tick Exposure in the first analysis were more predictive of an AGS case than those meat allergy cases excluded by hives and urticaria.

DISCUSSION

Our analysis corroborated findings from existing medical literature, in particular regarding some of the most common symptoms associated with clinical suspicion and confirmation of AGS. In addition, our observations of the clinical notes of such patients showed that environmental factors can be an important consideration for AGS. In general, our observation of the clinical notes aligned with the existing understanding that AGS can be quite idiosyncratic, as reflected not only through the variety of terms used to report or summarize patient symptoms, but also through some of the notes where doctors explicitly recorded the difficulty of making a clear diagnosis. Clinical notes appear to be a credible and stable source of information where the researcher can find information regarding both symptoms and environmental factors of AGS. In other words, the examination of clinical notes provides valuable research data that truly reflects and reveals the complexities of real-world patient encounters with regard to AGS, though the clinical notes are not without drawbacks, as we discuss in more detail below.

Safety checklists have been designed and implemented in the medical context to improve communication and consistency of care (Haynes et al., 2009). Based on the observation of symptoms and environmental factors, we propose a preliminary reference framework for recording symptoms (Table 4.1) and environmental factors (Table 4.2) of AGS. The rationale for proposing this preliminary framework is to facilitate understanding and potentially improve patient-doctor communication, since real-life situations of AGS can be complicated. Though confirmation of any one single or couple symptoms does not necessarily lead to an increased suspicion of AGS, the simultaneous confirmation of both symptoms and environmental factors might raise the possibility of a positive diagnosis of AGS. Also, as a tool that aims to facilitate understanding, this table could be used by patients or their family members to understand their symptoms, in order to identify possible symptoms and experiences, and to watch out for environmental factors, especially tick exposure.

Preliminary reference framework	Symptoms
Skin reactions	
	hives <input type="checkbox"/>
	itching <input type="checkbox"/>
	rash <input type="checkbox"/>
	urticaria <input type="checkbox"/>
Inflammation	
	swelling <input type="checkbox"/>
	angioedema <input type="checkbox"/>
Gastrointestinal	
	abdominal <input type="checkbox"/>
	nausea <input type="checkbox"/>
	diarrhea <input type="checkbox"/>
Anaphylaxis	
	throat <input type="checkbox"/>
	breath <input type="checkbox"/>
	syncope <input type="checkbox"/>

Table 4.1 Preliminary top symptoms of AGS

Preliminary reference framework	Factors
Environmental factors	
	tick exposure <input type="checkbox"/>
	delay of symptom <input type="checkbox"/>
	night time onset <input type="checkbox"/>
	rural/wooded environment <input type="checkbox"/>

Table 4.2. Preliminary top environmental factors related to AGS

We would like to suggest that our reference framework has the possibility of being further developed to function as a checklist to facilitate understanding and communication related to AGS. However, it is important to recognize that this reference framework is not meant to replace adequate communication between patients and their HCPs. It could be used as a tool, not for conclusive diagnosis. Most importantly, this reference table is preliminary in that more work is needed in order to finalize all the terms and their relevant significance. In addition, approval from a medical authority is needed for validation. It is expected that as this preliminary table continues to develop, the specific terms and their rankings will be open to further modification.

This study relied on clinical notes from the EMERSE system, hence understanding the features of the clinical notes themselves as well as the database features can be important not only for this work, but also for future work that may use clinical notes as the primary data source. Since clinical notes are a free-form, and often quick summary by clinicians, it was common to see notes vary significantly in length, details, and formality of language. For example, the entirety of one note included the medical record number and: “*RPT_TEXT: 'Please look up alpha gal to learn more about this red meat allergy.'*”, other notes were many pages of description of communication between the provider and patient.

More importantly, when it came to AGS related language, the clinical notes appeared to be a mixture or mapping between the more casual language of patients and the more medically professional language of HCPs. For example, on one hand physicians reported verbatim patients’ casual terms like “feel like not in this world” or “welts” (referring to welts), and on the other hand, the professional medical terms, such as “syncope” or “hives”. We suspect that in the case of AGS, such mapping of patients’ casual language onto medical terminology could be extra challenging, considering the wide range of possibilities of symptoms that patients might report. In addition, some notes were dictated or recorded, with concomitant transcription errors (e.g. “At this point she is a web search for meat allergy”).

Nonetheless, we believe the clinical notes from EMERSE provide documentation and a valuable opportunity to understand and investigate patient –provider communication with regard to AGS. However, the content from EMERSE is currently limited in that EMERSE only contains clinical records from June 2014 forward; there appears to be a breakdown in that for many notes, the truly first encounter regarding AGS is simply not recorded in EMERSE.

It was counter-intuitive that within the universe of records with the phrase “meat allergy,” the two most common AGS symptoms, hives and urticaria, did not seem to narrow the filtered records to those with AGS. This is likely because once clinicians are given very specific diagnostic inputs like a positive test or anaphylaxis, they may not be recording the more widespread factors like nausea or hives. If this is the case, this opens the possibility that words in the records of clinician notes are some combination of patient symptoms and the clinician’s record of diagnostic importance. The possibility that the most common and non-specific of terms are under-recorded with emerging conditions should be further explored.

The biggest limitations of our research come from the limited number of patient clinical notes analyzed, and the inability to distinguish confirmed AGS cases. Other limitations include the fact that the research took place in a region with a relatively high recorded prevalence, and at a university with high awareness of AGS, a high number of AGS specialists. Likely diagnosis is less common in most rural hospitals without a research component. We have looked at one medical system and clinical notes and descriptions may change between settings.

The limitation in number and structure of searching means the occurrence of symptoms are questionable in terms of their generalizability to a larger population. Also, because of the limited number of records, this study is not able to provide more detailed analysis or comparisons, like how common certain symptoms are across different population groups of patients (including age, gender, ethnicity, etc.). With the accumulation of more clinical notes of AGS, future work can improve on the limitations of this study, in that clinical notes analysis could help provide more

granular description of symptoms, for instance, specific body parts that are involved with swelling or itching; and even correlation analysis between symptoms, or between symptoms and environmental factors such as tick bites. Future research could also compare the clinical notes records with patients' electronic health records for a more complete picture of the medical encounter, though at this time there is no specific ICD-10 code for AGS.

CONCLUSION

Our study's in-depth analysis of clinical notes of AGS can serve as a basis for future automation of rare disease analysis; for example, it provides a basic understanding of the granularity of information that clinical notes may provide for rare disease identification. In addition, this paper provides a demonstration of how information scientists are uniquely situated when researching electronic health records. In addition, it also reveals the challenging and interdisciplinary nature of health information research.

Through a close observation of the clinical records of AGS, our study revealed the real-world interaction between patients and possible patients with AGS and their health care providers. Our observations are in alignment with existing understanding of AGS and have further revealed that HCPs rely on patient communication for two categories of input, namely symptoms and environmental information. We believe these constitute an important component of information exchange in the communication process for rare diseases such as AGS. To facilitate this information exchange, we have proposed a preliminary framework in the hope that with further development, it may be used for both the understanding and diagnosis of AGS by both patients and health care providers.

ACKNOWLEDGEMENT

This research was supported by funding from the Medical Library Association Donald A.B. Lindberg Research Fellowship.

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Neural Correlates of Realisation of Satisfaction in a Successful Search Process

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ABSTRACT

In a search process, searchers review documents to gather information relevant to their information need (IN). During this process, searchers may experience the satisfaction of their IN, indicating they have gathered adequate relevant information to answer their need. This complex concept of satisfaction is the ultimate goal of search systems. Most studies in Information Retrieval (IR) have been attempted to understand how searchers' needs are satisfied based on behavioural observation. However, the psychophysiological manifestation during the moment of satisfaction still remains unclear. Here, we use functional Magnetic Resonance (fMRI) to investigate which brain regions are involved during the moment of satisfaction. Twenty-six participants participated in the experiment, designed to represent a search process while being scanned. Our result shows the human brain regions involved during the moment of satisfaction. These findings provide an important step in unravelling the concept of satisfaction in a search process.

KEYWORDS

Satisfaction; fMRI; Information Need; Neural Correlates; Search Process.

INTRODUCTION

The satisfaction of an information need (IN) (referred to as satisfaction) is a fundamental concept in Information Retrieval (IR) (Al-Maskari & Sanderson, 2010). From the searcher's perspective, satisfaction can be seen to combine both the accuracy and the completeness of the task that a searcher performs (Al-Maskari & Sanderson, 2010). Satisfaction can be explained by the concepts of information seeking and foraging in which a searcher usually needs to acquire new information in order to fulfil their IN(s) (Kuhlthau, 1991; Pirolli & Card, 1999). This could lead to stopping a search process when (i) searchers realise that their INs are satisfied (i.e. a successful search), (ii) the current solution is sufficient to meet the individual's objective (Prabha, Silipigni Connaway, Olszewski, & Jenkins, 2007) (i.e. a sufficient search), or (iii) searchers gave up their search unsatisfied (i.e. an unsuccessful search). In this paper, we aim to understand the underlying brain regions associated with satisfaction in successful search scenarios, and whether cognitive or emotional processes appear to be involved in this phenomenon.

In the field of psychology and cognitive science, satisfying IN(s) could be thought of as an adaptive behaviour (Desender, Boldt, & Yeung, 2018). A searcher can be thought to employ a decision process such as accumulating evidence in completing a task. The evidence accumulation models assume that in a sequential information search, the searchers will terminate their search when sufficient evidence has been accumulated to pass a decision threshold (Hausmann & L'age, 2008). Thus, the realisation of satisfaction would lead to the stop of the search process. On the other hand, if the decision criterion is not met, then searchers would continue their information search and not show signs of satisfaction.

To understand the concept of satisfaction in a search process, several behavioural studies have been conducted based on observing human search behaviour and conducting surveys (Hassan, Shi, Craswell, & Ramsey, 2013; Hassan & White, 2013; Jiang, Hassan Awadallah, Shi, & White, 2015). However, such studies are limited in explaining what is happening to the internal states of searchers when their IN is being satisfied. Though recently a number of studies have begun to employ brain-imaging techniques such as fMRI and electroencephalography (EEG) to measure neural processing as a means to understand the internal states of searchers when performing search tasks (Moshfeghi, Pinto, Pollick, & Jose, 2013; Moshfeghi & Pollick, 2018; Moshfeghi, Triantafyllou, & Pollick, 2016). These studies have focused on the brain regions involved in representing relevance and IN, and the neural basis of satisfaction remains unclear.

Therefore, in this paper, we aim to investigate the following research question (RQ): **“What are the brain regions corresponding to the realisation of satisfaction in a successful search process?”**. To answer this research question, we utilised an fMRI technique which provides us with the ability to capture the brain signals of

participants while they engage in a search task. This technique has one remarkable advantage over other brain imaging techniques as it provides a superior spatial resolution of the brain signal, particularly in deep regions of the brain that are not readily accessible by other techniques. This is important as previous investigations of IN and satisfaction have revealed that deep brain regions such as the insula and cingulate cortex play an important role (Moshfeghi et al., 2016; Moshfeghi & Pollick, 2018). To use fMRI requires devising compatible paradigms, and we thus developed a novel task by using a puzzle idea where participants need to gather pieces of information by viewing piecewise, individual pieces of an image. This task demonstrates the possibility to simulate an information seeking process and was suitable for an fMRI study. Previous studies also show that using a puzzle as an experimental task could help in simulating an information seeking process (Kelly, 2009; Samimi & Ravana, 2014; Jansen, Bos, van der Vet, Huibers, & Hiemstra, 2010; Hills, Todd, & Goldstone, 2010; Dang Nguyen et al., 2019). This task helps us to examine brain activity during the times when participants were in a state of being satisfied in a successful search, and thus, the resulting brain imaging data enabled us to answer our research question.

The rest of the paper is organised as follows. First, we describe previous related work and background in Section 2. Section 3 provides a detailed methodological approach utilised in this experiment. Results are presented and analysed in Section 4. Lastly, Section 5 outlines the key conclusions.

RELATED WORK

Satisfaction and IR

Information Retrieval (IR) studies how to retrieve relevant information from a data collection in order to fulfil a particular IN. The satisfaction of an IN is similar to solving a jigsaw puzzle where a person needs to find all pieces of a puzzle and integrate them in order to solve the puzzle (Maggitti, Smith, & Katila, 2013; Nieuwenhuysen, 2006; Davies, 1989; Ellis, 1992; Frandsen, 1966). In the information seeking paradigm, the pieces of the puzzle can be considered as documents where searchers have to engage a search system in order to obtain relevant documents. During the search process, the searchers will integrate pieces of relevant documents to fulfil their IN. This is similar to solving a jigsaw puzzle where a player needs to integrate all pieces of the jigsaw to appreciate the full picture. The concept of a jigsaw has been used in several studies in IR, such as evaluating a retrieval system (Kelly, 2009; Samimi & Ravana, 2014; Jansen et al., 2010; Hills et al., 2010; Dang Nguyen et al., 2019)

Satisfaction can be linked to stopping behaviours in the information seeking process, where previous research has formalised the stopping criteria used to terminate a search (Kraft & Lee, 1979). The stopping rules used to terminate a search are fundamental aspects of information seeking behaviour and are thought to include both cognitive and decision-making processes. One way to conceptualise satisfaction is from the viewpoint of the decision process underlying satisfaction. This is typically achieved using the evidence accumulation model (Hausmann & L'age, 2008), where a searcher has to accumulate evidence, and their decision will be made when the accumulated evidence has reached a decision threshold. In such a framework, satisfaction could also be inferred from a searcher's level of confidence.

The satisfaction of an IN also appears to play a crucial role in Information Seeking Behaviour, which is the field of studying the behaviour of searchers in seeking information to fulfil their need (Wilson, 2000, 1981, 1997). Information seeking models propose that during the early stages of search a searcher will usually feel a lack of information and express a need to engage a search system to gather pieces of relevant information to complete a task (Kuhlthau, 1991; Marchionini, 1997). At the final stage of search, after performing a number of iterations in gathering pieces of relevant information, the searchers usually express the satisfaction of their IN by stopping their search to complete the task (Kuhlthau, 1991; Marchionini, 1997). For example, at the final stage of the information search process model, a searcher will experience a sense of relief after gathering enough pieces of relevant information to solve a problem (1991). However, it is unclear whether the satisfaction process involves cognitive processes, affective processes, or both.

A number of IR studies have been conducted to understand the phenomenon of satisfaction by using implicit measures (e.g., dwell time and click-through) and explicit measures (e.g., self-reported judgments) (Al-Maskari & Sanderson, 2010; Fox, Karnawat, Mydland, Dumais, & White, 2005). For example, Fox et al. (2005) demonstrated an association between searcher satisfaction and implicit measures gathered from behavioural actions during a search task. As well, Hassan et al. (2013) utilised query-reformulation to construct a prediction model of searcher satisfaction based on query-reformulation. In addition, Hassan and White (2013) introduced personalised prediction models of searcher satisfaction that were constructed from searchers' search logs. Liu et al. (2015) suggested mouse movement as another possible implicit factor that should be included in predictive models. Jiang et al. (Jiang et al., 2015) argued that satisfaction could be expressed in different levels and proposed a model that predicted searcher satisfaction at multiple levels. Lastly, work from Mehrotra et al. (2017) applied deep sequential models and novel machine learning techniques to predict satisfaction.

Neuroscience and IR

Recent years have seen IR's field take an increasing interest in neuroscience (Gwizdka & Mostafa, 2016; Gwizdka, Mostafa, Moshfeghi, Bergman, & Pollick, 2013). This interest has focused on gaining an understanding of how the different components of IR emerge from measurable activity in the brain. These studies have employed a wide range of brain imaging techniques to probe brain activity related to brain states involved in processing relevance and IN. Two imaging techniques that are frequently used in these studies are functional magnetic resonance imaging fMRI and EEG, with the choice between techniques often guided by the appropriateness of the technique to the question at hand.

A collection of fMRI studies by Moshfeghi and colleagues (Moshfeghi et al., 2013, 2016; Moshfeghi & Pollick, 2019, 2018; Moshfeghi, Triantafillou, & Pollick, 2019) has focused on using fMRI to understand the brain regions activated during relevance judgment and IN. Results from one study (Moshfeghi et al., 2013) revealed the brain regions that are activated during the relevance judgment process. Another study (Moshfeghi et al., 2016) indicated that IN was reflected by brain processes associated with the switching between internal and external information sources. Relevant to the current research was a study examining how transitions between stages of search related to activity changes in large-scale brain networks (Moshfeghi & Pollick, 2018). While this study included satisfaction as one of the stages it did not focus on satisfaction on its own.

Apart from the use of fMRI, other studies have applied different brain measurement techniques to investigate the concept of IR, especially relevance. For example, EEG has been applied in several studies to investigate the concept of relevance to text information (Gwizdka, Hosseini, Cole, & Wang, 2017; Eugster et al., 2014; Allegratti et al., 2015; Pinkosova, McGeown, & Moshfeghi, 2020). The related technique of Magnetoencephalography (MEG) has also been used to study the relevance of visual information (Kauppi et al., 2015). However, to understand the neural mechanisms of the satisfaction of IN it is important to investigate the activity of the entire brain. As stated in the Introduction, fMRI has the advantage over EEG and MEG in terms of spatial resolution and the ability to measure these deep brain structures. That is why it was used in the current study.

METHODOLOGY

Design

This study used a within-subject design. Participants were first given a caption and then presented with separate tiles of an image with the task of determining whether the caption matches the image. The independent variables were the realisation of satisfaction in a search process (SAT) and the validation of the response (VAL). The dependent variable was the brain activity revealed by the fMRI Blood Oxygen Level Dependent (BOLD) signal.

Participants

Twenty-six participants participated in this study (16 females; aged: 20-43 years, mean age: 25 years). All participants were typically developed and at least 18 years old. The recruited participants were right-handed, had a normal or corrected-to-normal vision. Six participants had head motion exceeding 3mm or 3 degrees and were excluded from the analysis. Two participants did not correctly follow the instructions, and one participant demonstrated poor performance (less than 50 per cent of captions self-reported correct). These three participants were also excluded, leaving seventeen participants entering into the final analysis. All participants were scanned using the fMRI scanner at the Centre for Cognitive Neuroimaging, University of Glasgow.

Stimuli Generation and Validation

Stimuli Generation

We developed a stimuli dataset by carefully selecting images from the Microsoft Common Objects in Context dataset (Lin et al., 2014), which provides a large set of images and a list of captions for each image. In order to obtain images that could be divided into tiles that could be sequentially presented to simulate a search task, we used the following criteria for selecting images from Microsoft COCO: a) an image had to be non-iconic and display everyday scenes. b) an image had to contain at least two objects and could not be easily matched to a caption by one small portion of the image. c) the caption for an image was effortless to understand and described more than one object appearing in the image. With this criteria, 100 images were selected. All images in this subset were converted into grey-scale images, and each grey-scale image was divided into nine tiles by constructing a 3x3 matrix.

Behavioural Study 1: Image Stimuli Selection

We conducted the first behavioural study in order to help distil a final set of images that on average were sufficiently difficult to engage participants to view multiple tiles before answering. A total of twenty-five healthy participants were recruited from the university environment for the study. For every participant, the procedure involved first being presented with a caption that described an image in the data set. Next, participants viewed, in random order and one at a time, the nine tiles that comprised the image. When participants were satisfied with the information extracted from the collection of tiles viewed, they were asked to press a button to indicate that they were satisfied that the caption matches the image. Results showed a distribution of difficulty for the 100 images and in choosing

final stimuli we avoided the extremes of this distribution to focus on images that were of moderate difficulty and primarily around the mean of 4-5 tiles to recognise that the caption matched the image. From this study we were able to choose 50 potential images.

Behavioural Study 2: Image Tile Sequence Generation

We conducted a second behavioural study in order to generate appropriate sequences for the presentation of the tiles for each image. Three assessors separately rated relevance using a 3-point scale (0-not relevant, 1-somewhat relevant, and 2-very relevant) for each of the nine tiles of an image. Calculating Fleiss' kappa for each image provided us images that had their component tiles consistently perceived.

We generated a pre-determined sequence for each image by sorting the tiles from the least relevant tile to the most relevant tile. We will use this sequence of tiles in the experimental task in order to simulate an information seeking scenario. At this early stage, participants will typically generate an ill-defined IN, which could identify the first couple of documents as irrelevant (Liu et al., 2018; White & Roth, 2009). So, the participants need to go through a series of documents to be able to complete the task. From this second study, we were able to select a set of images with a calibrated and fixed sequence of tile presentation for the main fMRI experiment.

Stimuli

A total of 24 images were chosen for the experiment. The majority of these images were of moderate difficulty. However, in order to encourage participants to pay attention to all trials, two trials were designed so that the image was inconsistent with the caption, forcing participants to view all tiles. Moreover, to break the pattern that early tiles were of limited relevance two trials were designed such that the first tile fully informed that the image matched the caption. These trials encouraged participants to pay attention to the task, and they also provided results that gave insight into whether participants were following instructions.

Procedure

This section describes the flow of the study, from start to finish. Ethical permission was obtained from the College of Science and Engineering, University of Glasgow. A pilot study was conducted before running the actual experiment in order to confirm that the experimental procedure worked as expected. Participants were instructed of the duration of the experiment, which included approximately 50 minutes to perform all functional brain imaging tasks examining search processes, and approximately 10 minutes to obtain an anatomical scan of brain structure. Participants were informed that they could leave at any point during the experiment and would still receive payment (the payment rate was £6/hr.). They were then asked to sign a consent form. Before beginning, the experiment participants underwent a safety check to guarantee that they did not possess any metal items inside or outside of their body, or had any contraindications for scanning, such as certain tattoo inks. They were then provided with gear (similar to a training suit) to wear for the duration of the experiment to avoid potential interference with the fMRI signal from any metal objects in their clothes.

Before starting the experiment, all participants were asked to complete an entry questionnaire, which assessed the participants' background related to demographics and online search experience. Following this, they performed the main task, as shown in Figure 1 where each participant encountered the experimental conditions related to information search while being scanned. Before starting to engage with the main task, participants were given a corresponding set of example trials in order to familiarise themselves with the procedure. At the completion of the study an exit questionnaire was given to assess participants' experience of the experiment.

Task

Our goal was to design a task that could represent an information search paradigm as well as be compatible with fMRI scanning protocols. The approach would provide a window on the neural and cognitive processes active during an information seeking task. From this approach, we were able to extract and analyse the moment of satisfaction of the participants. For the experimental task, we designed a task that was closely similar to a puzzle game to simulate the information seeking behaviour in the experimental

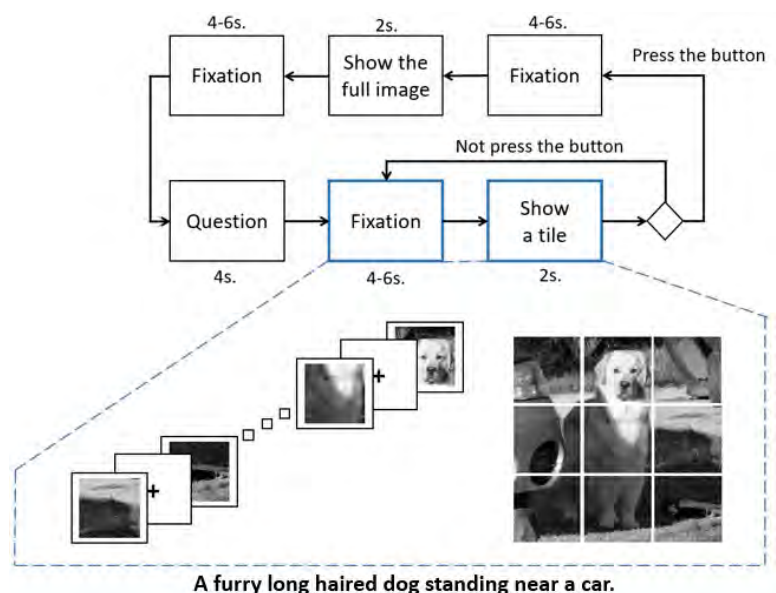


Figure 1. Flowchart of the main task

environment (Figure 2). In the task, participants encounter an image puzzle task, where they have to identify whether a caption matches an image. In the task, the image was divided into nine pieces. The participants viewed only one piece of the image at a time. Relating to a web search, each piece of the image could be thought of as a document in a web search that might satisfy an IN of a searcher. A piece of the image could contain relevant/irrelevant information to what the searcher is looking for.

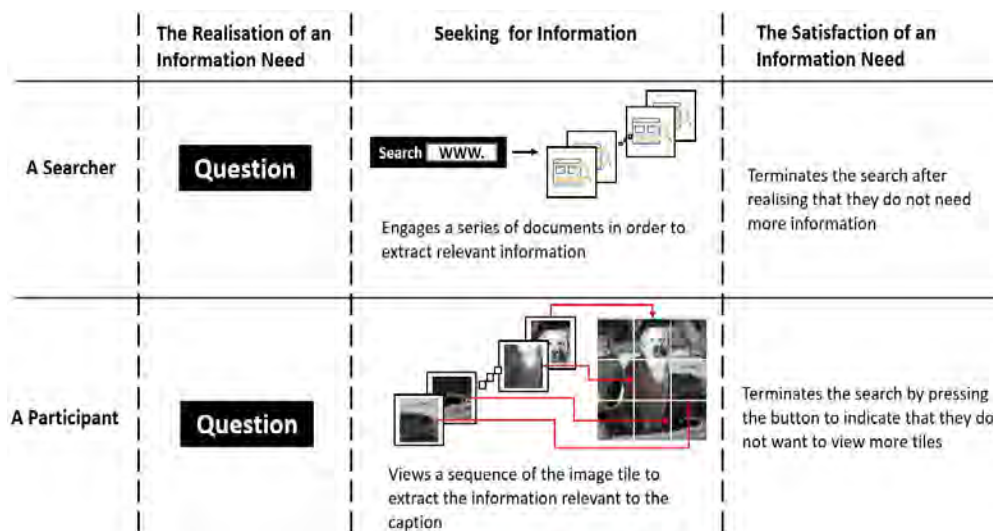


Figure 2. Illustration of the similarity between the web search paradigm and the image puzzle task used in this study and they were asked to press the button again if the response they had provided in the revelation phase was correct.

This experimental design is an imitation of the information search paradigm in the information seeking process, where a searcher has to gather pieces of information to fulfil their IN. Each piece of an image in this experiment can be thought of as a relevant/irrelevant piece of information in the search process. The searcher will terminate their search when they realise that they have extracted enough relevant information for determining that the caption matches the image. It should be noted that while the search scenario provided by the current procedure is not entirely congruent with the experience of everyday searches on the internet, it does allow us control over factors such as search history and the granularity of information provided at the moment of satisfaction. These issues of search history and information granularity are important to consider when doing brain imaging studies with fMRI, where not controlling such factors leads to experimental confounds that tremendously complicate the interpretation of brain data.

The task was divided into two phases, as illustrated in Figure 1. The first was a revelation phase where participants were presented a caption and then viewed individual tile pieces of the image presented sequentially until they determined that the image matched the caption. This revelation phase was meant to simulate an information seeking process, where the caption would represent a topic to search, and the individual image tiles would represent documents with differing levels of relevance that are evaluated as part of the search. The second part was a validation phase where participants were shown the entire image so that they could confirm that their response was correct.

In order to encourage participants to pay attention to all trials, two catch trials were designed so that the image was inconsistent with the caption, forcing participants to view all tiles. Two additional trials were added so that the first tile was fully informative that the image matched the caption (breaking the pattern that early tiles were of limited relevance). Participants, who failed to identify these trials were excluded from the analysis.

Revelation Phase

In this phase, for each of the 24 experimental trials, the participants were first presented with a caption followed by a sequence of tiles described in Section 3.3. The task was to decide whether or not the caption was appropriate to the image shown as a sequence of tiles. While image tiles were being presented to participants, they were asked to press a button (the response hand was counterbalanced) as soon as they noticed that the caption matched to the image (i.e., realised they satisfied their task).

Validation Phase

Once participants responded in the Revelation phase, the Validation phase began. In this phase, the image as a whole was shown to participants, and they were asked to press a button again if their response provided in the Revelation phase was correct.

The design of pressing the button at the moment of satisfaction realisation and validation is important for data analysis. We chose to contrast brain activity at these two periods since both include a button press and general recognition processes. In this way the brain activity associated with the realisation of satisfaction can be isolated.

Apparatus

The images were presented using Presentation software version 21.1 and projected using an LCD projector onto a translucent screen while participants watched them in an angled mirror in the scanner.

Image Acquisition

Imaging was performed using a 3T Siemens TIM Trio MRI scanning at the Centre for Cognitive Neuroimaging, University of Glasgow. Functional volumes were acquired using a T2*-weighted gradient echo, echo-planar imaging sequence (68 interleaved slices, TR: 2000ms, TE: 30ms, voxel size: 3 x 3 x 3 mm, FOV: 210mm, matrix size: 70 x 70). Also, a high-resolution anatomical volume was acquired at the end of the scanning using a T1-weighted sequence (192 slices, TR: 1900ms, TE: 2.52ms, voxel size: 1 x 1 x 1 mm, FOV: 210mm, matrix size: 256 x 256).

Data Analysis

We first analysed the behavioural logs resulting from 17 participants who passed the exclusion criteria in the procedure above. On average, the participants responded 17 (SD 2.7) of a possible 20 times that they were correct in matching the caption to the image. These trials were subsequently used in the fMRI analysis since they constitute successful search processes.

fMRI Preprocessing

The fMRI data were analysed using Brain Voyager 20. A standard pipeline of pre-processing of the data was performed for each participant (Goebel, 2017). This involved slice scan time correction using trilinear interpolation based on information about the TR and the order of slice scanning. Three-dimensional motion correction was performed to detect and correct for small head movements by spatial alignment of all the volumes of a participant to the first volume by rigid-body transformations. In addition, linear trends in the data were removed, and high pass filtering with a cutoff of 0.0025 Hz performed to reduce artefact from low-frequency physiological noise. The functional data were then co-registered with the anatomic data and spatially normalised into the Montreal Neurological Institute (MNI) space. Finally, the functional data of each individual underwent spatial smoothing using a Gaussian kernel of 6mm to facilitate the analysis of group data.

General Linear Model (GLM) Analysis

Analysis began with first-level modelling of the data of individual participants at the moment of satisfaction and the moment of validation using multiple linear regression of the BOLD-response time course in every voxel. Only trials that participants self-reported as correct were used in the analysis. Predictor time courses were adjusted by convolution with a hemodynamic response function. Group data were tested with a second level analysis using a random-effects analysis of variance using search epoch as a within-participants factor. A contrast was performed between brain activity at the moment of satisfaction and the moment of validation. To address the issue of multiple statistical comparisons across all voxels, activations are reported using False Discovery Rate (FDR) at a threshold of $q < 0.05$ (Benjamini & Hochberg, 1995). Using FDR, we control for the number of false positive voxels among the subset of voxels labelled as significant. The coordinates were converted into the Talairach space using the MNI to Talairach mapping (Lacadie, Fulbright, Arora, Constable, & Papademetris, 2008), and these Talairach coordinates were used to identify brain regions and Brodmann areas using Talairach Client version 2.4.3.

RESULTS AND DISCUSSION

Our analysis contrasted, for each trial, brain activity during the realisation of satisfaction to the validation of their response. We hypothesised this contrast would reveal brain regions involved in cognition, decision making and affect. It is notable that this contrast also controls for motor activity associated with the button press, as in both Satisfaction and Validation phases the participant is making a button press. Thus, we expect this contrast to primarily reveal high-level cognitive processes associated with the moment of satisfaction.

The results, based on seventeen participants, showed that 4 of 5 clusters had higher activation during the moment of satisfaction (shown in Figure 3 and Table 1). This included the right insula and superior frontal gyrus as well as the left anterior cingulate and posterior cingulate cortex. These regions were more active when participants indicated satisfaction than when they validated their response (Satisfaction > Validation). The frontal and cingulate regions found have been associated with the processing of higher cognitive functions such as memory retrieval process and decision-making (Bein, Reggev, & Maril, 2014). The right insula activity was found in the anterior region of the

insula, and the right insula has been shown to play a role in affective processing (Uddin, Nomi, H'ebert-Seropian, Ghaziri, & Boucher, 2017). It has also been implicated in the salience network, which is involved in the identification of stimulus properties of behavioural relevance (Uddin, 2015). As such, the results of the contrast of Satisfaction versus Validation reveal a multilayered response suggesting processing in both cognitive and affective domains.

There was only one cluster located in the ventral region of the right posterior cingulate, which had higher activation when participants validated their answer (Validation > Satisfaction). This general region can be associated with the default mode network, which is involved in various cognitive functions (Buckner, Andrews-Hanna, & Schacter, 2008), including confidence judgment, integrating memory, and information processing (Chua, Schacter, Rand-Giovannetti, & Sperling, 2006). The right ventral posterior cingulate has also been associated with scene processing (Chrastil, Tobyne, Nauer, Chang, & Stern, 2018). Greater activity for scene processing is consistent with behavioural activity during the Validation judgment because, at this time, the participant sees the scene depicted by all nine tiles together shown as a coherent image of a scene as opposed to separate fragments.

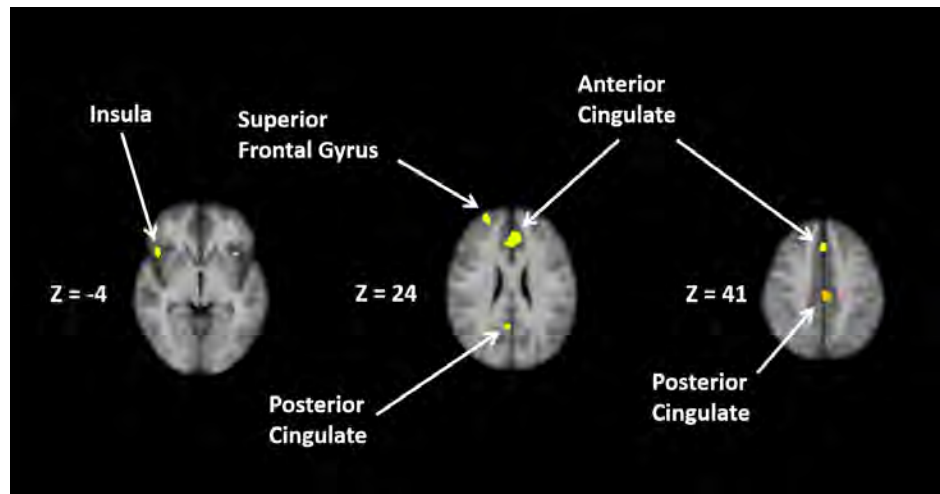


Figure 3. The five activation clusters from the contrast of brain activity at the moment of satisfaction to the moment when a Validation judgment was given. Results are projected onto the average anatomical structure for three transverse sections. Note that the brains are in a radiological format where the left side of the brain is on the right side of the image.

Condition	Brain Area	Hemi- sphere	MNI Coordinates				Effect size		Number of Voxels mm ³
			X	Y	Z	BA	F(1,21)	p-value	
Sat > Val	Insula	Right	45.0	20.0	-5.0	13	40.59	0.000009	311
	Superior Frontal Gyrus	Right	27.0	56.0	25.0	10	40.37	0.000010	732
	Anterior Cingulate	Left	0.0	35.0	19.0	32	56.01	0.000001	3964
	Posterior Cingulate	Left	-6.0	-25.0	40.0	31	50.30	0.000003	530
Sat < Val	Posterior Cingulate	Right	6.0	-55.0	16.0	23	115.78	<0.000001	1531

Table 1. For the contrast of Satisfaction (Sat) vs Validation (Val), including their anatomic label, Hemisphere (Hem), location (MNI coordinates), Brodmann Area (BA), effect size as indicated by F statistic and p-value, and volume for the different brain regions, as provided by the Number of voxels.

CONCLUSION AND FUTURE WORK

Using the brain imaging technique of fMRI, this study investigated brain activity of the realisation of satisfaction of an IN in a successful search process. We designed an experimental task that involved participants being presented

with an image caption and then being sequentially presented with segments of this image until they were satisfied that the caption matched the presented segments. A total of 26 participants were scanned, and after six participants were removed for excessive head movement and three participants removed based on behavioural performance, data from a total of seventeen participants were analysed. Results of the contrast of Satisfaction to Validation addressed our RQ to reveal five brain regions. Four regions showed greater activation during Satisfaction, and one region showed greater activation during the Validation phase.

The four regions associated with Satisfaction are consistent with the involvement of both cognitive and affective processes at the moment of satisfaction. One of these regions, the superior frontal gyrus, has previously been reported in studies of relevance (Moshfeghi et al., 2013) and IN (Moshfeghi et al., 2016), suggesting a general-purpose role in cognitive processing during search processes. However, this activity in the superior frontal gyrus appears to be found in the right hemisphere for image-based tasks and the left hemisphere for text-based tasks. While such a difference is consistent with what is known about the hemispheric specialisation of language and visual processing, more research is needed to understand the significance of this distinction for search. Evidence for affective processing during search processes, as suggested by brain activity in the insula, has been previously discussed (Moshfeghi & Pollick, 2018), where greater activity was found in the right insula for the realisation of IN as compared to query formulation. This finding of both cognitive and emotional brain regions associated with satisfaction is consistent with suggestions that it is appropriate to think of emotions as within the domain of cognitive control (Inzlicht et al., 2015; LeDoux & Brown, 2017; Pessoa, 2013). Within the context of this framework, we can propose that the inherent complexity of understanding satisfaction arises from the actions of inter-related neural systems for emotion and cognitive control.

There are many avenues for future research. Examination of the brain regions related to satisfaction holds promise to disentangle the cognitive and affective aspects of search. In particular, returning to the psychological perspectives of accumulation, one could potentially examine the time-course of brain activities building up to the moment of satisfaction. Finally, the systematic application of tools employing reverse inference (Yarkoni, Poldrack, Nichols, Van Essen, & Wager, 2011) might provide greater insight into how the current results fit into the broader domain of cognitive neuroimaging research and how brain activity relates to psychological functions. Finally, our findings are an important step towards unravelling the nature of satisfaction of an IN and, in turn, designing search systems that can better satisfy a searcher's IN.

There are limitations of the current research. For example, although the experimental task of extracting information from tiles of visual images is similar to a standard search at the conceptual level of accumulating information until satisfaction, there are practical differences between this and a standard search task. For example, in a standard search task we might expect to issue queries and receive documents that guide the formulation of additional queries. Although our results do not further inform an understanding of these aspects of standard search, given our focus on the cognitive processes involved at the moment of satisfaction we believe that the current results provide an important starting point to guide future studies that provide more realistic scenarios in which to understand the neural mechanisms of search satisfaction.

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Genuine Information Needs of Social Scientists Looking for Data

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ABSTRACT

Publishing research data is widely expected to increase its reuse and to inspire new research. In the social sciences, data from surveys, interviews, polls, and statistics are primary resources for research. There is a long tradition to collect and offer research data in data archives and online repositories. Researchers use these systems to identify data relevant to their research. However, especially in data search, users' complex information needs seem to collide with the capabilities of data search systems. The search capabilities, in turn, depend to a high degree upon the metadata schemes used to describe the data. In this research, we conducted an online survey with 72 social science researchers who expressed their individual information needs for research data like they would do when asking a colleague for help. We analyzed these information needs and attributed their different components to the categories: topic, metadata, and intention. We compared these categories and their content to existing metadata models of research data and the search and filter opportunities offered in existing data search systems. We found a mismatch between what users have as a requirement for their data and what is offered on metadata level and search system possibilities.

KEYWORDS

Information needs; social science; research data; user study.

INTRODUCTION

Publishing research data is becoming good practice or even mandatory in academic research (European Commission, 2017). The GO FAIR Initiative (2021) coordinates efforts to support data reuse by increasing the findability, accessibility, interoperability, and reusability of digital assets in science. More and more data search portals and dedicated dataset search engines aiming to provide access to datasets were established in recent years, e.g., Google Dataset Search (Brickley et al., 2019), Figshare (Thelwall & Kousha, 2016), dataverse (Altman et al., 2015), or Zenodo (Zenodo, 2021). However, with the rapidly increasing number of datasets in such systems, finding a relevant dataset is getting more complex (Kacprzak et al., 2018). Although research indicates that literature search and dataset search are different (Kern & Mathiak, 2015), such systems often look very similar to commonly known search systems for literature or digital libraries. In a comprehensive survey of dataset search, Chapman et al. (2020) identified a couple of open problems, including the desire to provide interfaces that go beyond simple keyword and faceted search. By comparing data requests and search query logs of the UK Government Open Data portal, Kacprzak et al. (2018) confirmed that keyword search does not cover data seekers' information needs. In our research, we go a step further and analyze the genuine and detailed information needs of researchers in a specialized domain. Instead of relying on log files containing independent data requests and search queries, we asked data seekers about their genuine information needs and let them provide the corresponding search query. With this setting, we can compare the request and the search query on an individual basis.

To narrow down the broad scope of dataset search in the context of academic research, we chose the social sciences as our application domain. Dataset reuse has a long tradition in this discipline (Hogeweg-de Haart, 1983), and the need to find the right data is one of the most observed information needs of social scientists (Kern & Hienert, 2018). Furthermore, there are already a couple of different domain-specific repositories (e.g., CESSDA data catalog, UK Data Service, GESIS data search) that address this target group. Understanding the information use and seeking behavior of social scientists also has a long tradition (Agrawal & Lal, 1987; de Tiratell, 2000; D. Ellis et al., 1993; David Ellis, 1989; Folster, 1989, 1995; Line, 1971; Meho & Tibbo, 2003) with recent research focusing on data search in this domain (Gregory et al., 2019; T. Krämer et al., 2021).

We contribute to this line of research by collecting and analyzing the genuine information needs of 72 social scientists formulated in natural language. We present a hierarchically structured schema of aspects and requirements for datasets mentioned by the participants and introduce the category “intention” besides the more common top categories “topic” and “metadata”. We analyze how well current search systems and vocabularies designed to describe research data cover our schema's categories. Our results confirm, for the social sciences, that search queries do not fully reflect the information needs and that current systems fail to sufficiently support scientists in their data-seeking process. The analysis of existing vocabulary revealed that only the most specific and comprehensive vocabulary, in our case “TheSoz”, matches most of the researchers’ information needs. The other analyzed vocabularies (DDI and CESSDA vocabulary) seem to be too generic. Our findings can help fill in missing attributes in existing vocabularies and thus help design search systems that support the genuine information needs of social science data seekers.

RELATED WORK

There is a long tradition to understand the information use and seeking behavior of social scientists. An early study by Line (1971) reports on social scientists’ information use and needs in the UK of the 1970s. Since then, studies have regularly confirmed four characteristics (Agrawal & Lal, 1987; de Tiratel, 2000; Folster, 1989, 1995): (i) journals are the most important source of information, (ii) tracking citations is the method to identify information, (iii) informal channels are an important source of information and (iv) library resources, such as catalogs, indexes, and librarians, are not heavily utilized. In this line, there is also a broader behavioral model of information seeking found by interviews of different groups of social scientists. David Ellis (1989), later D. Ellis et al. (1993), and Meho & Tibbo (2003) describe altogether eleven activities in social scientist’s information-seeking. Our study focuses on the first activity, “starting”, which refers to the initial search for information. Recent research highlights that searching for research data is complex, differs from searching for literature, and that current retrieval models do not sufficiently cover current data retrieval practices, not only in the field of social science. For example, Chapman et al. (2020) published a comprehensive state-of-the-art survey on dataset search. They mapped current research and commercial systems onto four abstract phases of the search process: querying, query processing, data handling, and result presentation. For querying, they found that it is impossible to state the task needs in a query. Current systems only offer keyword querying and filtering based on the data providers' metadata information to support users in their search process. Mostly, the content of the dataset itself is not considered in the data retrieval process. Similarly, Gregory et al. (2019) reviewed nearly 400 publications on data search. Their review focused on user needs, user actions, and dataset evaluation criteria in different disciplines: astronomy, earth and environmental sciences, biomedicine, field archaeology, and social science. In the context of user needs, they emphasize that users have very specific requirements, for example, regarding the geographical coverage of the data or the instruments that were applied to collect the data. In semi-structured in-depth interviews conducted by Koesten et al. (2017), participants stated the difficulty of finding the right data because of missing tool support and uncertainty if such data exist at all. Most participants used Google to find data online or asked other researchers for dataset suggestions.

A smaller number of log file analyses in the context of data search have analyzed real-life queries. Roughly two-thirds of all queries of a data archive for the Social Science are known-item queries (Kern & Mathiak, 2015), and the average query length in data.gov.uk is 2.44 words (Koesten et al., 2017). Additionally, Kacprzak et al. (2018) examined search query log files and data requests submitted to the UK Government Open Data portal to gather more insights into how people search for data. In both logged search queries and data requests, they identified four prominent themes: geospatial information, temporal information, restrictions (like format, price, data types, license), and information about granularity. Especially for geospatial information, they highlighted the huge mismatch between its appearance in search queries (5%) and data requests (78%). They concluded that dataset publishers should focus more on these aspects while preparing descriptions for datasets to increase findability and search success. Kacprzak et al. (2019) continued with their work on query formulation and compared their previous results to queries generated in a crowdworker experiment. The crowdworkers generated queries based on provided samples taken from a dataset containing data requests to the UK Government Open Data portal. The results showed that the crowdworker generated much longer search queries. These search queries contain seven times more mentions of temporal and geographical information than queries found in the log file. Even though the results were gained in a rather artificial setting and without including data professionals, they indicate that current search functionalities limit users in expressing their information needs.

Kacprzak et al. (2018) identified non-academics as the major user group of the UK Government Open Data Portal searching for data in many disciplines. We assume that the information needs of academics differ from non-academics. We therefore build on the work of Kacprzak et al. (2018) but focus explicitly on data search in the context of academic research. Additionally, we narrow our research scope and analyze the specific information needs within a single discipline: the social sciences.

EXPERIMENT

Research Questions

The following research questions formed the basis for our experimental setup and analyses:

(RQ1) What **constitutes the genuine information** needs of social scientists?

(RQ2) What are the **differences between the genuine information need and the queries** issued?

(RQ3) To what extent do **existing systems** cover the aspects of social scientists' genuine information needs?

(RQ4) Do **existing vocabularies** reflect these needs?

To answer these research questions, we collected social scientists' genuine information needs when searching for datasets. We structured the aspects and requirements for datasets mentioned by the participants in a hierarchical schema and compared the emerging categories with current data search systems' capabilities.

Data Collection

We set up an online survey on SoSci Survey (SoSciSurvey, 2021) to collect the information need descriptions of social scientists. After giving informed consent, participants first describe their research field and their current research topic. Subsequently, they are confronted with the following scenario (translated from German):

For answering your current research question, you need quantitative data. You have already searched for data but did not find a suitable dataset yet. You meet a colleague in the coffee corner. You know that your colleague has a great overview of your research topic. You tell her about your struggle to find relevant data. Your colleague offers help and asks you to describe exactly what data or variables you are looking for.

Participants are asked to describe the data in their own words and full sentences. We call those descriptions *dataset requests*. On the next survey page, participants are instructed to write down the search query they would issue to a generic search engine. Afterward, they fill in a short questionnaire about their experience with searching for quantitative data and their demographic background. The study received ethical clearance from our institution's ethics committee.

Participants

We recruited the participants via personalized email invitations. The email list was compiled according to mentions on the websites of social science institutes and social science faculties at German universities. A total of 852 social scientists were contacted initially, of which 72 participated in the study (30 female, 41 male, 1 inter/non-binary). The highest educational attainment was the habilitation (or equivalent) for 20 participants, a doctoral degree for 43 participants, and a Master's degree for 9 participants. Participants were, on average, 44.6 years old (STD = 12.7). Most participants were from sociology (39) and politology (19). Other disciplines mentioned were psychology (6), survey research (4), economics (2), criminology (2), political sociology (1), pedagogy (1), research on vocational training (1), and care research (1). Concerning their experience with quantitative research data, participants reported having worked with quantitative data for 17.6 years (STD = 10.8, min = 1, max = 60). Participants self-assessed their experience with quantitative research data on a scale from 1 (very inexperienced) to 7 (very experienced), with a mean score of 5.0 (STD = 1.3, min = 1, max = 7).

Data Annotation

To analyze participants' information needs, we developed a schematic overview of the dataset requests' content. We followed three steps: (1) Partitioning the dataset requests into segments, where each segment contains a single dataset characteristic or data attribute, (2) grouping the segments into semantic clusters, and (3) using the emerging schema to re-annotate the segmented data.

(1) The **segmentation** of the dataset requests was done by two independent annotators. Each annotator divided each request into logical segments. A segment contained a single piece of information, while unnecessary conjunctions between segments were neglected (e.g., "and"), for example:

I am looking for data on occupational and financial consequences of the corona crisis on older workers.

This request was segmented into four individual segments (delimited by commas):

Occupational consequences, financial consequences, corona crisis, older workers

Each segment stands on its own but should contain the original meaning. After both annotators segmented all dataset requests, they discussed discrepancies until they found a final segmentation. Before discussing, there was an agreement on 77% of the segments.

(2) With the individual segments, all authors participated in two collective **clustering** workshops. We grouped the segments according to their contents during the clustering, discussing cluster affiliation whenever in doubt. After all

segments were assigned to a cluster, each cluster was discussed in detail and divided into sub-clusters where applicable. Clusters were also grouped into main clusters. The final schema is hierarchical with three levels of detail (L1, L2, L3, from top to bottom). During the discussion, we also reviewed the labeling of clusters.

(3) The final schema that emerged from the clustering phase was then re-applied to the segments. A single annotator used the schema to **annotate** segments with L1-, L2-, and L3-categories. This additional step was taken to ensure that each segment is eventually assigned to suitable categories, regardless of its position in the clustering process: As clustering is an iterative process, a segment that was assigned earlier in the clustering process could eventually fit better to a cluster that emerged at a later stage. The extra annotation step ensures correct assignment.

RESULTS OF DATA ANALYSIS

All dataset requests, queries, and the complete category hierarchy that emerged from the clustering are available online (GIT Repository, 2021).

Segmentation

To develop a schema for the dataset requests' content, we divided the 72 data requests into 450 segments. Each segment is one coherent unit of meaning that describes a single characteristic of the data. On average, a request consists of 6.3 segments (STD = 3.7).

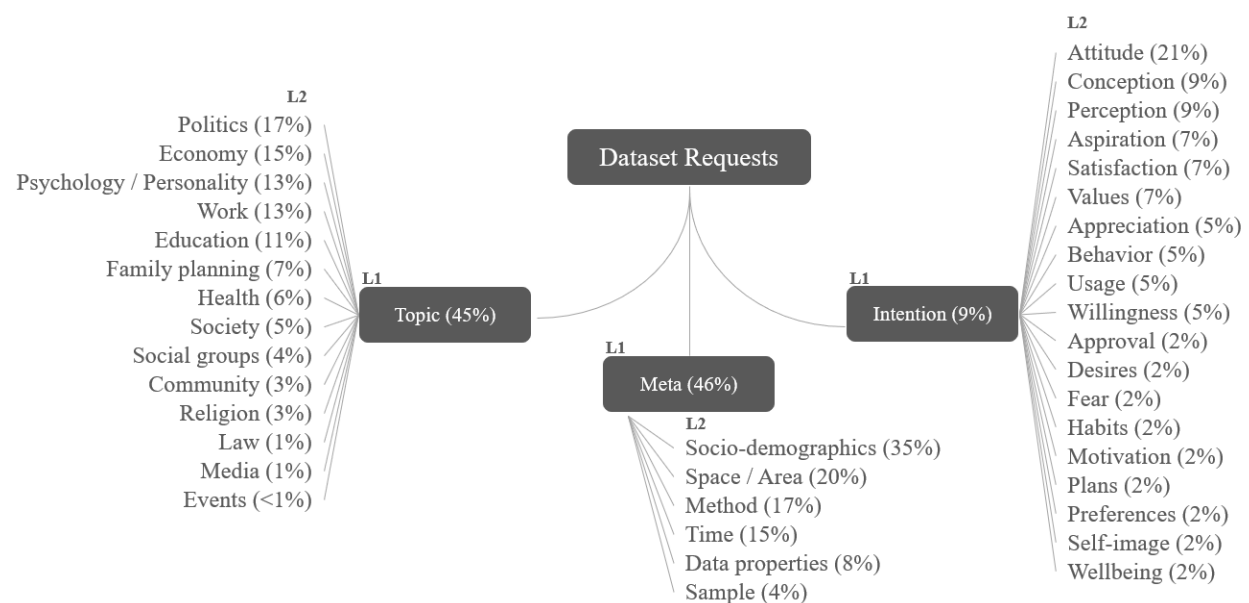


Figure 1. Hierarchical categories derived via segment clustering

Clustering

Subsequently, the segments were clustered. Figure 1 presents the hierarchical categories that emerged on the levels L1 and L2. For conciseness, level L3 is not included in Figure 1; the complete schema is available in our data repository (GIT Repository, 2021). The schema consists of the three L1-categories “Meta”, “Topic”, and “Intention”, with a combined total of 39 L2-categories. “Topic” encompasses the subject of the data, e.g., “health” or “religion”. “Meta” groups meta information about the data, i.e., the sample size, the geographical area in which the data was collected, or information on the collection method. The L1-category “Intention” could not be assigned to either “Meta” or “Topic” as it denotes fundamentally different information: It concerns information on what the researcher wants to find out - what the intentionality is (e.g., “aspiration”, “perception”, “use”). For example, the phrase “perceived hostility toward foreigners” contains the topic “hostility” and the intention “perception”. Due to the lower number of segments related to the L1-category “Intention”, we applied only one instead of two levels of further categorization.

Annotation of Categories

Out of 450 segments, 217 segments (46%) fall into the L1-category “Meta”. With a share of 35%, the most common L2-category of “Meta” is “Socio-demographics”. 215 segments (45%) are part of the L1-category “Topic”. Here, the L2-category “Politics” was assigned most frequently (17%). 44 segments account for the L1-category “Intention”. Out of 72 requests, 35 started with a “Meta” segment, whereas 34 started with a “Topic” segment. This shows that the syntax of requests is versatile and does not follow a clear pattern.

Table 1 presents the distribution of L1-categories per request. We found that most requests (56%) contain segments of two L1-categories (“Meta” and “Topic” categories). The second most common pattern (22%) is a combination of all three L1-categories. 12 requests (17%) contain segments from a single L1-category: Seven requests mention only “Meta” information, e.g., “Survey data of ESS”. Five requests consist solely of “Topic” segments, e.g., “Data on decisions on real losses”. The findings show that almost all requests contain a combination of categories, most prominently “Meta” and “Topic”.

L1-category combinations	Counts (absolute)	Counts (relative)
Only “Meta”	7	10%
Only “Topic”	5	7%
Only “Intention”	0	0%
“Meta”, “Topic”	40	56%
“Meta”, “Intention”	0	0%
“Topic”, “Intention”	4	6%
“Meta”, “Topic”, “Intention”	16	22%

Table 1. Categories occurrences in descriptions of dataset requests

REQUESTS VS. QUERIES

Besides the dataset request, participants reported the search query they would issue to a generic search engine when searching for the dataset online. We compare the queries with the dataset requests to understand the differences between naturally formulated dataset requests and queries. Queries are significantly shorter than dataset requests (Wilcoxon, $p < .001$). On average, queries consist of 4.1 segments (STD = 2.8), while dataset requests contain 6.6 segments (STD = 4.1).

Regarding the content (on level L1), the requests and queries do not differ much. On average, requests consist of 46% “Meta” segments, 45% “Topic” segments, and 9% “Intention” segments. Queries contain on average 41% “Meta” segments, 55% “Topic” segments, and 4% “Intention” segments. There is a minor tendency towards more “Topic” segments in queries as compared to requests. Analyzing requests and queries on the level of L2, however, reveals differences. Figure 2 depicts the distribution of L2-categories for “Topic” and “Meta”, both in queries and requests. The distribution of “Topic” L2-categories is similar in requests and queries, with the greatest deviation being an 8%-points difference in the L2-category “Community”. There is, however, a “Meta” L2-category that appears more frequently in the queries: “Data properties” (e.g., “survey”, “dataset”) accounts for 9% of the “Meta” segments in the requests, yet encompasses 38% of the “Meta” segments in the queries. Conversely, “Socio-demographics” (e.g., “elderly”, “youth”, “social professions”) is less frequently mentioned in the queries than in the requests (35% of segments in the requests but only 18% in the queries).

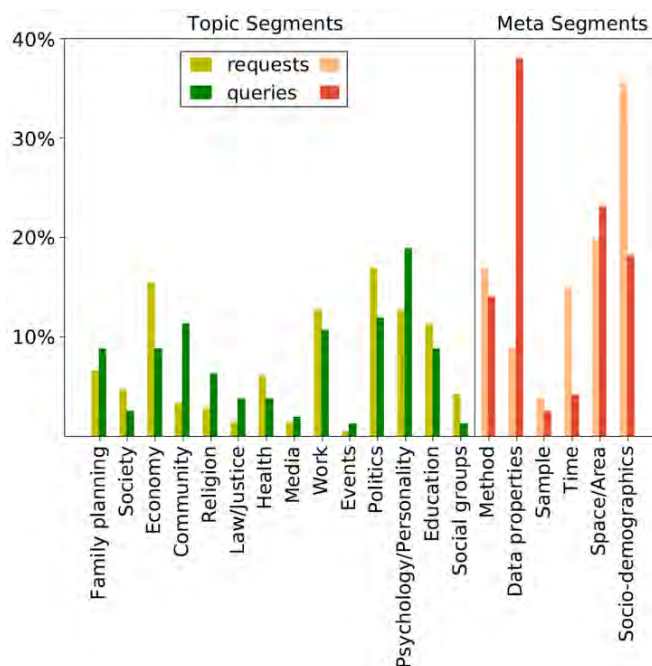


Figure 2. Distribution of L2 categories for ‘Topic’ and ‘Meta’ in dataset requests and queries.

On the level of individual segments, we found that only 54% of the query segments are also present in the dataset requests. Conversely, some information in the dataset requests does not appear in the queries. There is a multitude of reasons for these phenomena:

(1) The query is syntactically unrelated to the dataset request and appears to be an abstracted version of the dataset request, e.g.:

Request: “Data about the frequency of non-routine situations: During a shift at work (mean over all cases) Share of work processes with problematic non-routine situation at the total of work processes of the population”

Query: “competence or skill decay”

(2) Requirements mentioned in the dataset request are further elaborated in the query, e.g.:

Request: “(...) in selected African countries (...)”

Query: “(...) Africa, Britain Africa, French empire, North Africa, Uganda (...)”

(3) Information is added in the query, e.g., the collection method and geographic area:

Request: “I need data with repeated measures of cognitive abilities (...)”

Query: “cognitive abilities, panel data, Germany (...)”

(4) The query is less precise than the request by leaving out requirements, e.g., the “Intention” segment:

Request: “I am looking for representative surveys of the population that collects the personal attitudes towards democratic principles.”

Query: “survey, democratic principles”

(5) The request is greatly compressed as the participant performs a known item search, e.g.:

Request: “Longitudinal data about health behavior (smoking, drinking, sports, nutrition, sleep) of people younger than 50+”

Query: “SOEP” [abbreviation for the German Socio-Economic Panel study]

(6) The request is written in vague language, while the query contains precise wording.

Request: “I need data about *bibliographic* information of *African political actors* of the *present*”

Query: “member of parliament [country] list”

Phenomenon (6) is likely an artifact of natural language and appears to be a difference between dataset requests and queries. We therefore investigated vague language in more detail. Out of 72 dataset requests, 38 requests (53%) contained vague terms, while only one query contained vague expressions that would probably fail a strict string matching. Vague words were found throughout various L2-categories in “Meta”, e.g.: “different”, “various”, “as large as possible”, “of the present”, “young adults”, “as up-to-date as possible”. In 18 requests, participants included explanations of the vague terms. They used brackets for delivering further information, e.g., “questions of subjective wellbeing (life satisfaction + happiness)” or “great country coverage (30+)”, or added subordinate clauses, e.g., “information on the place of residency, for example, the location in cities, medium-sized town, or rural municipalities”. In three cases, participants later used terms of the explanations in their queries.

COMPARISON WITH EXISTING SYSTEMS

To analyze how well current systems support dataset requests collected in this study, we examined 30 dataset search systems. We distinguish between five groups of systems: generic data search engines (e.g., Mendeley Data Search), generic data repositories (e.g., zenodo), data search engines for the social sciences (e.g., CESSDA data catalog), data repositories for the social sciences (e.g., UK Data Service), and variable / question search engines for the social sciences (e.g., CESSDA European Question Bank). A detailed list broken down per search system is available online (*GIT Repository*, 2021). We observed how well different search activities (searching with queries and searching with filters) are supported. Table 2 shows how many systems support which type of search per search engine type.

For counting filters, we accounted facets at all levels of hierarchy. Filters did not have to mention our wording but were only counted if the purpose matched the categories depicted in Figure 1. That is, if a facet offered filtering of pre-defined topics it was counted as a “Topic” filter, even if the options did not match our category scheme. For “Meta” filters, a facet was counted if it allowed for filtering any of the categories on L2 or L3.

	generic data search engines	generic data repositories	discipline-specific data search engines	discipline-specific data repositories	discipline-specific variables / questions search engines	all
number of investigated systems	7	6	4	5	8	30
full text search covers “Topic”	100%	100%	100%	100%	100%	100%
full text search covers “Meta”	14%	0%	0%	0%	0%	3%
number of filters on average	6.4	4.5	6.5	7.0	6.3	6.1
number of “Topic” filters on average	0.1	0.5	1.0	0.6	0.5	0.5
number of “Meta” filters on average	3.1	1.3	3.0	4.4	1.9	2.6
number of “Intention” filters on average	0	0	0	0	0.1	0.03
number of other filters on average	3.1	2.5	2.5	2.0	3.8	2.9
share of relevant filters	51%	41%	62%	71%	42%	52%

Table 2. Comparison of search functionalities by search engine type

While all systems support searching the database for the topic via querying, not all offer explicit facets to filter for topics. In total, the 30 systems offer 183 facets. Out of those 183 facets, only 95 facets (52%) match the type of information that we identified in our study and are therefore considered relevant to the users. The other 88 facets (48%) concern information that participants did not mention in our study, for example, the publication year, discipline, contributors, or date of the last update. Some existing facets address the meta information that researchers are looking for, but in a different format: When mentioning temporal aspects of a dataset, our participants used formulations such as “time series”, “from the present”, and “repeated monthly”. Existing facets, however, cover only the publication year or year of collection. Only one of the systems currently supports filtering data by the “Intention”. The UK Data Service “Discover” offers to filter questions in their database according to two “Intention” categories: “Attitudes” and “Behavior”.

Only one system (Google dataset search) was able to identify metadata from the search query (the geographical area in the query “democracy in Europe”) and utilized the respective field in the data to filter the result list. Although other search systems were able to search for the words “democracy” and “Europe” in their database, the matching was purely lexical and did, for example, not make a difference between data “from Europe” or “about Europe”. Three search systems allow searching in specific data fields but do not automatically match the query text to the correct fields.

MAPPING EMERGED CLUSTERS TO ESTABLISHED VOCABULARIES FOR THE SOCIAL SCIENCES

After developing the hierarchical categorization, we reviewed existing standardized vocabularies for the social sciences and examined how well they relate to the emerged categories. Metadata standards determine the range of search and filter functions made available in data repositories. We selected three standards: Thesaurus Social Science (Zapilko et al., 2013), the CESSDA Topic Classification (CESSDA Topic Classification, 2020), and the DDI vocabulary family (DDI Controlled Vocabularies, 2021; Jaaskelainen et al., 2010). These standards have been explicitly developed to provide a means to describe topics and data used in the social sciences. Although the Dublin Core Metadata Standard is widely used in generic data repositories, we did not include it in our analysis as it is a general standard for the description of digital objects and cannot be considered a standard vocabulary specific to the social sciences.

The Thesaurus for the Social Sciences “TheSoz” (Zapilko et al., 2013) is a linked dataset in Simple Knowledge Organisation Format (SKOS, W3C Consortium, 2009). It covers topics and sub-disciplines of the social sciences as well as disciplines related to the social sciences, such as economics. It consists of approximately 12,000 keywords, divided into 8,000 preferable and 4,000 non-preferable terms. The TheSoz has been used to index literature in the German-speaking social sciences and served as an important building block for discipline-specific information retrieval systems. The second vocabulary is the CESSDA Topic Classification (CESSDA Topic Classification, 2020), an actively developed, versioned classification of data themes or data subjects. Version 4.1 consists of 95 terms and is available in 11 languages. A more recent development is the Data Definition Initiative (DDI)

Vocabularies developed by the DDI Alliance (DDI Controlled Vocabularies, 2021; Jaaskelainen et al., 2010) The DDI Vocabularies are a set of 24 controlled vocabularies, each focusing on a specific aspect of data, such as the TimeMethod vocabulary, that describes the data collection's time dimension. A vocabulary contains several terms, which might be organized hierarchically (e.g., vocabulary TypeOfInstrument term Questionnaire.Unstructured).

With the following comparison, we want to assess the overlap of the vocabularies developed by expert communities with the participants' data-seeking needs. The detailed findings are available online (*GIT Repository*, 2021).

For all 14 L3-categories in “Topic”, we could find corresponding concepts in TheSoz. Similarly, we found terms in the CESSDA Topic Classification for all but the least mentioned L3 category “events”. However, no single term in any of the DDI Vocabularies matched any of the L3 categories.

Similarly, we compared the L3-categories from the L1-category “Meta” with terms in the three vocabularies. Table 3 gives an overview of the coverage of L3-categories for “Meta” in all vocabularies. The TheSoz has corresponding concepts for all but five of the 33 L3-categories in “Meta”. An example of the five unmatchable categories is “sample size” from the L2-category “Sample”. The CESSDA Topic Classification covers 9 out of 10 sub-categories of the L2-category “socio-demographics”, but the remaining L2-categories are covered only sparsely. Five DDI vocabularies out of the family of 24 DDI vocabularies provided terms we considered a match with our L3-categories in “Meta”. For 19 out of 33 L3-categories, we found corresponding DDI terms. In “Socio-demographics” (L2), only one L3-category out of 10 could be matched to a DDI term. For some L3-categories, the DDI terms are too broad. The L3-category “gender”, for example, does not have a direct equivalent in DDI. The terms “SamplingProcedure.NonprobabilityQuota” and “DataSourceType.PopulationGroup”, however, denote the sampling procedure – of which gender could be an attribute. For other L3-categories, DDI provides related terms but no exact matches.

L1	L2	Number of L3 categories	Number of Corresponding TheSoz concepts	Number of Corresponding CESSDA Topic Classification terms	Number of Corresponding DDI vocabulary terms
Meta	Socio-demographic	10 e.g., <i>nationality</i>	10	9	1
Meta	Space / Area	7 e.g., <i>city</i>	6	2	6
Meta	Method	7 e.g., <i>research design</i>	5	1	5
Meta	Time	3 e.g., <i>time series</i>	2	0	2
Meta	Sample	2 e.g., <i>sample size</i>	1	0	2
Meta	Data properties	4 e.g., <i>data source</i>	4	0	1

Table 3. Coverage of L3 categories in metadata vocabularies

As “Intention” contains only L2-categories but no further L3-categories, we searched for corresponding concepts and terms for the 19 L2-categories in the TheSoz, CESSDA Topic Classification, and DDI vocabularies. 16 L2-categories have an explicit counterpart in TheSoz. For some L2-categories, we found one or more concepts with a compound name containing the category, e.g., “Appraisal” does not exist in TheSoz, but “staff appraisal” does. It seems that concepts of the TheSoz are rather specific, while generic concepts are missing. Conversely, in the CESSDA Topic Classification, we found 10 of 19 “Intention” L2 categories. Similar to the “Topic” L3-categories, we could not identify equivalents for any of the 19 “Intention” L2-categories in any DDI Vocabulary. DDI Vocabularies rather cover technical and methodological aspects of datasets than the subject and intention of social science texts.

DISCUSSION

In this study, we collected genuine information need requests (description of the information need outside the search context) and the respective queries (description of the information need formulated as input for the search system) for datasets from 72 social scientists.

The analysis shows that the dataset requests are very broad, both in their formulation and their contents. The requests cover a wide range of topics and types of meta information, consisting of almost an equal split of topic

information (45%) and meta information (46%). **The detailed aspects of dataset requests are presented in Figure 1 (RQ1).** There is no recurring syntax in how the information is structured: half of the requests start with topic information, while the other half starts with meta information. Topic information and meta information appear equally frequent. However, the analysis of existing search systems shows that specifying meta information in dataset search is currently not supported. Current systems offer only 2.6 “Meta” filters on average. Specifying meta information directly in the query text was supported in only one out of the 30 investigated search systems. **We conclude that current search systems do not offer suitable support for a substantial part of social scientists' dataset requests (RQ3).** Including meta information in search systems, e.g., via facets or filters, would benefit a large part of requests and queries. Moreover, even though “Intention” appears in only 9% of the cases, it is still a substantial share that should be accounted for when designing dataset search systems. These findings confirm the conclusion of (Chapman et al., 2020). They found that current system designs are driven by the availability of dataset meta information rather than searchers' information needs.

Comparing queries and requests reveals a mismatch in contents and form. Queries are significantly shorter than requests and contain different types of information. Similar to Kacprzak et al. (2018), we found that some categories or meta information appear more often in requests than in queries. Socio-demographic requirements, for example, are mentioned more frequently in requests than in queries, while data properties appear more often in queries than in requests. With 35% of the segments, “Socio-demographics” was identified as the most important “Meta” category in the requests. However, participants did not include their requirements regarding socio-demographics in their queries. We assume that they did not do this because they know that there is no standardized description for very specific requirements such as “youth” or “social professions” in the dataset documentation. We suggest that future development of terminology and data documentation standards should include a flexible description of socio-demographic information for filtering purposes. We also found a change in formulation and usage of vague terms: Dataset requests contained a variety of vague words in all categories, whereas queries contained almost solely precise language. Participants used explanations in their requests to clarify what their information need is. The general change in contents and vagueness usage shows that **users currently adapt their information need descriptions to what they believe the system can process (RQ2).** The queries are therefore not an accurate description of the genuine information needs. The same phenomenon has been observed by Barsky & Bar-Ilan (2005) and Kammerer & Bohnacker (2012) in general web search. Another reason for the discrepancies between dataset requests and queries is pre-existing knowledge of users about where to find the needed data, leading to known item searches.

We conclude that current search systems for social science datasets must be adapted to social scientists' information needs to improve the search support. However, before more satisfying search user interfaces can be developed, the metadata standards need to support the information needs as well. Existing vocabulary standards need to be extended with the help of the community, tools must exist for documentation, and published metadata records need to be available in search indices. For example, Krämer et al. (2018) assessed the availability and quality of 58 social science data providers' metadata. The adoption of the DDI metadata standard was low compared to the more generic Dublin Core standard, and metadata fields were often left unused. In our analysis of vocabularies (DDI, TheSoz, and CESSDA) to match our hierarchical schema of information need aspects, we found that only 16 out of 33 “Meta” L3-categories could be matched to a DDI vocabulary term, while the TheSoz offers related concepts for 28, and the CESSDA Topic Classification 12 out of 33 categories. All 14 L2-categories of the “Topic” L1-category have corresponding terms in the TheSoz, and 13 in the CESSDA topic classification. However, no matches could be determined in any DDI vocabulary. A similar conclusion can be drawn for the L1-category “Intention”. The “Intention” is, so far, also not supported by existing systems. Although it accounts for a smaller part of the information need aspects (9%), it is an important aspect of social science data. A similar concept has been described by Friedrich & Siegers (2016), who describe the “aboutness” of survey questions. In summary, this shows that concepts exist in specialized thesauri (e.g., the TheSoz) but are not entirely present in metadata standards (e.g., DDI). To allow for improvements on the search interface, **metadata standards used to describe datasets need to be improved to better address actual information needs (RQ4).**

CONCLUSION

To analyze social scientists' genuine information needs in data search, we collected dataset requests and queries of 72 social scientists in an online study. By identifying and clustering individual aspects in genuine information need descriptions, we developed an understanding of how social scientists can be supported in their data search process. We compared existing vocabularies and search systems to the identified information need aspects. In conclusion, our findings show that social scientists' information needs are broad and contain not only requirements for the topic and meta information of data but also information on the searchers' intention. Existing search systems do not provide suitable filters and facets to cover current information needs. To improve the search systems, vocabularies and metadata schemes need to be extended with the requested aspects of information needs of social scientists.

ACKNOWLEDGMENTS

This work was partly funded by the DFG, grant no. 388815326; the VACOS project at GESIS and the University of Duisburg-Essen.

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Toward Best Practices for Unstructured Descriptions of Research Data

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ABSTRACT

Achieving the potential of widespread sharing of open research data requires that sharing data is straightforward, supported, and well-understood; and that data is discoverable by researchers. Our literature review and environment scan suggest that while substantial effort is dedicated to structured descriptions of research data, unstructured fields are commonly available (title, description) yet poorly understood. There is no clear description of what information should be included, in what level of detail, and in what order. These human-readable fields, routinely used in indexing and search features and reliably federated, are essential to the research data user experience. We propose a set of high-level best practices for unstructured description of datasets, to serve as the essential starting point for more granular, discipline-specific guidance. We based these practices on extensive review of literature on research article abstracts; archival practice; experience in supporting research data management; and grey literature on data documentation. They were iteratively refined based on comments received in a webinar series with researchers, data curators, data repository managers, and librarians in Canada. We demonstrate the need for information research to more closely examine these unstructured fields and provide a foundation for a more detailed conversation.

KEYWORDS

Research data management; metadata; data documentation; data summarization; human data interaction.

INTRODUCTION

To encourage data reuse and maximize benefits of conducted research, funding organizations around the world are implementing policies that require research data to be made publicly available following completion of a project (cOAlition S, n.d.; European Commission, n.d.; National Science Foundation, 2020).

There are three ways in which data are normally published and encouraged for reuse: data can be included within a scholarly publication (perhaps as an appendix), they can be published in a data repository as a discrete object, or they can be published in a data journal as a research output describing a dataset in complete detail (Schöpfel et al., 2020). Recognizing that one of the primary purposes of publishing research data is to facilitate reuse (Wilkinson et al., 2016), and that not every dataset can receive the time and attention necessary for data journal publication, the area of greatest growth is data repositories. Common data repositories for non-specialized environmental research include Data Dryad, Pangaea, Figshare, and Zenodo, as well as national, institutional, and discipline-specific repositories.

Research data is generally documented using controlled vocabularies and well-defined metadata fields, supporting precise search and discovery tasks (Shen, 2017; Chapman et al., 2020) and a machine-readable semantic web. They are outlined by standards (e.g., the Digital Documentation Initiative (DDI) Codebook) and are essential to sharing data across multiple repositories (Corti et al., 2014; FRDR, n.d.; Google, 2020). Yet most repositories retain natural-language fields for data description, including the title and one or more blocks open-ended, unstructured text describing the data, often called the abstract, description, or summary. (We refer to this field as a dataset summary, without loss of generality.) The casual searcher is unlikely to choose search terms from a controlled vocabulary, and essential elements of the data collection are not captured in existing controlled vocabularies, so the title and dataset summary make routine search and discovery tasks possible (Chapman et al., 2020).

While the abstract section of a research article is well-understood and extensively studied, well-documented (from informal guides to ISO 214:1976), and a routine part of graduate student training, the dataset summary remains largely undocumented. Anecdotally, research data management (RDM) librarians suggest they build their expertise over years, and use that expertise to support individual researchers, similar to an archivist's expert approach to resource description. The guidance provided to scholars to assist in describing their own data in a way that supports search and discovery is limited, and review of how this field is used reveals an unsurprising lack of consistency and limited utility (see Literature Review and Environment Scan). As data repositories rise to the challenge of providing relevant search results from expanding collections, dataset summaries of consistent quality will be essential. Writing high-quality dataset summaries should be well-understood, well-documented, and routinely taught.

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This paper first establishes the necessity of improving our approach to dataset summaries as a discipline, reviewing relevant literature and conducting an environment scan of how dataset summaries appear across some of the most popular data repositories. In the Literature Review and Environment Scan section, we examine how dataset summaries are solicited at the time of data submission, describe how dataset summaries appear when searching, and report the state of dataset summaries in key repositories. Our literature review makes it clear that this is an understudied area in the field of information management, and our environment scan describes the consequences of this neglect.

Second, we take initial steps toward these best practices. We examined existing best practices for writing summaries (paper abstracts, archival description, and much more) and synthesized candidate guidance for research dataset summaries. We drew on our combined expertise and years of providing support to researchers in managing research data to refine the guidance. We then conducted a series of webinars with expert audiences to disseminate our prototype guidance, which we iteratively improved and further refined in response to feedback from the data librarians, managers of data repositories, discipline-specific repositories, and researchers in attendance. We describe this in the Methods, Results, and Discussion sections.

LITERATURE REVIEW AND ENVIRONMENT SCAN

Abstracts for research articles underwent a shift, from professional abstractors to those provided by the author of the resource (Borko & Bernier, 1975; National Information Standards Organization, 2015; Tenopir & Jasco, 1993). Reviewing abstracts has always provided researchers with a briefing of current research, helped them determine whether it is worth resources to obtain and review a full article, and simplified complex topics (Tibbo, 1993). In the context of today's federated search tools, they provide an indexable field, aligned with natural-language queries, and a quick way for searchers to see their keywords used in context and adjust their query (Chapman et al., 2020). Most result pages for research article searches show the title of the paper and a portion of the abstract (or full paper), with the keywords shown in context.

Whereas decades of knowledge from professional abstraction have been transferred to article authors, data summaries have not had the same knowledge transfer. Research data librarians, some researchers, and some research staff have built expertise in writing data summaries, but there has been little effort to capture this expertise and transfer to others. Key questions remain open for discussion, suggesting no agreement on best practices. From the beginning of repositories, most data summaries have been written by their creator, rather than a summary specialist or abstractor, though perhaps with the support of an RDM librarian. Yet in our review of the literature and our environment scan of common data repositories, we found that very few cues are available to creators, with predictable results.

Data Description in the Literature

The study of summarizing spans research in education, psychology, linguistics, and others (e.g. Hidi and Anderson, 1986). Writing summaries for an audience (what is potentially valuable for others) is different from writing a summary for oneself (what is important to self), and that the former is substantially more difficult (Hidi and Anderson, 1986). While there are elements in common with other forms of summarization, the translation from structured data to a meaningful description is clearly different from the process of summarizing text (Koesten, 2018), for example including elements of information not actually present in the object being described; imagining the potential uses of data instead of reinforcing the key message and contribution; and more.

Koesten et al. (2020) suggested best practices for open data summarization from the standpoint of understanding and improving dataset search. They share our view that this area is understudied; the bulk of previous literature on data description is from authors associated with this group. In their 2020 study, they asked data-literate users on a crowd-sourcing site to describe sample data based on screenshots. Using constraints established in a pilot test, participants were shown sample summaries, limited to 50-100 words, and were given 3-12 minutes to write each summary. They coded those summaries to understand the high-level information and the attributes summarizers focused on. They found participants described the data structure, the scope of data through a focus on the variables present, the quality of the data (e.g. missing values), and some ideas for analysis or use of the data.

Based on their findings and a previous study (Kacprzak et al., 2019), they propose a 9-question dataset summary template for use during data ingestion. Our approach and the Koesten et al. (2020) approach are different lenses on the same problem, and we suggest that both approaches are required. Understanding how users find data is essential to writing good data summaries. Understanding the natural tendencies of humans when asked to summarize datasets offers insight into how we should guide and shape this behavior when setting expectations. Yet time-limited, word-limited summaries from lay users are an incomplete source of information to inform data summary best practices. Our approach, to be guided first by authority and experience captured in written evidence, and then refined by a broad suite of stakeholders, runs the risk of under-valuing user experience, even as we focus on data descriptions

written by data owners. In the Discussion section, we reflect on how our recommendations align with theirs, and in particular how their work answers an essential question that we raise.

Data Description Instructions

There is little instruction available to data creators on the contents of a data description. The most basic question, “what should it include”, remains unanswered. Should the study that produced the dataset be described? The contents of the dataset, like key variables? The steps in processing the data? The file formats and standards used? All of the above? In what level of detail? We reviewed the interface and documentation available to data submitters / searchers at 5 major repositories (and Google Dataset Search). Table 1 shows the sparse information available.

The data submission interface is where many data submitters will start and finish in their search for instructions, but we must also consider data and metadata standards. Many are intended for expert users, and are not detailed. The Dublin Core Description element referenced is documented sparsely: “an account of the resource”. A comment elaborates that “description may include but is not limited to: an abstract, a table of contents, a graphical representation, or a free-text account of the resource”. The most detailed formal documentation we were able to locate was in the DDI Codebook, which we reproduce here in its entirety:

An unformatted summary describing the purpose, nature, and scope of the data collection, special characteristics of its contents, major subject areas covered, and what questions the PIs [principal investigators] attempted to answer when they conducted the study. A listing of major variables in the study is important here. In cases where a codebook contains more than one abstract (for example, one might be supplied by the data producer and another prepared by the data archive where the data are deposited), the "source" and "date" attributes may be used to distinguish the abstract versions. Maps to Dublin Core Description element. Inclusion of this element in the codebook is recommended. The "date" attribute should follow ISO convention of YYYY-MM-DD. (Data Documentation Initiative, n.d.)

This advice, intended for expert users and not readily available to data depositors, is still limited in detail. There is no guidance for language, length, or intended audience, and the terms used (“major”, “special characteristics”) are ambiguous. 13% of it (by word count) references other standards. This is sufficient documentation to start the task, but not sufficient to finish.

Almost two-fifths of the DDI entry refers to possibility of multiple summaries for a single data deposit, which is also considered a best practice in other contexts (Bascik et al., 2020) but is uncommon in actual practice. Having multiple summaries could speak to different levels of technical understanding, provide overviews for people who speak other languages, or give updated descriptions for datasets which change over time. Other guides have suggested using separate fields for the abstract and the methodology (DataCite Metadata Working Group, 2016), which Pangaea has adopted (among very few others).

Platform	Default summary-writing instructions
Dataverse (Scholars Portal, Canada)	Description: A summary describing the purpose, nature, and scope of the dataset.
Data Dryad	Abstract: Short description of dataset.
Figshare	Description: Describe your data as well as you can. Formatting is preserved when pasting from other sources and counts towards character limits.
Pangaea	Description: ABSTRACT and/or further details describing the data.
Zenodo	Description
Google Datasets	Description: A short summary describing a dataset.

Table 1. The instructions provided on what to enter in the data description field provided by various data repositories and indices as of August 2020

Data Description Exemplars

One way research article authors learn to write abstracts is by imitation: research training and research work necessarily includes exposure to hundreds or thousands of articles, with their abstracts. A search for journal articles shows portions of abstracts. Aspiring authors will find samples of great abstracts in every imaginable field a mere Google search away. In contrast, the lack of agreement on best practices for dataset summaries limits the number of positive examples. RDM experts tell us they know a good description when they see one, but this knowledge is not transferred to data creators and owners other than through iterative feedback.

We observed common data repositories for the presence or absence of key best practices for showing resource summaries in search results, and discovered that most have not adopted the practice of showing abstracts in their search results, and instead rely on the dataset title, as shown in Figure 1 and Table 2.

Note that both Dataverse and CKAN are open-source platforms that are highly customizable, and results may vary depending on the implementation chosen. (Open Data Canada is exclusive to government data, and the data submission page is not available to us.) These two platforms made the best use of dataset summaries.

Data Description in Practice

A systematic and comprehensive examination of dataset summaries is not possible without widely-accepted standards on how to write a good dataset summary. (In contrast, examination of the quality of journal article abstracts is a routine and ongoing practice, e.g. Wang et al., 2017; Nagendrababu et al., 2019). We examined dataset summaries across multiple repositories to build our own assessment of the state-of-the-art, and found that quality is (predictably) highly varied. We describe here some quantitative indicators of the state of dataset summaries.

Figshare is widely used for disseminating research artifacts, including datasets. Their dataset summary minimum length is 4 characters, and there exist datasets with summaries of this approximate length. We found dataset summaries that consist entirely of a list of the file formats available. Summaries that are shorter than the title are surprisingly common. At the other end of the spectrum, we found datasets carefully and meticulously described.

Deposited data are often supplement to journal articles, sometimes through automated processes that connect journal hosting systems with data repositories. In some research data repositories, it is normal to copy article abstracts verbatim to their supplementing dataset. This is true of over 36% of examined dataset summaries in Figshare (n=278 in a sample taken for this environment scan) and 95% of data summaries in Data Dryad (n=338). In many situations, common procedure leads to best practice – but the purpose of an article abstract is to describe an article and will include results based on the analysis of the data, which will not be apparent from the data alone. Even based on the brief documentation in DDI, this approach is not appropriate for a dataset summary, yet it is common.

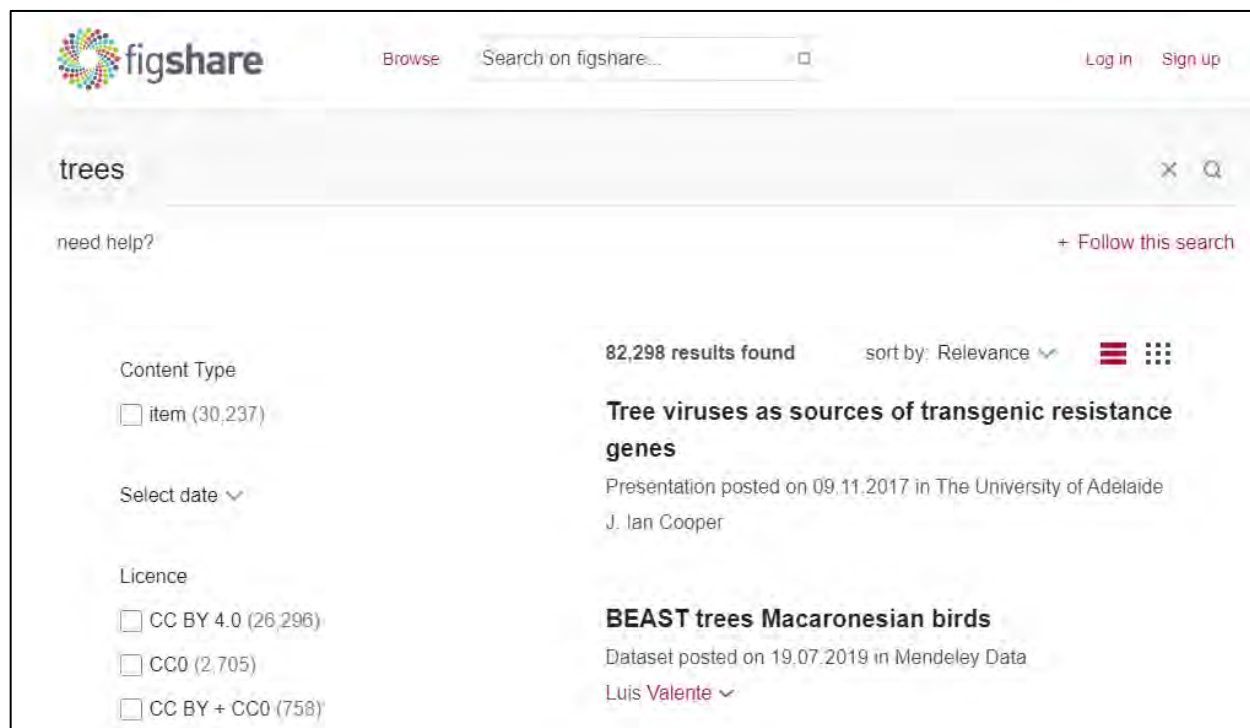


Figure 1. The search results page for figshare after a search for “trees”, limited to datasets. The display prioritizes title, date, and author, rather than showing a dataset summary with keywords in context

Platform	Observation
Data Dryad	No dataset summary shown on search results page.
Figshare	No dataset summary shown on search results page.
Pangaea	No dataset summary shown on search results page.
Zenodo	Dataset summary shown when available (dataset summaries are optional)
Dataverse (Scholars Portal, Canada)	An excerpt from the data summary is displayed; search terms are emphasized.
CKAN (Open Data Canada)	A complete summary is displayed; search terms are emphasized.

Table 2. The presence or absence of dataset summaries on the search results page of widely-used data repositories, as of August 2020

METHODS

We developed the proposed best practices for data summarization following a two-phase approach. Phase 1 synthesized existing knowledge on summarization into candidate principles, which underwent iterative review and discussion within the research team based on our experience supporting RDM. Phase 2 was intended as a knowledge transfer activity, sharing the results of our environment scan and literature review with key stakeholders, with beta concepts for effective data summaries to spark discussion. For this candidate version, we have incorporated and reflected on feedback from data and metadata experts, data curators, librarians, researchers, and research support staff. An overview of our approach is shown in Figure 2, and each phase is described in more detail below.

Phase 1

Key pieces of advice were extracted from a variety of sources related to summarization, including literature related to abstracting techniques for research articles, search strategies, the use of language, metadata, and data repositories. We also drew extensively on grey literature, including best practices from other disciplines, such as library catalogues for specific disciplines (especially health sciences); Rules for Archival Description (RAD); widely accepted principles such as the FAIR (Findable, Accessible, Interoperable, and Reusable) Principles for Scientific Data Management; metadata standards, especially those intended for data; and journal, repository, and federated search technical documentation for metadata. Much of this original source material was not directly applicable but could be translated to the context of describing research data. These candidate pieces of advice were reviewed, and those not applicable were discarded (filtering). Those that remained were iteratively sorted into loosely defined themes such as provenance and structure (aggregation). From this, a draft list of concepts for effective data summarization emerged and was used to intuitively rewrite existing data summaries to attempt to put the concept into practice. (One such revised data summary is in Figure 3.) Discussion and reflection within the research team served as an initial quality review.

Phase 2

In our effort to spark a wider conversation about this subject, we took a preliminary version of our guidance to a series of online, synchronous, video conference webinars. We held four private webinars with key working groups in the research data management space, and one public webinar advertised to the research data management community in Canada. Participants in the webinar were advised that we were there to share our work, but were also interested in their feedback, which we would use to improve our work.

Each of the working group consultations began with a ten-minute presentation outlining the current state of data summaries in public data repositories. This was followed by a twenty-minute moderated discussion focused on the concepts for best practices. Each working group had between seven and seventeen members. Discussion notes were taken at each meeting by the researchers. The research team met after each to share their notes and discuss the comments received to iteratively refine the guidelines. The final improved guide is described in the following section.

The first two consultation groups were from the Canadian Integrated Ocean Observing System (CIOOS; Stewart et al., 2019). The first of these was with a regional cross-section of CIOOS stakeholders, including oceans researchers, technical experts, user engagement specialists, and research administrators. The second was with a national committee of technical experts tasked with building the CIOOS repository, including the submission form, the onboarding process, and the standards, metadata, and controlled vocabularies in use. (Disclosure: several members of the first group report to one of the co-authors; the second group is co-chaired by one of the co-authors.)

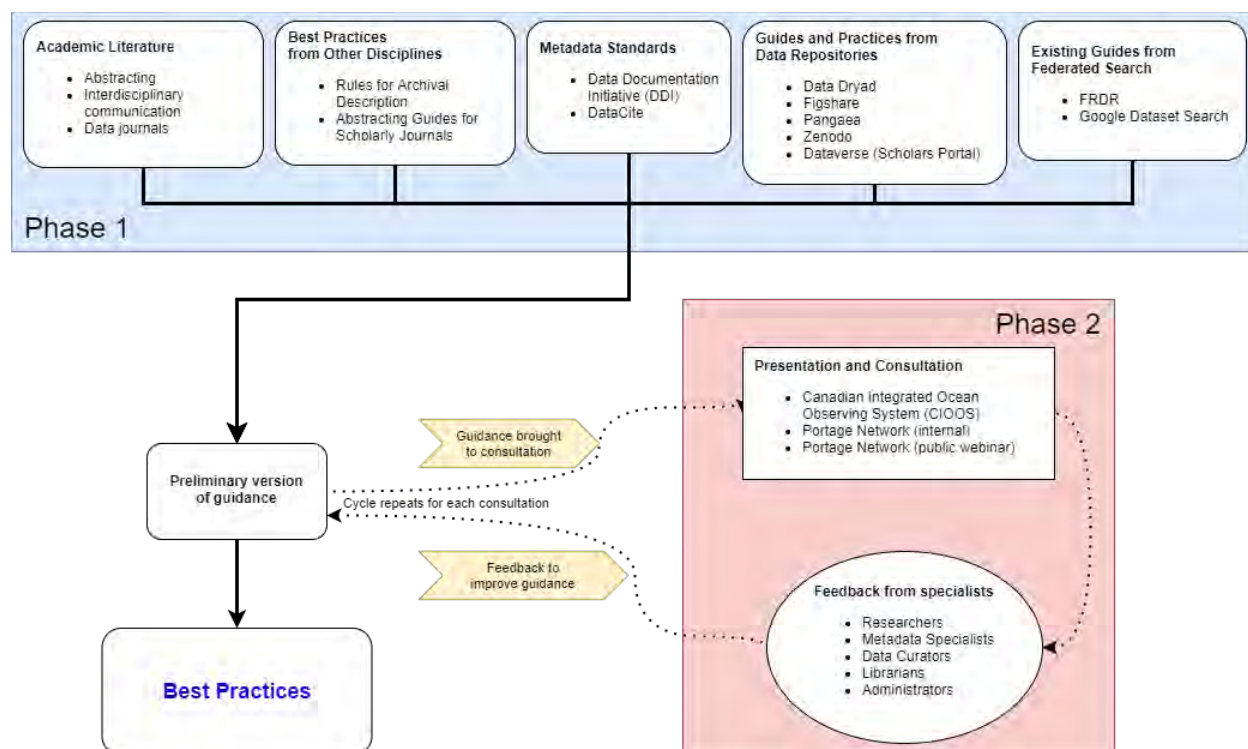


Figure 2. Visual summary of the methods used to create our best practices for dataset summaries

The next two consultations were standing expert groups at the Portage Network for Research Data Management, the data stewardship body of the Canadian Association of Research Libraries (CARL), and part of the New Data Research Infrastructure Organization (NDRIO) in Canada. One group focuses on how users search for and discover data; the other on how to submit, document, and curate data. Both groups are national in scope, and include metadata specialists, RDM librarians, archivists, systems experts, and others, who are invited from across Canada based on their expertise.

The final public expert consultation was a similar format, going into greater detail on the existing nature of public repositories and issues with their data summaries. The webinar ran for over 50 minutes equally divided between presentation and discussion. It was attended by 52 live participants who were not screened for expertise (a recording of the session is publicly available on Youtube: <https://www.youtube.com/watch?v=kUIoX3OB130>).

RESULTS

Our method of identifying key advice and filtering resulted in some very specific advice, but the second step (aggregation) ensured that advice remained high-level. These best practices are not yet suitable for teaching or training researchers to write dataset summaries, or for assessing quality. Rather, they serve as a starting point for discipline- or context-specific guidance. More specific guidance (word counts, structure, vocabulary, headings, and other such matters) will, like research article abstracts, be guided by the relevant scholarly community, publishers, and the experience of both creators and searchers. Our conclusion is that data summaries vary so widely in style and function that we do not yet have a clear idea of what specific elements are effective, but that ultimately variation among disciplines is likely necessary. These best practices are a starting point; if followed, writers of data summaries will develop norms from which effective techniques can be identified and best practices can continue to evolve.

We describe here five high-level principles intended to guide the establishment of discipline-specific guidance for dataset summaries. For each, we describe the provenance, variations and changes considered, and an explanation of the importance. Without loss of generality, we focus our examples on environmental data.

Best Practice 1: Describe Datasets with Attention to the Searcher

Convenience of the user is the first and most important of the International Cataloguing Principles (Galeffi et al., 2016, p. 5) and has been adopted in some form by several related standards for description (Bureau of Canadian Archivists, 1990; Wilkinson et al., 2016). When presented with the description, a searcher should be able to quickly identify whether a resource is *useful* to them and whether the resource *can be used* by the searcher.

To determine whether a resource is *useful*, a searcher should be able to identify whether data are relevant to their needs. The quality of relevance has been extensively studied in information retrieval research, which we do not reproduce here. We simplify it to this: the searcher of environmental data will have a scope for their search that overlaps with one or more dimensions of the dataset. Dimensions common to environmental data include geospatial (the location where data were collected and/or the location that is immediately impacted by collection), temporal (the date range that the data covers), and subject. While structured metadata can retrieve data by dimension, the decision on relevance is ultimately made by humans, and the dataset summary is essential to this task.

To determine whether a resource *can be used*, a searcher should be able to identify the extent to which data have been processed and the format the data are in. A dataset summary should not be so specific as to give file formats that may change with versioning (*Data on the Web Best Practices*, n.d.), but it should be possible to provide an understanding of data structure such that users will know whether they have the technical expertise to use them (Wilson et al., 2017).

There was some discussion within Phase 2 on whether restrictions on data use (i.e., licensing and rights considerations) are appropriate within the data summary. If so, this is arguably a consideration for whether data *can be used*. We decided to not recommend this information be included, as permissions for use may change with time. While licensing information should always accompany a dataset, it does not need to be contained within the summary.

Best Practice 2: Begin with Language Appropriate to all Potential Audiences

For both expert and less-experienced users, terminology is not always understood outside of a specific discipline or the context of an in-depth analysis (Montesi & Urdiciain, 2005). It is generally understood that a summary should be written such that a layperson can understand it (Borko & Bernier, 1975).

Writing to the lay reader has been a specialized skill that professional abstractors have developed. Although subject matter specialists writing their own summaries may not have developed this skill (Borko & Bernier, 1975), this still provides an objective to strive towards. The summary should begin such that readers understand the general topic of a dataset from reading the first few sentences, and depending on their literacy of the topic, continue reading to understand it in greater depth. In situations where data cannot be sufficiently described without the use of jargon, it might be appropriate to incorporate impact statements for laypersons (Sick, 2009) as an introduction to the summary.

We stop short of requiring that the entire summary be appropriate to all audiences. One portion of the audience, particularly in the research data context, is expert users. Their determination of relevance will rely on the details and vocabulary of domain experts. For example, a climate modeller accessing ocean observation data will require detailed and specific information about how the water salinity was measured to ensure consistency, comparability, and quality. While much of this detail is appropriate for accompanying documentation, and the use of a controlled vocabulary for variable names, this expert user will be well-served by the use of the terms “refractometer” or “absolute salinity” in the summary, as they imply a wealth of information. However, this detail belongs later in the summary, and it requires judgment to use technical jargon in appropriate measure.

Best Practice 3: Describe the Dataset as an Independent Research Output

In response to the concern that scholarly journal abstracts are copied directly into the summaries of the datasets that supplement them, describing the dataset as an independent research output reinforces the idea that a dataset can be (and should be) considered a standalone object. Other description standards speak to this through a statement on accuracy, describing discrete items or collections without describing those around them (Bureau of Canadian Archivists, 1990, p. 23; Galeffi et al., 2016, p. 5). The principle of sharing research data suggests that the data has value beyond the work already done: while some of this work may be replication, other types of analysis are possible. The data should be described appropriately.

Data which supplement a resource (such as an article) should still be linked to that resource. This could be done either within the data summary or through the use of another user-facing metadata field. It is important that the description of the source study not overtake the description of the dataset as a discrete object. The practice of copying abstracts may benefit user groups who are searching for similar studies, but the link between research artifacts should not rely on the similarity of unstructured text fields. Relying on a research article abstract will obscure datasets from other searchers who could benefit from the reusability of data in less direct ways.

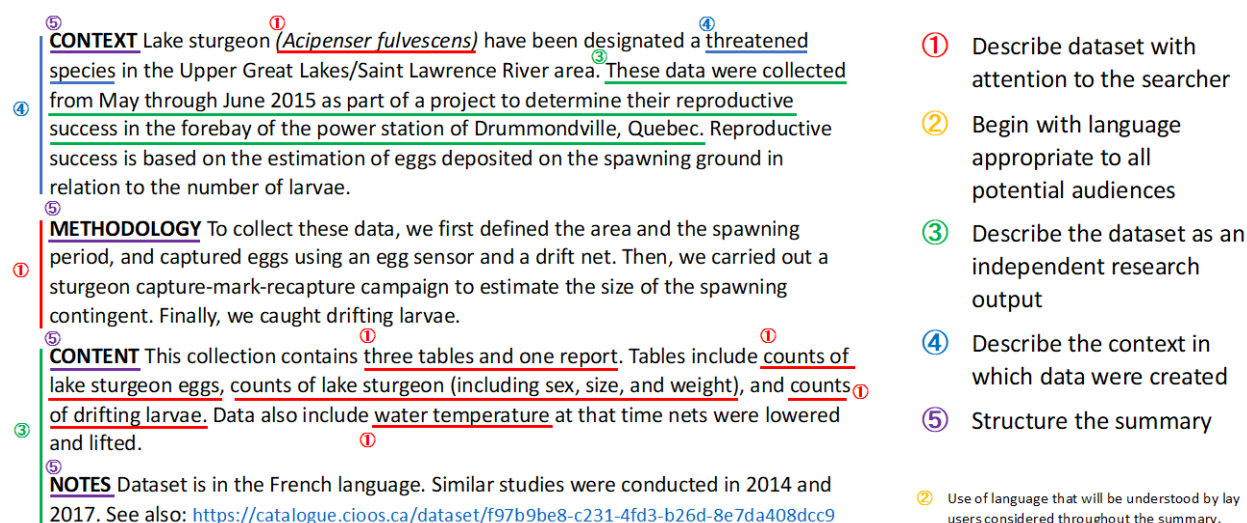


Figure 3: A sample dataset summary written following the best practices proposed here, annotated with numbered and color-coded notes to illustrate how the best practices guided language. Source: (SLGO, 2015)

Best Practice 4: Describe the Context in which Data were Created

While datasets can be considered an independent research outputs [Best Practice 3], environmental data are not created without an intended purpose. Understanding the original context for their creation is necessary for evaluating provenance, the completeness of data, and the degree to which they have been processed. Looking to the exemplar data summary (Figure 3), a dataset has been published out of a project to measure the reproductive success of lake sturgeon (*Acipenser fulvescens*). Without understanding that lake sturgeon is designated as a threatened species in the area where these data were collected, the conditions described by these data may be misinterpreted as typical.

Put another way, this best practice asks researchers to provide the “why” in addition to the “what”. The data summary should explain what is interesting, unique, important, notable, or otherwise relevant to understanding the dataset.

Best Practice 5: Structure the Summary

Structured abstracts with consistent headings are considered more readable and help to provide consistency across publications. These are common in fast-moving disciplines such as medicine, and there are efforts to bring this practice into other areas of research (Hartley, 2014; Hartley et al., 1996; Montesi & Urdiciain, 2005).

In the medical sciences, a structured article abstract consists of clearly labelled sections such as Background, Aims, Participants, Methods, and Results. Using a similar structure for environmental data can help develop search tools to distinguish background from methodology (DataCite Metadata Working Group, 2016), which in turn helps address the context of creation [Best Practice 4] and help researchers find studies that use similar techniques and tools. During Phase 2, one consultation group highlighted using structure as means of addressing reuse potential or concerns with data which are necessary in their interpretation (i.e., flagging missing data). This can be compared to the way a scholarly article abstract should be clear about the limits of the study. One possible structure is shown in Figure 3.

DISCUSSION

Our work was based on our understanding of how users search. There is some indication that dataset search has unique properties (Kacprzak et al., 2019), but our fundamental assumption is that search behavior is learned, and that users seek to apply skills learned in one type of search to other contexts. This informed our strategy to begin with literature and practices from other forms of catalogues, and to compare data repository search interfaces with academic journal databases. Several data discovery experts in our consultations believe that this is a flawed assumption: that researchers often have a very clear understanding of what usable data should exist and refine their search criteria using clearly defined filters rather than broad search terms. One participant in Phase 2 commented that the summary is the very last thing that a researcher in their field would read. While this type of search filtering remains essential, we continue to assert the importance of the dataset summary, based on our confidence in information retrieval literature and mental model user experience research (supported by Koesten et al., 2020). In general, our reflection on input was guided by our recognition that experts do not always see the perspective of end users.

One challenge to our approach is that data summaries are often not written with the searcher in mind. People who are experts in search and retrieval may have developed other techniques to overcome the limitations of poorly written data summaries. It would be interesting to see a comparison of the processes used by experienced data searchers with researchers who are searching for data for the first time. This was discussed within the public consultation, noting that data repositories used by academic institutions have a very different audience, and they often have research experience already. This is different than government open data portals in which the inexperienced public are encouraged to browse for interesting data. The techniques used by each audience may have led to the different ways that repositories display data summaries in search result pages (see Environment Scan). Likewise, different search techniques may be used between people interested in environmental resources (often natural scientists) and other groups seeking characteristics of an environment to supplement social science observations. The importance of discipline expertise in reviewing, implementing, and developing processes based on our best practices is essential.

There was a recurring question on the notion that it is always possible to write summaries that any reader can understand, or that this should even be a primary objective. Some searchers *are* experts, and in many contexts, these are the users who can best reuse data. The prevailing belief is that experts have other means of finding data in the current search environment without using data summaries at all. Including our best practice – that summaries *begin* with language appropriate to all audiences – suggests that expert language can be used as the summary progresses while still providing a foundation for those who do not yet know whether a particular deposit is useful.

We also considered the specific questions suggested by Koesten et al. (2020), listed in Table 3, in light of our high-level best practices. We found common themes. In general, the user-focused methods employed by Koesten et al. (2020) align with our Best Practice #1 (BP1): they have undertaken substantial user studies that provide concrete information to inform the implementation of BP1. Questions 2, 3, 4, 5, 6, and 7 serve this role: providing sufficient information to enable the searcher to assess relevance. We would suggest that 5-7 should not be optional: while recognizing that setting achievable goals is valuable, we should aim for the data summaries we want to see. Question 8 aligns with BP 5, where we suggest that understanding limitations of the data is one benefit of structured abstracts. This suggests that we should be including limitations in our assessment of useful / usable headings. Structured data summaries are also aligned with their approach of asking specific questions to guide the creation of dataset summaries.

Template question	Explanation
*1. How would you describe the dataset in one sentence?	What is the dataset about?
*2. What does the dataset look like?	File format, data type, information about the structure of the dataset
*3. What are the headers?	Can you group them in a sensible way? Is there a key column?
*4. What are the value types and value ranges for the most important headers?	Words/numbers/dates and their possible ranges
5. Where is the data from?	When was the data collected/published/updated? Where was the data published and by whom? (required if not mentioned in metadata)
6. In what way does the dataset mention time?	What timeframes are covered by the data, what do they refer to and what is the level of detail they are reported in? (e.g. years/day/time/hours etc.)
7. In what way does the dataset mention location?	What geographical areas does the data refer to? To what level of detail is the area or location reported? (E.g. latitude/longitude, streetname, city, county, country etc.)
8. Is there anything unclear about the data, or do you have reason to doubt the quality?	How complete is the data (are there missing values)? Are all column names self explanatory? What do missing values mean?
9. Is there anything that you would like to point out or analyse in more detail?	Particular trends or patterns in the data?

Table 3. The 9 questions (with documentation) proposed by Koesten et al. (2020) as a data summary template. The four required questions are noted with an asterisk

There are also points of disagreement, which are not meant to detract from the important work of Koesten et al. (2020). Koesten et al. start from assumption that the summary author is not a domain expert, while our best practices are meant to guide data owners and other experts in writing effective summaries. Question 1 is suggesting a topic sentence, which is good advice, but we are concerned that without the expectation of BP2, the requirement for brevity will result in the use of technical language or an otherwise dense sentence. Question 9 suggests the summary include information on analysis of the data, which seems to contradict the spirit of BP3, to not pre-suppose the possible analysis of the data, and to not limit the summary to the use identified by the creator. It might also be seen as aligned with BP4, in relating the context. Finally, their advice is actionable, while ours is formative.

Who is responsible for authoring the dataset description remains an important question, with no clear answer. We think it is unavoidable that research data creators will bear this responsibility, but recognize that this may require thinking about more than improving data summaries: the entire data submission system may need to be rethought (Smit et al., 2020).

CONCLUSION

Research data management is an important sub-field in information research, building on concepts borrowed from archives, reference services, and data analytics. We must also borrow from information retrieval and user experience research to ensure that we realize the benefits of open research data.

Data repository platforms have a role in encouraging the ongoing development and enforcement of best practices. This is well understood by the working groups who acted as consultants throughout Phase 2: they exist to work with data repositories and data catalogues to promote and advance data stewardship. While many standards organizations provide frameworks and advice on how metadata should be developed, it is repository platforms that can best educate researchers on the expectations of their descriptions. This can be done in any of several ways, whether a callout box appears when a researcher begins to make a deposit, exemplars are provided for reference, a trained manual reviewer speaks with researchers, or the search experience passively highlights examples of well-crafted metadata. Of course, this advice must first exist.

The high-level best practices proposed in this paper are a step toward better data summaries. To be impactful, they must be matched with continued user studies, ongoing reflection and conversation, the development of discipline-specific guidance, and implementation in data repositories. In short, they must become more actionable, which requires continued conversation among interested scholars. Our ongoing and future work includes users studies; examining the impact of automatically translated data summaries; improving the semi-automatic generation of data summaries from structured metadata; and (carefully) crowd-sourcing the structured and unstructured description of datasets from the scientific community to address concerns about researcher burden and expertise.

ACKNOWLEDGMENTS

Research funding was provided by the Ocean Frontier Institute, through an award from the Canada First Research Excellence Fund; by a MITACS Research Training Award; and by the MEOPAR NCE Observation Core.

Some of the earliest conversations on this topic were with Adrienne Colborne (School of Information Management, Dalhousie University), Sarah Stevenson (Dalhousie Libraries), and Erin MacPherson (Dalhousie Libraries) in 2018. Thank you!

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“It makes me sad”: Archival Pedagogy in a Time of Covid-19

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ABSTRACT

Despite COVID-19's devastating repercussions on higher education, scholars have yet to address its impact on Library and Information Science pedagogy. This exploratory qualitative case study centers on how archival educators weathered the onslaught of the pandemic. Drawing upon semistructured interviews with 31 archival educators and documentary evidence, this research addresses the sudden shift to online education; the concomitant loss of hands-on work opportunities and the workarounds educators developed; affectivity and an emergent ethics of pedagogical care among students and educators; and educators' lessons learned from the pandemic and their future projections regarding archival education. This paper illuminates the evolving landscape of pedagogy and its attendant challenges preparing the next generation of archival professionals during an unprecedented period of duress.

KEYWORDS

Archival education; Library and Information Science education; ethics of care; online learning; pedagogy.

INTRODUCTION

Declared a public health emergency on January 27, 2020, by the Secretary of Health and Human Services, COVID-19 ignited a “global frenzy of COVID collecting,” including by the National Library of Medicine, the Centers for Disease Control, and myriad museums, libraries, historical societies, and community groups (Spinney, 2020). Leveraging social media and other technologies, archivists and historians began developing new archives to capture the pandemic experiences of diverse Americans (Parry, 2020). But in this flurry of archival work, archival education has been overlooked. Focusing on graduate education, this exploratory, qualitative case study poses the research question: How did the pandemic impact archival pedagogy?

First, we review the literature on online education, hands-on education, communities of practice (COPs), and affect and the ethics of care. Next, we discuss our methodological approach, which centers on a qualitative case study. Third, we broach findings, which revolve around the shift to online education; the concomitant loss of hands-on work opportunities and the innovative workarounds educators constructed; affectivity and an incipient ethics of pedagogical care as manifested in community development, student comprehension, and student stress; and lessons learned and future projections regarding financial issues and online education. Fourth, our discussion addresses our findings' implications for scholarship and for practice. Fifth, we offer conclusions and directions for future research.

LITERATURE REVIEW

This paper engages the literature on communities of practice, on online education, on hands-on education, and on affect and the ethics of care.

Communities of practice

“The site where collective learning is accumulated into social practices” (Davies, 2009, p. 104), a community of practice (COP) is an organic, participatory, “curriculum for the apprentice” (Wenger, 2006). Three attributes earmark COPs (Wenger, 2000, 2010, 2017). First, members of a COP engage in joint activities, share information, learn from one another, and cultivate relationships. Second, a shared interest anchors membership in a COP; this promotes a common sense of identity, belonging, trust, and accountability. Membership indicates a commitment to the domain of the COP and a shared competence that distinguishes a COP's members from others. Third, a COP's members develop “a shared repertoire of resources: experiences, stories, tools, [and] ways of addressing recurring problems” (Wenger, 2006).

COP members collectively address tacit and dynamic aspects of knowledge creation, management, and sharing, thereby connecting learning and performance directly. Key activities of a COP include solving problems, soliciting information, seeking experience, (re)using assets, aligning and coordinating, talking and discussing developments, documenting projects, visiting, identifying gaps, and mapping knowledge (Wenger, 2006).

Members of a community of practice learn through authentic domain activity and experience in specific, ordinary contexts and situations, i.e. through enculturation (Brown et al., 1989). This process of cognitive apprenticeship—“learning-in-working”—braids knowing (abstract) and doing (situated) (Brown et al., 1989). Through legitimate peripheral participation, individuals become “insiders”; they change their identities and their skills and develop mastery (Brown & Duguid, 1991; Lave, 1991; Wenger, 2017).

The community of practice perspective redounds to pedagogy’s benefit (Wenger, 2006). First, it grounds learning in domain-based community participation. Second, it encourages students to connect learning experiences to actual practice through extracurricular activities such as internships. Third, it encourages lifelong learning by centering topics of lasting interest to students.

COP scholars hailed the web for purportedly offering new possibilities for social learning qua communities of practice (Brown & Adler, 2008; Wenger, 2006). The web augured a user-centric participatory information infrastructure—a “demand-pull” instead of a traditional “supply-push” approach—that sparked experimentation, exploration, and innovation, and thereby promoted situated learning (Brown & Adler, 2008).

Online education

As early as 2004, Haythornthwaite et al. labeled online education a viable alternative to on-campus education; this viability only grew over time (e.g., Cunningham, 2017; Oguz et al., 2015). According to recent Association of Library and Information Science Education (2021) statistics, well over half (55%, or 32) LIS programs offered course sections off-campus (a total of 1,976) as of the 2019-2020 academic year. Nearly half (48%) full-time LIS faculty taught asynchronously online, 54% synchronously online, and 75% hybrid.

Despite the increasingly vital role played by online education in Library and Information Science, archival scholars rarely addressed the issue. Cox (2006), for one, scorned distance education, where “content is packaged in digestible bites and training replaces education” (p. 250). As he later (2015) wrote, not only did online education center on mere technical training, but it undercut opportunities for faculty-student collaboration. Overall, Cox (2015) viewed online education as a cat’s paw of the neoliberal corporate university, that generated tuition revenue but churned out too many graduates into an already saturated job market. Despite his disdain, however Cox (2015), predicted that all archival education but doctoral work would migrate online—as rapidly as technology permitted.

Experiential education

A focus on hands-on training both in the classroom and as part of an internship or practicum dates from the profession’s inception. The Society of American Archivists (SAA’s) Committee on Training (1938-1943) contended that internships constituted an essential component of archival training; only practice ensured theoretical comprehension (Trever, 1948). Second Archivist of the United States, Buck (1941) called archival work an “applied science” (p. 85). In like mind, Posner (1941) insisted that training include repository-based laboratory work. In fact, he (1967 [1954]) believed the most grievous flaw in American archival education was its lack of practical work opportunities. In prescribing an optimal archival curriculum, Schellenberg (1968) favored “technical” laboratory work that included “cleaning, repairing, and reproducing documents and...the physical facilities for maintaining documents” (p. 159).

Subsequent literature continued to advocate for practical work experience. SAA’s Committee on the 1970s concluded, “The tradition of on-the-job training has always been strong in the archival profession, “and no amount of formal classroom instruction can substitute for such essential training” (Mason, 1972, p. 209). Warner’s (1972) study determined that nearly all archival programs included field visits, and Bower (1977) determined that every instructor in his study emphasized practical work. Until the middle of the 1970s, in fact, archival training concentrated on hands-on repository-based apprenticeships, which often involved processing collections and writing finding aids (O’Toole, 1997).

The inaugural SAA Guidelines (1977) foregrounded “laboratory elements” that included “opportunities for field collection, for work with audiovisual or other physical types, and for an introduction to simple preservation and conservation techniques” (“Archives Education Guidelines Approved,” 1977, p. 5). Helmuth (1981) insisted on the need for an authentic and professionally-supervised practicum to complement theory and develop skills.

But SAA’s Guidelines came under fire, not only for appearing unduly vocational, but also for lacking connection with the broader intellectual tenets of historiography or information science (Miller, 2000 [1983]). Countering such rampant criticism, Eastwood (1988) argued that training was not mere mechanical vocational activity, but was “skill building, acquisition of practical knowledge, and development of specialization,” and complemented education (Eastwood, 1988). All the same, as Cox (1990a, 1990b) noted, although the practicum had been an article of faith for archival education, its effectiveness had never been evaluated.

Continuing Cox's skepticism, O'Toole (1990) castigated archival education's "workshop mentality"—its "irresistible disposition toward practicality" (p. 463). O'Toole (1997) lauded the decreased use of hands-on practical projects in introductory archives course syllabi; he urged educators to move away from them further still.

Conversely, Bastian (2002) and Bastian and Webber (2008) made a strong case for the value of hands-on internships as professional preparation. In the same vein, Sinn's (2013) content analysis showed that practical exercises remained dominant; they were present in more than three-quarters of the 18 syllabi and 50 course descriptions she analyzed. Unlike O'Toole, Sinn believed that practice-based learning created appreciable and sustainable educational value. Even so, Tibbo (2015) argued that acquiring meaningful, authentic hands-on experience remained graduate programs' most formidable challenge. Not only were on-campus students limited by their proximity to local repositories, but online students faced steep odds in securing meaningful work.

Affect and care

An overarching concept encompassing feelings and emotions, affect bridges mind and body, cognition and sensation, reason and emotion, and conscious and unconscious processes (Cvetkovich, 2014). Affect mediates the global and the local, the individual, the environment, and the collective and social (Ahmed, 2004a, 2004b; Brennan, 2004). Individuals cannot extricate their cognitive work from their embodied emotions; a fusion of perception, thinking, reflection, judgment, decision-making, and affectivity prevails (Asma & Gabriel, 2019; Nias, 1996; Ruddick, 1980; Wetherell, 2012). Although information behavior researchers have explored affect in various contexts (e.g. Nahl & Bilal, 2007), the concept remains neglected in LIS pedagogy.

An ethics of care take root in affectivity. Both value and practice, care is an elemental human need; it at once satisfies a need in the person cared-for and enriches the carer's sense of self (Folbre, 2001; Held, 2005; Noddings, 1992, 2013). A normative feminist moral theory, an ethics of care cultivates, maintains, and enriches caring relations (Noddings, 2013). Jettisoning traditional, laissez-faire moral theories, whether Kantian or utilitarian, it centers on interdependence and interconnection, relationships with and responsibility for others (Gilligan, 2003; Noddings, 1992). Social bonds and cooperation characterized by direct person-to-person attention and response supplant competition (Held, 2005; Noddings, 2013). Under this aegis, moral emotions include mutual concern, attentiveness, sympathy, empathy, sensitivity, responsiveness, trust, and solidarity (Held, 2005). The pandemic encouraged the development of what we christen an ethics of pedagogical care.

METHODS

This paper is based on a qualitative, exploratory case study that examines complex current phenomena in-depth. This approach obtains a holistic, "insider" perspective (Gorman & Clayton, 2005; Pickard, 2013a; Schwandt & Gates, 2018; Yin, 2009). We employed semistructured interviews, which gave us detailed, descriptive, specific data. They thereby provided us access to the observations, perceptions, experiences, and interpretations of our participants. In reconstructing past events, understanding social and political processes, and obtaining descriptions of and feelings about current events, we integrated multiple perspectives to generate holistic interpretations (Pickard, 2013b; Rubin & Rubin, 2005; Weiss, 1995).

We relied on purposive sampling to choose information-rich cases (Pickard, 2013c). We sought to interview all 46 full-time faculty contacts for archival programs listed in the Society of American Archivists Directory of Archival Education. We conducted interviews with 31 educators between December 2020 and May 2021.

Our coding progressed iteratively from initial/open to focused/axial (Charmaz, 2014; Saldaña, 2013). We employed the constant comparative method of analysis, which proceeded until saturation. Analysis was ongoing, iterative, inductive, and grounded (Corbin & Strauss, 1990; Glaser & Strauss, 2009).

In service of trustworthiness, we relied on multiple data sources—documentary evidence complemented our interview data (Bowen, 2009; Hodder, 2000; Prior, 2003; Shenton, 2013; Wildemuth, 2009). Though not generalizable, our conclusion are potentially transferable (Pickard, 2013a).

Participant demographics

Primarily based at institutions in the United States (30 of 31; the other works at a Canadian institution), participants included eleven males, nineteen females, and one nonbinary individual. Twenty-four participants are white, four are African American, one is Latinx, one is Pacific Islander, and one is Asian. Thirty of 31 had earned a doctorate; their fields included LIS (19), History (7), American Civilization (1), Education (1), Organization and Management (1), and Archival and Book Heritage (1). Nine are Professors, ten are Associate Professors, nine are Assistant Professors, one is a Clinical Associate Professor, one is an Assistant Teaching Professor, and one is a faculty member (1). Most (27 of 31) hold positions in Information Science programs; the other four work in History Departments.

RESULTS

Interviewees discussed COVID's onset, the transition to online education, the loss of hands-on experiential work opportunities and the workarounds educators developed; affectivity and the ethics of pedagogical care as seen in community development, and student stress; and lessons learned and future projections, primarily with respect to online education's effect on the curriculum, students, faculty, and professionals, and financial issues.

Onset

Two interviewees discussed the pandemic's precipitate, disorienting onset. P20 remembered a faculty meeting in March when her university's administration ordered campus evacuation. "I remember them saying, 'oh we'll come back to this in April'...and then April came, and it was like 'okay,' on and on and on." She experienced a dramatic shift: "I had students who were attending in my classroom and then one week we weren't." "That first [online] meeting, we were all shell shocked," she recounted, "so I made that class really about connecting with my students and letting them speak"; "We just had to acknowledge this huge elephant in the room, of our worlds completely changing." P22 likewise saw her pedagogical world upended. As she recalled of her grant-funded digitization project, "one day we were scanning, the next day we were shut down."

Conversely, one respondent's program, which had offered online instruction for nine years by the time COVID struck, found new possibilities beckoning. P16 believed the pandemic seemed "kind of exciting." She and her colleagues wondered, "'What are we going to do and how are we going to make things happen?'"

Shifting to online education

On the one hand, the fourteen participants who had previous experience teaching online, who were currently teaching online, or both experienced less of a rupture to their pedagogy than their colleagues accustomed to face to face education (P3, P8, P11, P13, P14, P16, P17, P19, P20, P22, P26, P28, P29, and P31). "None of our instructors were stressed," P13 claimed. P31 chimed in, "I don't think the pandemic had a whole lot of impact, because we were pretty much doing all these classes remotely anyway."

For P17, the pandemic trammelled her approach but little. "Instead of recording in my recording studio in my office I record in my recording studio at home," she commented. Like P17, the pandemic scarcely affected P14's work: for her, "it was just like, 'cool, I don't have to commute to work.'" She simply hunkered down in her home office. P14 noticed a slight increase in her workload, namely monitoring the discussion board, but she had taught online previously and revamped that content on Canvas. Armed with a decade of online teaching experience, P11, too, saw little change, although working from home while raising a small child proved challenging initially. In similar spirit, P28 noted, "Our courses have been online for years, so the [pandemic] changes were more to do with our students' challenges and schedules," e.g. internships. An experienced online instructor at a program replete with them, P22 joked, "No one had to show us which is the Zoom button on the computer." P22 tended to intersperse teaching the same class face to face and online by semesters and develop equal facility. "I did my Covid prep long before there was a Covid," she quipped.

On the other hand, seventeen educators shifted from face to face or hybrid to remote teaching, while one remained in-person, albeit socially distanced and masked (P1, P2, P4, P5, P6, P9, P10, P12, P15, P18, P21, P24, P25, P26, P27, and P30; P23). P30 put it laconically, "It created more work, obviously," namely in "rethinking" course content and delivery. For example, P10's program migrated from face to face to nearly all online. Such an arrangement was "not what anyone really signed up for," she observed regretfully. Though feeling akin to "a network news broadcaster" while recording lectures, P10 believed her pedagogy remained fundamentally the same. The pandemic also compelled a "really resistant" P18 to become receptive to online teaching. P4 thought online teaching "so depressing." She elaborated: "in class, I lecture, but I walk in between the desks, I stop at each with each person talking with them. I write on the whiteboard."

Just as P4 castigated remote learning, so did two educators speculate on the deleterious cognitive consequences of online learning. P27's students were "all struggling in different ways concentrating, the constant Zoomed stuff." P26 mused over learning efficacy as well: "The human brain processes things differently when you go someplace and you sit in a room. You remember things visually and contextually in a way that sitting in this chair all the time or wherever you are you don't."

Online learning also posed questions for appropriate scheduling. Offering her courses asynchronously to accommodate students' often unpredictable schedules, P24 highlighted the challenge of accessibility during the pandemic. "I've seen a lot of people say that, in terms of parity, you should really be offering courses asynchronously because...you just don't know what folks are going through." Also teaching asynchronously instead of in a three-hour weekly block, P9 broke content into 20 minute modules that students could engage over the full week. By contrast, P25 offered students optional synchronous Zoom classes, which most students attended. "They

were just as sick of being isolated as anyone,” she averred. Most important, however, the shift to remote teaching obviated hands-on learning.

Loss of experiential learning

Eighteen educators commented on losing face to face hands-on pedagogical opportunities either in the classroom or in internships or practica (P2, P4, P5, P6, P7, P8, P9, P12, P15, P16, P18, P22, P24, P25, P27, P28, P29, P30). P27 called COVID’s effect “definitely not good.”

Shifting from in-person to online loomed as a “huge problem” for P6’s program. “Our bench conservation, our bench media archiving, our bench printing classes, we can’t run any of them,” she lamented. P27 likewise missed “the materiality of being there and being with people and watching professionals work.” P4, too, stressed the difficulty of teaching archives bereft of the archival record’s materiality. This loss of materiality also undercut peer learning. COVID made social distancing and masking imperative for P23’s classes. “When you can’t read everybody’s faces it’s challenging,” she said.

Not only coursework, but also complementary experiential learning suffered. P27, for one, remained skeptical that online practica represented optimal learning experiences. For P7, the pandemic decimated the availability of in-person internships. “I feel bad for them,” she said, “because they’re not going to have that practical experience.” The loss of in-person internship opportunities deprived P15’s students of projects to augment their professional portfolios. Summing up, P18 thought it well-nigh impossible to replicate hands-on work online whether synchronously or asynchronously.

Workarounds

Twelve educators developed workarounds to mimic face to face hands-on learning, namely virtual internships or work, and field visits (P2, P5, P7, P8, P9, P12, P18, P20, P22, P28, P29, P30).

Virtual internships and work

P5, P8, P28, and P30 developed, coordinated, and supervised virtual internships, practica, and field work. Most of P30’s archives students were engaged in internships involving in-person processing when COVID struck. She recalled, “most [students] got dumped out of their internships last spring, so I quickly came up with this, ‘okay you’re all doing self-directed online professional development and here’s links to webinars and here’s links to SAA’s resources.’” In other words, P30 resorted to the “band aid of self-directed online professional development”; “I had to take a course that was otherwise running on its own steam and completely redo it on the spur of the moment and have more of an individual plan with every student.”

Adapting to the pandemic-induced restrictions, one of P5’s students did metadata work for a digital repository; another conducted oral histories via Zoom. Due to the closure of the university’s key special collections repository, P29 meanwhile shifted her Graduate Assistant’s arrangement and description work online. P20’s program simply changed student’s previously required field experience to optional.

Field visits

After COVID truncated hands-on opportunities, eight educators developed creative, situated workarounds. For example, P8’s students leveraged tools such as WordPress and Omeka to mockup digital archives. Second, pre-pandemic P2’s class would make a field visit to the university archives, where staff would walk students through a processing exercise. “I really love that,” she commented. “They are literally trying to do what you would do if you have the job.” P2 unearthed a digitized collection to mimic this experiential learning. Third, P9 replicated an open data assignment. Before COVID, P9’s students visited the archives to identify historical materials they could repackage as open data. After losing this opportunity, P9 identified materials that had already been digitized for the same purpose. As P18 put it, “the bell went off... ‘ok, you don’t just have to assign papers and books, you can mix it up, be a bit more creative.’” But ultimately, educators agreed with P25: in-person, hands-on engagement remained essential.

Affect and care

Eight educators (P3, P7, P12, P15, P16, P18, P21, and P26) described their affective responses to the pandemic. COVID “makes me sad,” P15 admitted. She underlined the “mental anguish” of shifting to online education: “It’s been hard for me,” P15 noted, “worried about my students in a way that I wasn’t before.” As she said, “you can’t believe what’s happening in their life.” P7 similarly worried, “if [class] is completely online, I won’t be able to connect with [students].” P21, for example, worked to cultivate relationships among new students. “I’ve been really spending time... ‘Oh, I know this group, and this group, and how can I connect these folks,’ and they can do like a socially distanced walk or something.” P21 invested far more labor in checking in with her students, and P20 recalled “a lot of extra communication with students to let them know I was thinking of them.” As she put it, “We’re trying to maintain what we have and support the students who are here.” Finally, given students’ anxiety, P5 made even more concerted efforts to provide both academic and pre-professional advising.

COVID spurred educators to reflect on their pedagogical approaches. P12 elevated “compassion and flexibility” over abstract learning outcomes, rigid deadlines, and even the weekly workload. In similar spirit, P26 commented, “I’m more relaxed in the sense that, ‘hey we’re all struggling here.’” “I don’t care when they pass in their assignments, as long as they at least go to the trouble with telling me why it’s going to be late.” Like P26, P3 adopted an approach with her students of “let’s be flexible, yes, we have the syllabus and yes, we have these due dates, but nothing is rigid.” P16 reflected, “I think of myself as a hard ass but holding hard a hard line...doesn’t really pay right now.” She was “trying to be empathetic and listen to what other people are experiencing and adding some flexibility.” P18 bluntly advised other educators, “be empathetic.”

P21 highlighted a key tension. “How do you still challenge [students], but create...a space of care, a community of care in the classroom and outside?” More trenchant, P16 enjoined, “at the end of the day, just care that they learn.”

Community development

The pandemic undercut a sense of community among students and faculty, as seven interviewees noted (P10, P12, P15, P18, P19, P24, P30). P10’s students struggled to cultivate a sense of community with their peers. Similarly, P15’s students lacked the opportunity to develop community “just...hanging out in the lab together working on projects.” P15 thought online interaction could mimic this but pallidly. According to P30, “the great loss of the pandemic has been less around the teaching and almost entirely around the students’ ability to connect with each other, the kind of chatting before class, hanging out chatting outside the building after class disperses, getting a coffee together...relationship-building among students.” Despite its generally deleterious effect on community, the pandemic also elucidated peer support. P13 expressed pride in her students. “When the pandemic hit and people were really, really stressed out at work, [students] were sometimes called on in order to help others get used to working online.”

A sense of community between students and educators also suffered in some cases. P24 noted, COVID upended her teaching experience. She found a sense of community well-nigh impossible to replicate online environment. “I feel really disconnected from my students,” she admitted. P30 inaugurated “Zoom lunches”: “every Wednesday at noon, I would sit at my desk and eat my lunch with my Zoom room open for whoever wants to show up.” “We didn’t talk about school,” she noted, “it was just like shoot the breeze, talk about whatever.”

Educators also noted the cost of COVID vis-à-vis community. P18 reported plummeting communication among her colleagues, which she found “really isolating.” “I don’t miss the amount of money I used to spend on travel,” P19 noted, “but I am starting to miss not being able to go to any conferences.” An enervated P12 admitted that she lacked the stamina to attend even virtual conferences.

Student stress

Seven educators discussed student stress (P10, P12, P15, P16, P21, P24, P30). P15’s students faced “so much stress.” They were “stressed about their projects and then they’ll be like, ‘oh my aunt has Covid’”; some of them had childcare responsibilities as well. Of student stress, P16 reflected, “people have lost family members, they’ve lost friends, they’ve taken on additional responsibilities and caretaking.” P30’s students “were in varying levels of crisis, of just needing more attention and connection.” P21 chimed in, “some students are sick and some who have moved here to go to school are just living in a little one bedroom apartment and they are away from their families.” One such student was “all alone and...they didn’t have funding to even get their student ID which they needed to access our [food] pantry on campus.” In still another example, P24 recalled, “in the first three weeks of class or so, folks weren’t showing up...in the Slack channels, they weren’t doing the weekly prompts assignments, they weren’t engaging the questions that I was posing.” When she checked in directly, they explained, “I’m so overwhelmed, I’m having a really hard time getting started, the semester it’s been really tough.” At P10’s program, a “crazy high” number of students (39%) of students reported encountering a mental health issue during the fall of 2020.

While P12 also saw many stressed and overburdened students, she learned that for some the classroom represented “a haven.” There students bracketed the pandemic or politics—the “stressful things going on in their life and in the world.”

Lessons learned and future predictions

Online education

Interviewees predicted that reliance upon online education would continue post-pandemic. They foresaw changes to the curriculum, and to student, faculty, and professional work. For example, P8 conjectured that the pandemic accelerated an existing trend; she forecasted a shift to a wholly online curriculum. Similarly, P15 suggested that her university’s administration would exploit the pandemic to change the current policy that proscribed asynchronous graduate education.

The pandemic also encouraged educators to exploit technology more explicitly in the curriculum. Summing up lessons learned from what she called “the great experiment in Zoom teaching,” P30 maintained, “Zoom forces you

to get a little more organized and a little more clear in your instructions to students and maybe to shave off the stuff that isn't entirely necessary." In this vein, as P16 pointed out, technology such as Zoom "allowed us to face a pandemic and still move forward in many, many ways." For example, the pandemic made guest speakers indispensable. According to P26, Zoom was "great at bringing people into class that we wouldn't have in other ways." P27's program benefited in similar fashion.

Although P21 anticipated returning to face to face education, she predicted that faculty and other administrative meetings via Zoom would continue. P27 commented, "I don't think we're going back from recording all classes, it's too much of a boon both for the good students who get better and the ones that have a number of learning disabilities." Students had long requested such affordances; in this case, COVID "raised all boats," P27 concluded.

To this point, P27's program already offered students online support tools. They "can stay home and from their home couch get together with their team members around the whiteboard online." She affirmed that tools honing soft skills such as team building would continue to be used post-pandemic. P12 predicted the normalization of long distance virtual internships, and P18 thought that even if she were teaching online in the future, students could visit physical repositories local to them and thereby get exposure to hands-on work. Having set up the infrastructure for remote work after COVID's onset, P22 noted that she could fund students regardless of the pandemic's duration. "We are ready to be virtual as soon as we would have to [be]." Conversely, P15 fretted about a lack of infrastructure for online teaching, especially to promote community among students.

The pandemic encouraged new thinking about remote faculty work, too, as P8, P11, P17, and P19 suggested. "You can be productive at home in a safe place in a safe environment," P8 concluded, "Why don't we have remote tenure track faculty positions?" P19 likewise predicted that in the future, faculty might choose not to live locally. "Much as we enjoy seeing each other in person face to face," she noted, "our comfort level of doing online committee meetings" was increasing. In this vein, an unanticipated benefit for P17's program was the ability to hire remote faculty. This made hiring easier; she invoked the appeal of "Not having to say, 'you have to move to the deep red South.'"

Last, two educators considered the pandemic's effect on professional work. P24 thought that COVID might change researchers' access channels to archival materials (e.g. more digitized materials available online and fewer in-person repository visits) and drive concomitant change in professional roles and responsibilities. In this spirit, P7 pointed to a nearby university library's furloughing their archival processing staff; she wondered if archivists could work remotely.

Financial and sustainability concerns

Financial concerns included institutional budgets, enrollment, and professional employment prospects. First, because of the pandemic, P8's program instituted an adjunct hiring freeze. COVID also hindered her program's ongoing curriculum redevelopment and expansion. P6 weighed in at length on her fears about the adverse institutional economic impacts of the pandemic. Given the expense of specializations, she worried about losing them, particularly because they relied heavily on adjunct educators, who "don't carry the same weight with curriculum development and with fights for resources." Universities, P6 asserted, would trim the number of faculty members even as they would push programs to maximize revenue. Further, universities would stretch their resources by mandating faculty not only to teach more online, but also to teach more courses overall—or to farm out those extra courses to adjuncts.

Second, although P29 did not foresee COVID impacting her teaching, she feared a potential dip in enrollment. "A [graduate] certificate [in archives] may not provide them with something as tangible as an MBA," she worried. P17 surmised, "a lot of undergrads are now going to have a very bad taste in their mouth about online education." She, too, predicted an impending enrollment drop.

Third, in line with her apprehension about university finances, P6 foresaw a tightened job market. In like mind, P12 projected the pandemic would not only negatively impact the already-saturated job market, but also would further entrench programs' reliance on "precarious positions" among both faculty and staff. She went so far as to invoke the "existential issue" of the profession's viability. P30 agonized over this issue as well, saying, "we're training students for jobs that don't exist...because of furloughs and layoffs, and so that's the thing that concerns me most."

DISCUSSION

This exploratory qualitative case study shows that COVID-19 deeply impacted archival educators and students in terms of communities of practice, online education, experiential learning, and affect and care.

Communities of practice

The coalescence of communities of practice is essential for enabling students to "think like archivists" (O'Toole, 1990, p. 463). But this study's findings suggest that both in-person experiential learning and in-person peer-based bonding, whether in the laboratory or in the classroom, are crucial in developing COPs. Joint activities, peer

learning, a shared repertoire of tools, experiences, and stories, a sense of belonging, trust, and shared competence and commitment—all may be hindered by a solely online archival program. This study's findings suggest that COP scholars' optimism about the web and social learning (user-centered, participatory, and experimental) demands empirical exploration and testing.

Online education

Despite the recalcitrance of scholars such as Cox (2015), these findings jumpstart a necessary and indeed rather overdue conversation about the integral place of online learning in archival pedagogy. The pandemic compelled nearly half of this study's participants to embrace online archival education. On one hand, as P26 noted, "Online education is often easier for people who are older, who are working, who have kids, all those things. I am constantly amazed at how well people do." On the other hand, as she put it drily, "Even if they don't say much [on Zoom], but when you do it in front of a class, most of the people in class didn't talk then either, we have this romantic vision that everyone was, and that [educators] were like Mr. Chips." Yet although educators adapted extemporaneously and creatively to the online environment, overall their online activities could not fully mimic those done in-person. Concern about student comprehension, community, and wellbeing also surfaced among participants.

Whether the cause of approbation or consternation, online archival education and its attendant repercussions for the curriculum, for students, for faculty, and by extension, for working professionals, seems a harbinger of things to come. It extends opportunities to students who otherwise might not have them and it makes sense in light of ever-present LIS enrollment-cum-sustainability concerns (Association of Library and Information Science Education, 2021). Fourteen participants in this study already had experience teaching hybrid or wholly online courses. The responsibility facing educators is therefore not to deride online education as mere training or as reflecting merely a workshop mentality, but rather to determine how to avoid an insidious binarism between theory and authentic practice, education and training. To wit: both/and should supplant either/or. Likely accelerating an ongoing curricular shift, as P8 asserted, COVID represents a clarion call to action. Stakeholders should inaugurate a field-wide conversation about and begin developing best practices specifically for online pedagogy.

Experiential learning

Experiential learning remains a central priority for educators, not least because of its ability to enculturate students into COPs. Replicating hands-on activities with analog materials online will remain a formidable if not insurmountable challenge, given the importance of materiality and the profession's longstanding preoccupation with laboratory work as part of the field being an applied science. But COVID also signals an opportunity. As the record becomes increasingly born-digital, aspiring archivists will necessarily face a surge of digital materials; the sooner they embark upon salient education and training to deal with such materials, the better. Indeed, numerous scholars have emphasized the need for increased student understanding of and engagement with information technology (Cox, 2006, 2015; Eastwood, 2006; Tibbo, 2006, 2012). Locating meaningful practical, hands-on experiences remains a most daunting but essential challenge (Tibbo, 2015); such authentic domain activity is part of the cognitive apprenticeship that channels into COP formation.

Affect and care

Affectivity flooded graduate archival pedagogy during COVID. Educators and students endured wrenching intellectual and emotional changes in their personal, professional, and/or academic lives. Stress, worry, and angst—all pervaded pandemic life. Students struggled to complete academic work on schedule, particularly as they dealt with a lack of interpersonal contact and community with both peers and educators. Many faced new caretaking or child-rearing responsibilities. Educators meanwhile adapted to online teaching, to a dearth of interpersonal contact and connection with both students and colleagues, and to unprecedented reliance on technology as a pedagogical helpmate. Remaining empathetic, flexible, and deeply invested in their students, educators focused on the end goals of learning, and not as heavily on conventional milestones in getting there. They ramped up their communication and advising efforts, they remained respectful of and receptive to student voices, and they fostered new ways of learning and new forms of interpersonal community. As P3 concluded, "Being empathetic is something I hope to carry on."

This research attests to the fusion in pedagogy of the emotional and intellectual, the professional and personal, and the individual and the community—the hallmarks of affectivity. During the pandemic, educators and students favored relational, particularistic, and experiential bonds instead of abstract, laissez-faire, individual, autonomous, and rigid ethical approaches (Gilligan, 2003). Educators showed students direct, person-to-person respect and recognition, thus foregrounding interdependence, interconnectedness, and solidarity. In doing so, they laid a foundation not only for resilience, but also for future connection and community. Care was manifested through empathy and sympathy, sensitivity and flexibility, responsiveness and engagement, trust and mutual concern. Care represented both value and practice for these educators; they showed an embryonic feminist ethics of pedagogical

care. This ethical approach offers inspiration and direction for future pedagogy in archival and Library and Information Science education alike.

CONCLUSION

Despite their resilient adaptation to the pandemic, educators lamented the loss of in-person education. P25 ruminated, “it seems like it has been forever since we taught face to face.” There is “something to be said for that actual being in the same room with people sometimes,” P19 said ruefully. P7 found students still interested in face to face education, and both P26 and P27 denied remote learning would persist in their programs post-pandemic. “I don’t like it,” P4 asserted of teaching online. “[But] I know it will be soon over.” P24 described hers as “a very tight knit close community.” “We’re all eager to actually be back in person with one another,” she enthused.

This exploratory study suggests four directions for future research. First, considering the likelihood of online archival education persisting if not increasing, how can institutions best facilitate online teaching? (Marek, 2009). P15, for one, grappled with a “constant feeling of failure” as she revamped one of her in-person syllabi for online education. The pandemic meanwhile spurred P9 to reflect on how students learn online. Working with her university’s Center for Teaching and Learning, she admitted, “I’m very much continuing to learn there.” Similarly, how can educators and students build a spirit of community given the constraints of technology and temporality (Haythornthwaite et al., 2004)?

Second, what hands-on exercises are most conducive to being replicated online? Although educators ported many exercises online, limitations surfaced. P2, for example, observed that replication of the classroom experience online proved difficult or impossible unless the platform or tool offered a sandbox.

Third, the pandemic not only took an extraordinary affective toll on students and educators, but also teased out an embryonic ethics of care. “We have to be mindful,” as P20 reflected. “I want students to bring their whole self to the classroom and I try to do the same, I try to model that behavior and bring my whole self and be willing and be an open book.” How might this ethics of care be nurtured further?

Fourth, the pandemic exacerbated existing financial and sustainability concerns. What might an examination of archival program enrollment trends over time suggest about future enrollments? Similarly, is the employment market for archivists in fact changing? If so, in what way(s)?

Ultimately, COVID-19 revealed both strengths and weaknesses in archival pedagogy. On one hand, adversity brought out resilience in the educational community, namely in elucidating an ethics of pedagogical care. Similarly, both students and educators adapted remarkably to changed circumstances. On the other hand, the pandemic brought into high relief the need for change, primarily in how to foster the formation of robust online communities of practice, reconfigure online and experiential learning, use technology proactively but judiciously, and provide for sustainability.

ACKNOWLEDGMENTS

This project was made possible in part by the Institute of Museum and Library Services (re-246422-ols-20). We would like to thank our 31 interview participants for their keen insights.

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Just Infrastructure? Field Research on a Standardized Assessment Tool for a Continuum of Care for People Experiencing Homelessness

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ABSTRACT

As community-oriented programs move from intervention to infrastructure, questions of just and equitable access to that infrastructure both arise and become more consequential to those served. However, extant tools are general in scope, often undertested, and inconsistently linked with positive outcomes for served communities and service providers. We explore the dynamics and implications of a key tool within this infrastructure intended to enable portable collaboration across organizations serving those who are experiencing homelessness: the VI-SPDAT (Vulnerability Index - Service Prioritization Decision Assistance Tool). This tool, while providing a means of coordinated assessment, must itself be negotiated according to the values, data concerns, and goals of the agencies and service providers who make use of it. This paper reports findings from 29 interviews with individuals working in nonprofits, charities, and government agencies that provide services or resources to people experiencing homelessness within the City of Austin's Continuum of Care. The life-and-death stakes of the VI-SPDAT, which is designed to prioritize access to services based in part on a prediction of potential for premature mortality, drive home the need for equitable and just infrastructure.

KEYWORDS

Knowledge infrastructures; homelessness; VI-SPDAT; infrastructural justice; critical infrastructure studies.

INTRODUCTION

In leveraging information to seek a more equitable and just world, one of the major challenges that we face as a society and as information professionals is the injustice of homelessness. Former Hawai'i Governor Linda Lingle (2004) once said about homelessness, "But, this is a moral issue here, that we ignore at our own peril. We have come dangerously close to accepting the homeless situation as a problem that we just can't solve" (para. 6)." In his memoir, *Just Mercy*, lawyer and author Bryan Stevenson (2014) wrote, "my work with the poor and the incarcerated has persuaded me that the opposite of poverty is not wealth; the opposite of poverty is justice" (p. 18). This paper reports findings from a study designed to leverage information and technology to empower people experiencing homelessness and better equip service providers with data, information, and knowledge to maximize the potential for good of their limited resources.

Like many cities in the United States, the City of Austin, Texas's current approach to addressing homelessness is oriented around a Continuum of Care (CoC), a regional organization that coordinates access to federal assistance funding, with a dedicated organization known as ECHO (Ending Community Homelessness Coalition) taking on a leadership role among the many providers of services, shelter, or other resources in the area (ECHO, 2021). Coordinating of information resources and knowledge is done through an HMIS (Homelessness Management Information System). This approach, recommended by the US Department of Housing and Urban Development (HUD) combines a coordinated assessment approach with the development of an infrastructure for sharing information about participating clients and available resources. The components of CoC were created through the McKinney-Vento Homeless Assistance Act and then consolidated in HUD through the Homeless Emergency

Assistance and Rapid Transition to Housing (HEARTH) Act. A CoC provides funding to nonprofit, government, and other entities that serve people experiencing homelessness within a defined geographic area. CoCs, under this program, are required to use a coordinated assessment system that includes a standardized assessment tool, and to provide a central point of contact for coordination and sharing of data resources.

The standardized assessment tool used most commonly among cities participating in this program is the VI-SPDAT. The VI-SPDAT (Vulnerability Index - Service Prioritization Decision Assistance Tool), is a standardized assessment tool that uses a guided survey interview to prioritize limited resources for those experiencing homelessness according to the likelihood of mortality in the near future. In a recent 2015 report conducted by HUD's Office of Priority Development and Research, which reported on a workshop held among experts drawn from both government and academic roles, such coordinated assessments were described as "[lacking] a strong evidence base and... limited in their ability to select the best interventions for families and individuals or to predict which families would be the most successful in different interventions," (PDR, 2015, 5). However, "because of the regulatory requirement that all CoCs use coordinated assessment, no comparison group exists," (PDR, 2015, 4) to test these instruments, or to adequately assess their effects, in randomized controlled trials. As such, related in this report is a recommendation for "mixed-methods research to better understand the systems involved," (PDR, 2015, 4)—a call for research situated in practice that considers the efficacy and impact of these assessments.

In this paper, we report preliminary findings from interviews conducted as part of an ongoing study of approaches to homelessness amelioration in Austin. Throughout these interviews, an image of the VI-SPDAT emerges that emphasizes its infrastructural role as a key point of collaborative access for disparate, heterogeneous, and often parallel, providers of services and information for those on the continuum of homelessness. When using this tool, such service providers, alongside engaged local and state government agencies, expressed an awareness of the flaws of the assessment tool and described how they navigated established information systems and personal relationships to negotiate these known flaws. Participants related how the VI-SPDAT often fell short of its goal of prioritizing those most vulnerable for reasons both endogenous and non-endogenous to the assessment survey itself. In this paper, we engage with the 'coming to be' of a knowledge infrastructure (the HMIS, as mediated through coordinated assessment in the form of the VI-SPDAT) in Austin.

BACKGROUND

Approaches to the amelioration of homelessness are often fragmented, with significant asymmetries of knowledge, resources, and data expertise. For example, librarians, who in many urban settings are a first point of contact with those on the continuum of homelessness in need of information and support in their professional roles, often disagree as to their level of responsibility, or are unsure of their capacity for relaying expert knowledge, such as health information (Williams, 2016). The usefulness of information resources directly available to those on the continuum of homelessness is related, in part, to the flexibility and portability of those resources (Woelfer et al., 2009).

Community-based organizations (CBOs) have significant barriers in terms of access to open data and coordinated information systems, including tensions related to disparate access to data, limited utility of collected data, limited data capacity among CBOs, and the tendency of extant infrastructure to exclude the concerns faced by those organizations (Yoon & Copeland, 2020). Similarly, minor differences in how the issue of homelessness is presented evoke different values and differing levels of public support for ameliorating policies (Koepfler, Templeton & Fleischmann, 2012). Information intermediaries, like many of the organizations engaged with Continuum of Care, thus play a key role in addressing the information needs of those in disadvantaged or dependent circumstances and work to bridge knowledge gaps between services and these users (Buchanan, Jardine, & Ruthven, 2018).

Much like infrastructure itself, people experiencing homelessness might be thought of as similarly fading from visibility in the absence of systemic breakdowns (Koepfler, Mascaro, & Jaeger, 2014). Much as current federally led approaches to funding and addressing homelessness in communities relies on a continuum of care, our definition of homelessness embraces the notion that homelessness is itself a continuum, ranging across situations like housing instability and aging out of the foster care system, to reintegration from incarceration, episodic homelessness, living exclusively on the street, or couch-surfing. Ongoing, community-oriented efforts such as the Continuum of Care serve a valuable role in maintaining visibility and engagement with this diverse range of communities, but the technologies through which they understand, manage, and address homelessness bear significant consequence in how services are provisioned and the population of users is understood, advocated for, and prioritized.

The Knowledge Infrastructural Perspective

"One of the most important developments in science and technology studies (STS) has been to refocus attention away from the spectacle of the pageant of history toward the formation and operation of infrastructure" (Slota & Bowker, 2017, 530). Infrastructure studies, especially through the lens of knowledge infrastructures (Edwards et al., 2013), provides a means for understanding and assessing how novel systems become integrated with, work

alongside, or are in tension with existing systems already in use. These may be systems of standards, agreements, and national policy as well as sensors, storage, and analysis (Edwards, 2010). Infrastructure is not best defined according to the technical characteristics of a given system or set of systems, but instead through numerous relational characteristics as defined by Star and Ruhleder (2001). Following these characteristics, we can assert that a system is infrastructural when it is embedded and transparent in practice, learned as a part of membership, linked with conventions of practice, and embodying some set of standards. Infrastructure is also built upon an installed base that has some inertia of its own, exceeds a single site or physical location, resolves tensions between the global and the local, and becomes much more visible upon its breakdown. This heterogeneous list of features recognizes “that infrastructure [is] integrally a social, organizational, and physical phenomenon” (Slota & Bowker, 2017, 537).

In many ways, infrastructure encapsulates a discourse about the future (Larkin, 2013), where novel infrastructure is presented as both a vision of an idealized future and the pathway towards that future. In similar fashion, the development of novel infrastructure negotiates the tensions inherent in the “long now” (Ribes & Finholt, 2009) of its production, where work towards immediate needs is in tension with work towards future goals from the inception of its development. Infrastructure is not built as such (Bowker, 2018), but rather comes into being through the confluence of practice, policies, standardization, and system integration. Mediation (Latour, 1994) thus becomes a vital consideration in understanding how infrastructures assemble, organize, and become available to use (Baker & Millerand, 2008). In this work, we reminded that “as accretions that are formed slowly over time, infrastructures are made by and constitutive of diverse political rationalities, past and present” (Anand, 2015).

Conceptually, knowledge infrastructures may either disintermediate, providing a closer connection to data among an identified group of ‘end users’, or structure intermediation, where local participants are empowered as mediators of data and information flows between connected data and users (Baker & Millerand, 2008). Knowledge infrastructures are fragile (Borgman et al., 2016), and their durability is closely linked with the invisible work of maintenance, repair, and adjustment (Jackson, 2014). It is in repair and maintenance that “order and meaning in complex sociotechnical systems are maintained and transformed, human value is preserved and extended, and the complicated work of fitting to the varied circumstances of organizations, systems, and lives is accomplished” (Jackson, 2014, p. 222). No infrastructure is established in developed form—they are in a constant state of responsive adjustment to changing circumstance, systemic requirements, and necessary resolutions to key moments of breakdown. According to Anand, “thinking of infrastructure as accretion draws our attention to how these are not smooth surfaces that perform as planned; instead they are flaky, falling-apart forms that constantly call out for projects of management, maintenance, and repair” (2015, para. 1). The VI-SPDAT, in this study, is explored as the initial point of contact for the knowledge infrastructure that supports the provision of services to those on the continuum of homelessness.

History and Critique of the VI-SPDAT

The VI-SPDAT is the combination of two prior tools. The first, the Vulnerability Index (VI), was developed by Community Solutions to assess the risk of death of the survey-taker on the basis of medical history and prior conditions, and was based in part on prior research conducted by Boston’s Healthcare for the Homeless program (Hwang, et al., 1997). The second, the Service Prioritization Decision Assistance Tool (SPDAT), was developed by OrgCode Consulting, Inc., and considered socioeconomic and psychosocial risk factors of homelessness. The combined tool, the VI-SPDAT, is among the more popular tools used in required prioritization of resources and has been deployed in over 1000 communities in the US, Canada, and Australia (OrgCode, 2015), and is notable in its accounting for social, psychological, and health risk factors in assessing vulnerability and prioritizing service provision. Questions in the VI-SPDAT consider factors such as environmental threats, social network threats, health conditions, alcohol and drug use, and mental health (King, 2018).

There are, however, reasons to question the validity and reliability of this instrument (Brown et al., 2018). The VI-SPDAT is a deficit-based assessment (Frisch et al., 2017), and lacks questions about the strengths that a surveyed individual might bring to their management of a home and family, instead focusing on areas where behavior and history indicate higher vulnerability. Its focus on discrete events, rather than patterns of behavior, potentially causes the VI-SPDAT to under-assess key risk factors for survivors of domestic and sexual violence (McCauley, 2020). VI-SPDAT scoring was also not found to effectively predict placement in housing, especially when compared to housing eligibility or consistent interactions with service providers (King, 2018). The VI-SPDAT’s success has in prior studies been closely linked to the rapport between the assessor and client, especially considering the discomfort clients would often feel in honestly answering questions about risky behaviors such as drug use or sharing deeply personal information about mental health (Frisch et al., 2017).

The structure of the VI-SPDAT may also produce some level of racial inequity, as critical research into the intersectionality of the tool has indicated that it scores White clients as being of notably higher vulnerability than Black clients (Cronley, 2020), which is further troubled by the overrepresentation of those of Black identity among

the population of those experiencing homelessness (Henry et al., 2018). Gender differences in social support and mental health further complicate the fair provision of permanent supportive housing (Winetrobe et al., 2017), especially in underlying assumptions of vulnerability. Coordinated assessment, itself, may not be the most equitable means of prioritizing resources, with options such as lotteries or progressive engagement recommended by a team of experts as being more equitable and efficient (PDR, 2015). Rent assistance, similarly, may play a key role in the Housing First approach, with demonstrated effectiveness in improving quality of life and similar measures (Pankratz, Nelson, & Morrison, 2017), displacing the Housing First mentality that often underlies coordinated assessment approaches.

Infrastructure, as “flaky accretions of sociomaterial processes” that come to be through the relationships between humans, discourses, technology, and other things (Anand, 2017, 13), are “neither ontologically prior to politics nor are they the effects of social organization” (13). Infrastructure results both in spaces of visibility and invisibility, and centers and margins (Star and Ruhleder, 2001). Thus, an understanding of how an infrastructure produces both justice and injustice in its technical characteristics, operation, and social or organizational dynamics, is vital to those developing novel infrastructure, or engaged in its development, maintenance, and repair. This paper is driven by the exploration of how an infrastructure might become more or less just as it is used, iterated, and developed, and by understanding how components of that infrastructure, especially ‘entry points’ like the VI-SPDAT, bear consequence to how that infrastructure arranges knowledge about the world. As such, this analysis was directed towards a pair of complementary research questions: what are the social, organizational, and ethical consequences of an infrastructural ‘tool’ such as the VI-SPDAT, and how does such a tool work to produce a more or less just world?

METHODS

This study, which is a portion of a larger, in-progress, mixed-method study, focuses on the experiences of stakeholders within government and non-profit organizations working with those on the homelessness continuum in Austin, Texas. For this study, we interviewed 29 individuals, all of whom were engaged at various levels with the provision of services or information for individuals on the continuum of homelessness. Interviewees were selected initially following recommendations from key informants from the City of Austin who were collaborators on this project, then further developed through snowball sampling, to leverage the unique social knowledge of participants in identifying relevant future participants (Noy, 2013). Nineteen of the interviewed participants held leadership roles within their organization (Manager, Director, or Coordinator titles), where the remainder held more direct service provision or similar roles, such as working on homelessness ‘street teams’ to identify areas of service need or providing contract and grant support. Of these participants, 4 were drawn from ECHO itself, 13 from CoC-affiliated community organizations, 11 from collaborating local or state governmental roles, and 1 participant who was primarily in an academic role.

In order to draw deeply from the lived experience of those directly engaged with the knowledge infrastructure of the CoC, we structured these interviews according to critical incident technique (Flanagan, 1954; Morrissey, 2015). Interviews took approximately one hour and were recorded over teleconferencing software. Transcribed interviews were then analyzed inductively through thematic analysis (Clarke, Braun, & Hayfield, 2015), and key themes in the data were inductively identified as findings for reporting. Thematic analysis was selected due to its versatility in describing rich qualitative datasets both deductively and inductively. Major themes presented in this writing relate to service provider’s engagement with their clients through data traces, the techniques and negotiations that come from managing a flawed system, and the infrastructural justice of service provision and information systems. The findings reported here are part of a larger study for which data collection is still ongoing. To inform and supplement the service provider interviews, we are currently engaged in data collection in the form of open-ended surveys delivered to users of those services who are experiencing homelessness somewhere along the continuum and engaged in data collection and cleaning for a complementary quantitative approach.

FINDINGS

HMIS and the CoC as Infrastructure

The coordinated HMIS system used in the City of Austin’s CoC can be best characterized as a knowledge infrastructure intended to enable and support collaboration among the city/state government offices and service providers around the amelioration and management of homelessness in the region. In this approach, collaboration and coordination of parallel services was addressed through information infrastructure such as data sharing, coordinated assessment and entry processes, and participation in HMIS databases. HMIS, here, provides a central point of contact and data repository for groups within the CoC, among its other administrative and leadership roles. Participants often related that this data sharing infrastructure was among the only, or at least the most consistent, means of direct collaboration and coordination with these other agencies. As the below participant, who works in the Community Court system (a branch of the courts that deals only with those on the continuum of homelessness) relates, this led to gaps in coordination where those who did not have a license or access to the system felt excluding from ongoing work.

“You know, our communication is limited to these open meetings, really. And we haven't really honestly had a one-on-one discussion with them... that's the case because the Public Health Department has the contract with ECHO. We don't. So, a lot of times, I hear things secondhand, and they obviously hear things secondhand, as well.”

As indicated above, participants also related that this knowledge infrastructure was built upon a prior infrastructure of personal relationships, implicit knowledge, and in-person interactions. While the HMIS knowledge infrastructure was not intended to displace these dynamics, participants reported these modes of engagement as serving a secondary role in achieving their goals. A key item of note here is in the need for traces of individuals as they progress through the heterogeneity of disconnected, and often parallel, providers of services. Being able to find people and their histories—as data representations and as physical humans—and their traces in the infrastructure, was seen as vital to effective service provision. The loss of these traces was related to bear significant negative consequences for the individuals on the homelessness continuum in discovering and making effective use of vital services, such as access to prescription medication. The case below was related by the director of a faith-led coalition that mediates access to services and housing and describes these infrastructural effects in detail.

“But you know, it's such a large organization that there's different teams and the teams don't communicate with each other. And so, for instance, one of our clients needed to get her medication and had been off of her meds for like six to nine months. And, and she had just in their system had been tagged as part of a group that is up north, you know, like a 30-minute bus ride from here, and she'd never even been there.”

Of note here is that data quality becomes of issue—inaccurate location information arises as problematic for the individual described here, and her needs are clearly understood. This participant describes this as an issue of coordination and communication across different service providers, but the central dynamic here, and related consistently by other participants, is the loss of traces of an individual, both physical and data. This participant goes on to describe the consequence of this ‘broken trace’:

“because she was tagged as part of that group, the doctor that was here couldn't see her. And so we housed her and she ended up literally tearing the drywall off the walls. And they've ended all of it was because just some tag in the system said that she was part of some teams you'd never even met with. But because she was part of that team, she couldn't see the doctor that was here because that doctor was part of a different team.”

The individual described, due to the flawed data within HMIS, essentially lost access to medical care that would have enabled her to maintain the housing that the group was able to provide. Without contributions across the continuum that address mental health alongside physical health, ongoing access to housing was related as becoming significant fragile. Returning to the narrative, we find that these infrastructural interactions can even preemptively disqualify potential admissions to the system through lack of access to or capacity within the prior infrastructures subtending (Slota and Bowker, 2011) the HMIS system.

“that's just kind of exemplar of a lot of other issues that have to do with, you know, their system... [being] just incredibly difficult for the for the folks experiencing homelessness to navigate... multiple appointments that... I have to somehow get a homeless person to sit on the phone for an hour and a half to do these intakes. And if they cut out early, the entire thing is wasted, and you can't count any of it. And then they don't get their meds.

Engagement with the CoC was built upon the assumption of prior communications infrastructure (telephones and cell phones) to which those on the continuum of homeless often have limited access, or no access at all. Similarly, frictions arose in providing services when assumptions about consistency and reliability of scheduling did not reflect the lived experiences of users. This same participant goes on to further relate,

“And even if they make it through that, then they've got it, then they've got to meet with a caseworker who, some of whom, again, can only be met with via phone, and are all carrying like hundreds of people on their caseloads and can barely meet with a person once per month.”

And even when all of these issues are effectively negotiated, additional bureaucratic steps to engage other supportive infrastructures further arise:

“They've got to figure out how to get the meds from the pharmacy, they've got to figure out how to get a MAP [Medical Access Program].... [which] doesn't always cover Integral Care prescriptions. And then once you get your prescription, [you've got] to try to hold on to your prescription and not get it stolen and take your meds correctly... and if you'd lose your meds, they weren't going to replace them. So, it's like the odds that are stacked against a person trying to get mental health care in our system are... huge.”

While the above story does not necessarily conform to the patterns of engagement related by service providers across the entirety of our participant group, it is nevertheless evocative of the sometimes-significant barriers to

following the intended process of individuals throughout a system. The individual's trace in the system was seen as necessary to achieve a desired outcome for that individual and required that infrastructural gaps were accommodated through individual work on the part of service providers, often personally or altruistically motivated. For the majority of participants' organizations, the VI-SPDAT, or coordinated assessment process, was the originating point of these traces, and bore consequence throughout the system for individuals so assessed. Needs and expectations evolve and change based in significant part on data traces within the heterogeneity of inconsistently-interlinked infrastructures within the CoC, and novel struggles can be introduced along each step of this process. This is a "fragile" infrastructure, where if traces are lost, progress is also lost, and, often, significant avoidable harm might occur—maintenance of the individual across the infrastructure is vital.

Negotiating Coordinated Assessment

The VI-SPDAT was a tool that was known to be flawed across all levels of engagement by our participants. Many related how they survey was found to insufficient for adequately assessing vulnerability of individuals within the system.

"And, you know, with that coordinated entry system, they do an intake, and they do, you know, an acuity assessment, and a score, whatever. And that's how they're prioritized. But, you know, I appreciate the system, because I think it does create some transparency, and also accountability... but I also think there's still this population that just isn't able to do that assessment sometimes, or because they're so ill, and they don't realize they have issues or they're very paranoid. So, they don't want to tell anybody their business. They may score lower acuity when they're actually some of the most high-acuity folks."

Of interest in the above statement made by a participant holding a social work role within the Safe Haven veteran's organization is the 'mixed assessment' of the VI-SPDAT. This participant was personally aware of how the VI-SPDAT, in its reliance on self-reporting of medical and social conditions that are often embarrassing or threatening, could fail to adequately assess vulnerability because of the level of trust between the assessed individual and those conducting the assessment. This issue with self-advocacy was reported elsewhere:

"A lot of the people that we serve are so ill that they were not scoring as a priority through the continuum of care process, they were scoring very low as a matter of fact, probably because they're not the best advocates for themselves, given their mental health and substance use issues. So, they were never going to get housing through the continuum of care, while we were still seeing the severe need for them to be housed, because they were literally dying on the street... The reason they're not getting prioritized is because those coordinated assessments are based on self-report."

This quote, from a member of the Community Courts, which serve those on the continuum of homelessness and represent the first point of contact for many who seek services and information, relates how participants can in fact be in such a vulnerable condition as to render coordinated assessment ineffective. Service needs, as related by our participants, neither start nor end with immediate housing. However, housing enables a point of trace contact, a means by which an individual might be recovered to the system for further case management, and thus has value in negotiating the accretion of infrastructures that comprise the Continuum of Care.

Individual traces throughout the system, then, were vital in both their necessity for progression through steps of care and service provision, as well as key factors in understanding the system and its outcomes. As such, the known flaws in the VI-SPDAT became less important to our participants than the means by which the tool might generate more consistent systemic traces. "This could be more efficient if we all had access to the same resources..." related an individual working in a service seeking housing for unhoused senior citizens. "Not having access to vital records... makes the whole process crumble." Issues raised in prior assessments of the VI-SPDAT also structured how leadership in the CoC approach negotiating it as a necessary, but flawed, tool. As related in the background section, in practice the VI-SPDAT tends to score with some level of apparent inequity, consistently scoring White clients as higher vulnerability as Black clients, for example. A participant in a leadership role in the coordinated assessment process related that:

"past our pilot, [we have] implemented additional equity points on top of the existing scoring system for the VI-SPDAT. And basically, the plan moving forward along with our HUD support is to just kind of make sure that we're monitoring our outcomes and the kind of assessment pieces on a very regular scale, to make sure that we are prioritizing folks early on for housing resources, and that we can kind of right this inequity that we see in the disproportionate overrepresentation of Black African-Americans in our homeless population."

Again, of note here is the necessity of ongoing maintenance and repair of the VI-SPDAT as point of contact to the larger coordinated infrastructure of the CoC. A very important feature of the above quote is that the VI-SPDAT, though known to have inequitable outcomes, was also seen as a key point of inflection towards a more just infrastructure of care, one that has the potential to help correct disproportionate overrepresentation, rather than

initiate it, should it be sufficiently adapted to local conditions. Trained assessors were seen as key mediators in the process of gaining access to the infrastructure on the part of clients, and capable of improving the quality of data collected through this process of assessment through their own experience and expertise. This level of contextual knowledge was vital in assuring access to the infrastructure, as related in the below quote from a participant in a leadership role in Community Courts:

“This individual, [who] did have... developmental disabilities and had been in and out of prison and jail for his behavior, when asked, ‘Do you have access to food?’ He said yes. And his access to food was eating out of the dumpster. And we knew that because we would see it...”

Finally, the nature of the VI-SPDAT as prioritizing through vulnerability, affords counter-intuitive engagement with infrastructurally-mediated resources, where reductions in apparent factors of vulnerability rendered clients more vulnerable due to scoring more poorly on the assessment. As related by the below participant, who held a leadership role in a veteran-specific organization:

“This person is very ill, and he's gonna get out in a week when his IV antibiotics are done. If they're in a hospital, they're determined safe... So, it's like, you have to wait till they're back in a really horrible position... all that to say is like, there's just not a thorough assessment tool, and there's not a push. And I think there's also lack of, like, providers sometimes don't know what to do, when that happens, because it takes a lot of advocacy.”

Across these findings, an image emerges of the VI-SPDAT as a necessary point of mediation between infrastructural resources and those who need them, and thus a facet accreted to that infrastructure. It is, however, significantly complexified by its fit with prior infrastructure and its need for ongoing maintenance and advocacy following the completed assessment. This is further complicated by how the VI-SPDAT's technical features were found to be potentially productive of inequity. However, in generating initial data traces within the CoC's knowledge infrastructure, the role of a coordinated assessment tool was seen as vital for coordination and collaboration among service providers beyond the federal mandate from which it originated.

DISCUSSION

The infrastructural perspective is a vital lens for uncovering the relational complexity of novel systems, especially those intended to support knowledge sharing and resource provisions. We considered in this paper the negotiations, dynamics, and relationships that enable the ongoing provisional maintenance of a knowledge infrastructure deployed by the City of Austin to coordinate and collaborate among the many governmental offices, community-based organizations, and non-profits that provide services, often disconnected and parallel, to those on the homelessness continuum. As a result, implicit knowledge and lived experience with negotiating this system on behalf of clients/service users was vital for effective navigation of the infrastructure, and shared success stories often related where this knowledge, born primarily of experience and history, was able to facilitate service access where other means was unsuccessful, in line with Star and Ruhleder's assertion that infrastructures are learned as a part of professional practice (Star and Ruhleder, 2001).

Coordinated assessment in general, and the VI-SPDAT in particular, is a clear illustration of the negotiations and invisible maintenance work (Jackson, 2004; Star & Strauss, 1999) that go into the development of knowledge infrastructures intended to address areas of vital social concern. Even when in possession of knowledge as to the shortcomings of the instruments, participants nevertheless continued to reference the assessment process as a major portion of how services are initially considered. In many ways, the VI-SPDAT could be *any* survey at all - what was related as valuable was less the specific information collected, and more in its role of initiating the ‘chain of reference’ in the system as it generates initial traces within the infrastructure. This fits well with Anand's (2015) notion of infrastructure as flaky accretion. Similarly, the need for trained assessors mediating access to the service infrastructure fits well with Buchanan, Jardine, & Ruthven's (2018) findings relative to the importance of information intermediaries.

Missing data traces were both a logistical hurdle for interviewed service providers and a key loss of agency over data among service users. Repeated and redundant collection of data as traces were siloed or lost, gaps in understanding how the data was being used to prioritize, and a lack of knowledge on where and how data exist about an individual, all happen when traces and interconnectedness of represented data are lost. While on the one extreme surveillance and potential targeting might be of significant concern (Clarke, Parsell, & Lata, 2020), on the other a lack of system visibility erodes rights of access to support. This Continuum of Care and its attendant systems represents a growing knowledge infrastructure, the negotiations and dynamics of its adoption and ongoing maintenance work (Jackson, 2014) encapsulating the ‘long now’ (Ribes & Finholt, 2009) of infrastructure development. Key to the operation of this system was how fragile data traces within the system become durable through ongoing supplemental, and often invisible, efforts on the part of those providing services and mediating

access to the infrastructure. As such, justice, in the infrastructural perspective, is closely related not only to the technical characteristics of the systems that accrete to form that infrastructure, but also to the daily, iterative and reflective, practices of those working through that infrastructure. As such, we identify here a need for further work understanding not only how infrastructures are built and used, but how they are maintained, repaired, iterated, and managed towards achieving social and political goals.

CONCLUSION

This paper evaluates this assessment and explores its role in initiating traces and structuring engagement within a knowledge infrastructure. The invisible work (Star & Strauss, 1999) of managing, negotiating, and maintaining these traces was vital to effective service provision through the system. Coordinated assessment is federally required for those communities seeking federal funding to address and ameliorate homelessness in a specified region. However, extant tools are general in scope, often undertested, and inconsistently linked with positive outcomes for served communities and service providers. This work raises the question: is the VI-SPDAT *a* just infrastructure, or is it *just* (only) infrastructure? Tools like the VI-SPDAT, as the first point of contact, more immediately raise questions of just and equitable access to infrastructure, but are often dismissed as unrepresentative, flawed tools, rather than consequential dynamics of that infrastructure in practice—as being just (only) infrastructure. Explorations of infrastructural justice do not effectively respond to studies of infrastructure that do not consider its temporality (Appel, Anand, & Gupta, 2018), and see it as a stable and consistent set of systems.

Infrastructure, in practice, is a messy, uncoordinated accretion (Anand, 2015) requiring constant maintenance, repair, and adjustment. So too is the VI-SPDAT. Even with the best intentions, tools are often chosen according to ineffectively defined needs or in the absence of a full understanding of the problem space. Each solution is not perfect and usually comes with unintended consequences, and usually in either development or fielding of a tool, we blame the tool instead of the gap in policy or process. It is perhaps too easy to dismiss the VI-SDPAT as inequitable or unjust solely due to some aspect of its design, rather than considering it to be, like all infrastructure, a “flaky, falling apart form” (Anand, 2015, para. 1) that grows through a regime of ongoing maintenance and adjustment. Generally, medicine and law are seen as life-and-death professions, warranting greater care in licensing of professionals in these fields. Physical infrastructures such as bridges, roads, and electricity service provision are of similarly high stakes. The VI-SPDAT provides a compelling example of how data, information, and knowledge infrastructures can share these life-and-death consequences.

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MetaFAIR: A Metadata Application Profile for Managing Research Data

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ABSTRACT

This paper reports on the development of a metadata application profile (AP), MetaFAIR, designed to support research data management (RDM) to make research data findable, accessible, interoperable, and reusable. The development of MetaFAIR followed a three-step process that included learning about the characteristics of datasets from researchers to establish their context and requirements, as well as iterative design and testing with researchers' feedback. Guided by the FAIR principles (Findability, Accessibility, Interoperability, and Reusability), MetaFAIR focuses on accommodating description needs particular to computational social science datasets while seeking to provide general enough elements to describe data collections across many different domains. In this paper, MetaFAIR is placed in the context of historical and recent developments in the areas of RDM and application profile creation; following this contextualization, the paper describes the central considerations and challenges of the MetaFAIR development process and discusses its significance for future work in RDM.

KEYWORDS

Research data management; metadata application profiles; DCAT; FAIR principles.

INTRODUCTION

Research data management has evolved significantly over the last 16 years since the pioneering report on scientific data management by Gray et al. (2005) was published. During this time, metadata standards, best practices, policy mandates, and the FAIR principles have worked in orchestration to create an ecosystem for research data management. The FAIR principles refer to the four high-level guiding principles that contemporary data publishing environments should support in order to make research data findable, accessible, interoperable, and reusable. As Wilkinson et al. (2016) indicate in their defining paper for the FAIR principles, metadata is the underpinning of data findability, accessibility, interoperability, and reusability in the deposition, exploration, sharing, and reuse of research data. Although the level of awareness of the need and importance of managing research data has improved a great deal compared to the first decade of the millennium, there are still many obstacles and challenges to making research data FAIR. The first of such obstacles and challenges is the gap between metadata standards at the global level and description needs at the local level. The idiosyncrasies of different disciplinary fields create data complexities that are often unique to a field, while a metadata standard for research data must be general enough within the limit to accommodate metadata description needs from all fields under a broader disciplinary domain. The fact that almost all data repositories use metadata schemas modified from one or more standards is the best illustration of such a gap.

The second obstacle is the grey area between local research data management (RDM) and formal RDM at a community repository. By grey area of RDM we mean that there are many questions to be answered and decisions to be made before the RDM practice transitions from local to community repositories. For example, what should be done with raw data, intermediary data, and final data used for publications? What are the criteria for long-term preservation and access? How should data be described and represented for easy discovery and reuse? What metadata standards are suitable for adoption if metadata descriptions are needed at local RDM level? Answering these questions will require someone who has a deep understanding of the research data to be managed as well as the knowledge of metadata, FAIR principles, and data modeling, among other areas. Finally, RDM is still an area of work not high on researchers' priority list because of the fact that it is time consuming and carries little weight in promotion and tenure decisions, which have been the subjects of extensive discussion in recent literature (Curty et al., 2016; Neylon, 2017).

This paper reports a case study of managing a research data collection for a project team through the development of a metadata application profile. An application profile (AP) is a metadata schema that draws elements from

established standards (i.e., source schemas) with or without local adjustments and locally defined elements. AP examples are described in the Literature Review section below. The data collection under consideration was created as part of the GenBank Metadata Analytics project carried out by the Metadata Lab at Syracuse University, which started in 2013 and is ongoing. Situated at the intersection of network science and scientometrics, this project investigates collaboration networks between scientists who submitted datasets and had publications listed in NCBI's GenBank database (Bratt et al., 2017; Costa et al., 2016). Some of its main goals include showing what kinds of collaborations have occurred over a multi-year timespan, and what kinds of collaboration networks for data submissions preceded the production of scientific publications. The data collection contains a range of different types of data objects, such as CSV files, code (R and Python scripts), log files, .rda files, PNGs, PDFs, and Word documents.

The case study reported here will begin with a discussion of the pre-RDM work, which includes analyzing the data collection, assessing the needs for data discovery, reuse, and quality control, and surveying major metadata standards for adoption/adaptation. In the process of designing the metadata model, we ran into many decision-making situations that required considerations based on use scenarios and visions for broader data sharing and reuse as well as long-term curation.

LITERATURE REVIEW

The creation of a metadata application profile (AP) requires an understanding of researchers' data practices as well as the needs for data sharing and reuse. The FAIR Data Principles (Wilkinson et al., 2016) provide clear guidelines for AP developers to explicitly focus on data sharing and reuse, rather than treating them as givens in the process. This literature review will focus on how metadata application profiles relate to the concepts of data sharing, data reuse, and FAIR.

Data Sharing and Data Reuse

The RDM process can be viewed as a cycle that involves a series of actions: collect, process, store and secure, use, share & communicate, archive, reuse & repurpose (Miller et al., 2018). The goal of RDM is to make data findable, accessible, interoperable, and reusable. Some common steps in this process can be seen in many academic libraries' guides to RDA, for example, the University of Pittsburgh Library System (2020) considers finding data, organizing data, describing data, storing data, and sharing data as parts of RDM services. Data sharing is the practice of making research data available for other scholars, and data reuse is the incorporation of that shared data in new research. The dynamics of sharing and reuse constitutes a continuum that involves "primary reuse," "data integration," and "data release." Primary reuse uses existing data as the primary resource for a research study without collecting any original data. Data integration is another method of data reuse that integrates existing data with original data generated for a study. Data release is the process of making original data independently available for future reuse (Sakai et al., 2020, p. 1). These definitions depict common methods by which researchers work with data in their research. For instance, the developers of a research data repository may be primarily concerned with storing experimental data within that system and making the information publicly available. This would be an example of data release. Other researchers may use the data in the repository to test new hypotheses. Depending on whether they wholly use the shared data or augment it with original research, this practice would either be an example of primary reuse or data integration. Thus, both data integration and release are forms of data reuse. Based on the work of the University of Pittsburgh Library System (2020) and Sakai et al. (2020), data sharing and reuse can be understood to be the two ends of the continuous cycle of scientific research. In the past five years, the release of the FAIR Data Principles has caused data sharing and reuse to shift from being latent concepts to being a focus of RDM scholarship.

The FAIR Principles

Wilkinson et al.'s (2016) FAIR Data Principles have become a landmark framework in RDM. The guidelines dictate that data and metadata should be findable, accessible, interoperable, and reusable (Wilkinson et al., 2016). Each part of the framework contains four clauses that explain the concepts in further detail. Wilkinson et al. (2016) explain that the driving factor for developing FAIR was to support "discovery." As they explain, "Good data management is not a goal in itself, but rather is the key conduit leading to knowledge discovery and innovation, and to subsequent data and knowledge integration and reuse by the community after the data publication process" (Wilkinson et al., 2016, p. 1). The "data publication process" refers to data sharing, and "knowledge integration and reuse" is data reuse. Therefore, the concepts of data sharing and reuse are at the core of the FAIR Data Principles. Just as data sharing and reuse are prevalent across scientific fields, FAIR is relevant for a wide array of applications. As Wilkinson et al. (2016) affirm, "These high-level FAIR Guiding Principles precede implementation choices, and do not suggest any specific technology, standard, or implementation solution; moreover, the Principles are not, themselves, a standard or a specification" (p. 5). This indicates that the FAIR Data Principles can be used to augment a wide array of RDM practices, including the development of metadata application profiles.

Recent scholarship on data sharing and data reuse supports the ideas that Wilkinson et al. (2016) present with FAIR. In a qualitative study of the perceptions of data reuse among social scientists, Curty and Qin (2014) found that scientists may not reuse data because of “perceived risks” and the “perceived effort required” (p. 3). However, Curty and Qin (2014) also noted that “social influences” and the “availability of facilitating conditions” both have a positive effect on whether social scientists reuse data. Using FAIR in RDM, especially when developing metadata application profiles (which themselves are built on the concepts of data sharing and reuse, as discussed below), can alleviate researchers’ concerns about data reuse. Literature published after the FAIR Data Principles elaborate on the framework with the ideas of data sharing and reuse. Pasquetto et al. (2017) argue that the benefits of data sharing are contingent on the ease of data reuse. They identify the FAIR Data Principles as a “promising new development” to boost the effectiveness of scientific data reuse (Pasquetto et al., 2017, p. 3). Groth et al. (2020) note how data citation infrastructures like repositories already present a potent way to share and reuse data via FAIR. Scholars have also advocated for the FAIR principles as a way to begin to address disciplinary data concerns. Reiser et al. (2018) call for biologists to foster data reuse by following a checklist inspired by FAIR when publishing their research data. Similarly, Lannom et al. (2019) suggest that research institutions use FAIR when digitizing specimens in biodiversity science and geoscience, especially so that information may be reused in related fields. In systems medicine, McQuilton and Sansone (2021) identify the community-driven tool FAIRsharing as a beneficial way to find “data and metadata standards, databases, and repositories” for the purpose of sharing data (p. 1). RDM researchers can support the growing use of the FAIR Data Principles through tools like metadata application profiles.

At a macroscopic level, research policies around the globe have been shifting to incorporate the FAIR Data Principles (Reiser et al., 2018). The European Commission, the executive branch of the European Union, has cited FAIR as a driving factor in the development of the European Open Science Cloud (Hill, 2019; Mons et al., 2017). The Australian National Health and Medical Research Council recommends that the country’s institutions and researchers implement FAIR (National Health and Medical Research Council, 2019). In the United States and Canada, forthcoming policies from the National Institutes of Health and Tri-Agencies will recommend that intuitions and researchers look to FAIR for guidance as part of their RDM practices (Government of Canada, 2021; National Institutes of Health, 2020). The widespread acceptance of the FAIR Data Principles by scholars and nations indicates that this framework is beneficial for new metadata application profiles to emulate.

Metadata Application Profiles for Research Data

Metadata application profiles are created by adopting elements from one or more metadata standards to meet specific metadata description needs that one metadata standard alone would be insufficient to fulfill. Application profiles predate the FAIR Data Principles and are considered as a type of metadata schema (Hillmann & Phipps, 2007) consisting of “data elements drawn from one or more namespaces, combined together by implementors, and optimised for a particular local application” (Heery & Patel, 2000). As such, application profiles typically mix only those relevant properties from different standard metadata schemas for the purpose of describing resources in a particular context (Tennis, 2015). Notably, this idea of “only those relevant properties” means that those who create application profiles should be cautious of not overextending their schemas. Other researchers discuss the intricacies of application profile development. For instance, Coyle and Baker (2009) describe guidelines for creating a Dublin Core Application Profile. They note that “application profiles promote the sharing and linking of data within and between communities” (Coyle and Baker, 2009). Thus, application profile development features both data sharing and data reuse. Namespace schemas serve as mechanisms to share metadata elements with the RDM community, including application profile creators. In turn, implementors reuse those elements for new schemas. The purpose of application profiles in RDM also fits into the cycle of data sharing and reuse as they are the customized versions of standard metadata vocabularies and developed with the aims to meet needs for data description, organization, discovery, and reuse in the disciplinary or field they serve, which facilitate FAIR data and boost scholarly data reuse.

Although fully adopting a metadata standard without customization is rare in research data repositories, e.g., Interuniversity Consortium for Political and Social Research (ICPSR) uses the Data Documentation Initiative (DDI) exclusively, creating metadata application profiles for research data repositories has been an established practice since the early 2000s. The large number of biomedical data repositories at the National Center for Biotechnology Information (NCBI) all have their own metadata schemas and many of them pre-date the digital era. Examples of well-known modern data repositories include the Dryad that uses terms from Dublin Core and Darwin Core namespaces (Krause et al., 2016), and the Dataverse Project’s metadata model that incorporates vocabularies from DataCite 4.0, Schema.org, and DCAT/RDF to support data discovery function as well as from other specialized standards for preservation, provenance, and privacy (Castro, 2016). The FAIR data requirements and development in metadata application profiles raise both the necessity and feasibility for us to develop the MetaFAIR application profile for a computationally intensive social science domain.

METHODS

The GenBank Metadata Analytics project has produced a large collection of research data that come in a wide range of data types and formats. Before the metadata application profile development started, we had to address several questions fundamental to metadata description. While it is clear that the description unit would be dataset, what a dataset is and how to determine the boundary to separate one dataset from another required careful consideration and discussion. We analyzed the data collection to understand the general characteristics (contents) as well as more detailed aspects of the different types of data, code, and documentation, and their relationships to one another. One of the central challenges of this process was structuring the AP so that it would be able to capture the unique qualities of this particular data collection, while also ensuring that it will be efficient and effective in describing other datasets and data collections. In the context of this project, we define a dataset as a complete set of data and code files that are used to produce the analysis results designed to address one or more coherent research questions. A dataset may be accompanied by output files, which may be transformed data, higher-level of processed data, visualizations, and/or merged data generated from data fusion. This Metadata for FAIR Data (MetaFAIR) project went through a three-step process.

Step One: Establishing the context

The MetaFAIR AP has the mission of facilitating the need for managing data generated from computational social sciences research. It is therefore imperative to understand the research lifecycle, data and work flows, and the characteristics of data generated from the research lifecycle. The initial analysis included informal, semi-structured interviews (with Institutional Review Board application filed) with members of the Metadata Lab team who were involved in the GenBank Metadata Analytics project, and who thus had greater domain knowledge and familiarity with the data collection. Interviewing these team members helped the authors to determine not only the characteristics of the datasets, but also important aspects of the research lifecycle and requirements of researchers in terms of supporting FAIRness (Wilkinson et al., 2016). These informal meetings/conversations took place over a period of seven months and served as the basis for the general analysis of the collection; furthermore, they were part of a process of iterative testing and design for the application profile.

The questions asked of interviewees were designed to establish 1) practices and habits of researchers in working with data, and 2) key attributes most important for researchers to describe, find, and locate data files. The former will help metadata creators understand and identify components of a dataset and make necessary references and connections when creating metadata descriptions, while the latter can validate and reinforce the metadata element selections from established standards. Based on the interview results, the interviewers generated a list of elements that were considered to be most effective for describing the data collection. This process supported our research on DCAT 2 as a potential source schema because of the range of properties it offers for describing different components of datasets and their related resources. Subsequent interview conversations focused on a discussion of which properties from this vocabulary would be most useful for researchers in the domains of network science and scientometrics.

One example of a DCAT property that was an early choice for inclusion in the profile is “temporal coverage.” The GenBank Metadata Analytics data collection includes datasets and visualizations for a period spanning the years 1992 to 2018, so the ability to describe temporal coverage was central. Although the property “spatial/geographic coverage” was not a significant element as of the time in developing this AP, it is a popular measure in computational social science data and may appear in future datasets, hence was included in the AP. Other DCAT properties identified as useful to the purposes of this AP were the multiple properties for describing access and rights information, as well as technical information about format and media type.

In the first interview, it was also noted that this data collection includes code files (specifically, R and Python scripts) that were used with the project datasets to perform analysis and produce visualizations. For this reason, we established that the profile should include elements for describing computational programming scripts and related data objects that make up a significant part of the collection, such as .rda files.

Another important consideration was how the AP could allow for description of dependencies among the files in the collection and between stages in the workflows that produced the files. This type of description would be important for any researchers who wish to reuse the data produced by the GenBank Metadata Analytics project, as well as the methodologies employed in data processing, transformation, and aggregation. Further discussion in the interview also covered various possibilities of how the datasets might be stored and made accessible in a repository of the type provided by Harvard Dataverse, ICPSR, and Figshare.

Step Two: Specifying the vocabularies

Having identified the source schemas and selected an initial set of elements, the profile structure began to take shape. In addition to DCAT 2, we also examined DataCite 4.3 and identified useful properties for specifying different types of agents, as well as relationships among different data objects. With the initial set of elements in

MetaFAIR AP, we went back to the GenBank Metadata Analytics project team. The aim was to define a set of terminology associated with the data collection in order to create locally controlled vocabularies for use with the AP. It was determined that two local vocabularies were needed. One vocabulary would be used for describing the subject(s) of the collection (and of individual data objects within it), accounting for both “of-ness” and “about-ness.” The other, smaller vocabulary would be a term list for describing dependencies that exist between the data objects.

Step Three: Testing and evaluating

Once the AP structure had been implemented as an XML schema, we created sample records using this schema to test the schema and assess whether the XML schema could capture the relationships between data objects accurately and efficiently. This process was iterative – we modified and tested the schema until it exhausted all possible description requirements we knew. The relationships between data objects in the collection were reviewed, and the sample records were examined in order to confirm that the relationships and dependencies recorded were correct. A central question at this point was whether the relationships and dependencies among the data objects would be best captured through the local element “dependency” or through the “related identifier” and “relation type” properties from DataCite 4.3. The answers that the team reached regarding this question are detailed below. In this final stage of the interview process, possible future adjustments and additions to capture more specific elements of dependencies and other relationships were noted.

Feedback and insights from the interviews were crucial to the design of the AP structure, which was established through a combination of top-down and bottom-up approaches, with the FAIR principles as guiding determinants of which elements should be included and how they should be organized. Once the main modules had been determined (see below), elements were selected from DCAT, DataCite, and other source schemas, and arranged within each module. The authors determined that a nested structure would be the best choice for enabling more granular descriptions and clarifying the relationships between elements. Because the development and goals of the AP are rooted in the FAIR principles, the team decided on a fitting name: the MetaFAIR Application Profile.

It should also be noted that throughout the process of creating the MetaFAIR AP, the Metadata Lab team engaged in *collaborative documentation*, defined by Bratt et al. (2017) as “a team-based effort to record goals, rationales, strategies, steps and activities [for search, reuse and informational purposes]” (p. 38). This documentation took a variety of forms, including general brainstorming notes, recordings of team meetings on Zoom, lists of desired elements and vocabulary terms, tables of elements from matched schemas, and drafts of the overall schema structure. These materials were organized and stored in a shared Google Drive.

RESULTS

The MetaFAIR AP includes a total of 39 elements in its current form (see Figure 1). As noted above, the elements are arranged into five top-level modules, which contain elements and sub-elements. The modules are based on categories of metadata that the authors determined would be most important for ensuring that the profile adheres to the FAIR principles. The five modules include: *Agent*, *Descriptive*, *Access*, *Technical*, and *Provenance*, as shown in Figure 1.

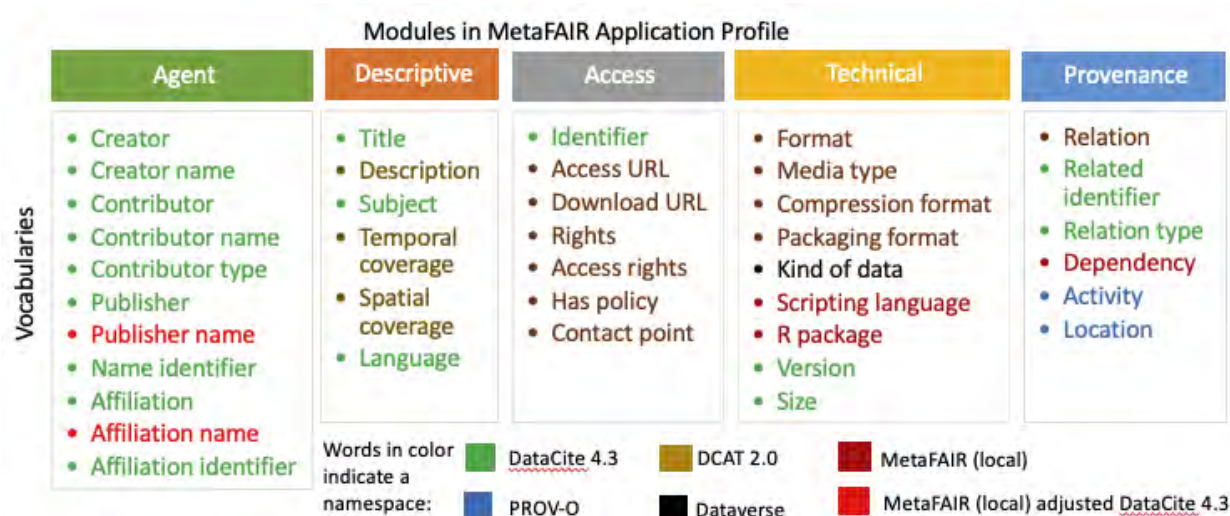


Figure 1. Models and vocabularies in the MetaFAIR Application Profile

The elements included within these modules reflect the domain-specific characteristics of the GenBank Metadata Analytics project data collection; at the same time, they provide flexibility and extensibility that will enable the description and FAIRification of other datasets (GO FAIR Initiative, 2021).

Most of the elements were drawn from existing schemas, with some additional elements created locally. As noted above, the two main source schemas are DCAT 2 and DataCite 4.3, a large portion of which come from the DC terms. These schemas provided elements that enable general and broadly-focused descriptions of the five areas reflected in the modules. To allow for more granular descriptions of data types, the provenance of data objects, and relationships among files, a few elements were also taken from the Provenance Ontology (PROV-O) and the Dataverse citation metadata block. Elements drawn from PROV-O include “location” and “activity”; the element from the Dataverse citation metadata block is “kind of data.” Even more important to facilitating the granular descriptions of data types, sources, and relationships are the locally-created elements, “scripting language,” “R package,” and “dependency,” which are discussed in more detail below.

The MetaFAIR AP supports **findability** and **accessibility** through elements and attributes that enable the inclusion of permanent identifiers for data objects, agents, and institutions. Many of these elements are situated in the “Access” module, though they can also be found in the “Agent” and “Provenance” modules. The “Access” module includes a required “identifier” element (to provide a permanent ID for the data object), as well as optional elements for “access URL” and “download URL.” The element “contact point” ensures that researchers exploring the data collection will be able to contact the agents associated with the project with any questions about accessing or using the data.

Interoperability and **reusability**, meanwhile, are supported through the MetaFAIR AP’s highlighting of relationships and dependencies among objects in the data collection. The locally-created elements “dependency,” “scripting language,” and “R package” are crucial in this regard. The elements “scripting language” and “R package” were created to ensure that the MetaFAIR AP could be used to describe the Python and R scripts in the collection and the components upon which they depend, such as packages. We debated about whether to use a programming language specific element or to use a more generic element name for representing the specific software component associated with the script and dataset. In theory, a more generic element name for this purpose would allow for broader applicability to datasets in other fields/domains, and R package may become outdated term as technology evolves. We resolved to keep this element name for the current version as the term R package is unique and widely used and recognized in multiple disciplinary fields. It is also an important piece of information for the reuse of code and datasets. Singling out this detail in dataset metadata would increase the discoverability of datasets by this unique property while this piece of information can be automatically acquired from the script file.

The “relation” element from DCAT 2 contains the local element “dependency” as a sub-element, along with two sub-elements drawn from the DataCite 4.3 schema: “related identifier” and “relation type.” Because the processes and activities that produced this data collection involved dependencies (not only between scripts and packages, but also between scripts and visualizations, scripts and datasets, and workflows), the element “dependency” (and its associated term list) will ensure that researchers examining this data collection can understand how the data objects were produced and how they are related to each other. The dependency relation establishes trackable traces from the creation of datasets to processing steps to analysis results, which builds the foundation for trackability and reproducibility, an important characteristic of open science. A clear understanding of these relationships and workflows is crucial for supporting reuse of the datasets (and/or the research methods used) in future projects. The dependency types included in the locally-created list and their definitions are as follows:

- RCodeDependency: describes any R package or other part of R code necessary to the data analysis/output
- AnalyticDependency: describes any relationship between datasets in which one dataset is reliant upon the other; for example, dataset A produced dataset B
- SequentialDependency: describes any processing or workflow in which one output depends upon another; for example, step A preceded step B
- TechnicalDependency: describes any processing, analysis, or workflow that depends upon a certain type of software or other technical element
- EntityDependency: describes any processing, analysis, or workflow that depends upon a certain resource; broader in scope than TechnicalDependency

The development of these types and their definitions was influenced by the dependency taxonomy presented by Strode (2016). This taxonomy was created for the domain of agile software development projects, but its categories and concepts proved useful in helping the Metadata Lab team to articulate the types of dependencies we needed to describe. While the “dependency” element is meant for descriptions of specific dependency-type relationships, the

“related identifier” and “relation type” elements allow for more general descriptions of data object relationships. The “relation type” element is intended for use with the list of relation types provided in DataCite 4.3.

Reusability is also supported through the “rights” element and its sub-elements, “access rights” and “has policy.” The former is intended to provide a more general description of whether access to the data object is restricted or non-restricted, while the latter can be used to specify policies from the ODRL model.

In addition to the local elements described above, two other elements were also created locally as variations of properties from DataCite 4.3. These include the sub-elements “publisher name” and “affiliation name.” Since the AP included the DataCite properties “creator” and “creator name,” as well as “contributor” and “contributor name,” it seemed best to establish more consistency within the overall structure by also including “name” sub-elements for “publisher” and “affiliation” (which, in the DataCite 4.3 schema, do not have such sub-elements).

The MetaFAIR AP has been encoded as an XML schema. In the process of XML schema creation, some elements were reconsidered and incorporated as attributes, in order to streamline the schema structure. For example, elements from DataCite 4.3 enabling the description of identifier schemes and scheme IDs (e.g., “name identifier scheme,” “scheme URI,” “affiliation identifier scheme,” “Scheme URI”) were reworked into attributes for their respective elements (e.g., “name identifier,” “affiliation identifier”). Within the XML schema, the vocabulary for dependency relationships is incorporated as a set of enumerated values for the “dependency” element’s “type” attribute. The other locally-created controlled vocabulary for subject terms, which is significantly longer, is not incorporated into the XML schema, but will be provided as a separate list of terms.

DISCUSSION

The MetaFAIR AP demonstrates how the FAIR principles can be applied to create a metadata element set that facilitates data reuse and sharing through more effective RDM. As the methods and results described above illustrate, developing such an element set requires striking a balance between elements for general descriptions that are applicable across many domains (title, description, subject) and those for describing dataset characteristics that are specific to a particular domain and/or project. Furthermore, the inclusion of elements for describing relationships and dependencies among data objects and workflows reflects the importance of this type of information for ensuring that researchers can discover dataset by employing attributes specific to their domain of research and reuse various kinds of data objects with a good understanding of the reusability of datasets. In this way, the MetaFAIR AP seeks to support both the primary reuse and data integration described by Sakai et al. (2020) through more effective data release.

The development process of MetaFAIR AP also illustrates the vital role that locally controlled vocabularies and term lists can play in making it possible for an application profile to meet general and domain-specific description needs. The locally controlled vocabularies that the Metadata Lab team created allow the MetaFAIR AP to more effectively and thoroughly describe the type of scientometrics and network science data and methodologies for which it was designed. At the same time, the MetaFAIR AP also supports use of other controlled vocabularies such as the Library of Congress Subject Headings (LCSH). The process of creating controlled vocabularies, as well as the broader task of determining the structure and source schemas for the AP, highlighted the need for regular consultation with the researchers who produced the data collection. Information professionals and the domain specialists with whom they work should be in close contact throughout the AP creation process, and iterative design/feedback is key for ensuring that data collections can be more effectively shared and reused. In this way, such collaboration is fundamental to the furtherance of RDM practices that support the FAIR principles.

Likewise, collaboration was a central part of the process of encoding the MetaFAIR application profile as an XML schema. Once an initial schema structure had been developed, it was iteratively tested and evaluated through the creation of sample records. These records were shared with the GenBank Metadata Analytics project team, and the team’s feedback informed adjustments that were made to the schema, such as the reworking of some elements into attributes (described in the “Results” section). In creating the sample records, the Metadata Lab team made sure to use various types of files from the data collection in order to evaluate how well the schema captured unique characteristics of different data objects and the relationships between them. For example, one sample record was created for an R script that was used in the production of network powerlaw plots for data from every year included in the project (1992-2018). The relationship between this script and the powerlaw plots derived from it was recorded in the “relation” element, using the relation type vocabulary provided in DataCite 4.3 (“Is Derived From”). Additionally, the “dependency” existing between these files was noted using the “R Code Dependency” type. These relationship descriptions were reviewed with the project team to ensure not only that they were accurate, but that the manner in which they were recorded would support further sharing and reuse of the project’s data and methodologies.

The next stage of the Metadata Lab's MetaFAIR project will focus on taking advantage of the potential for data FAIRification that is offered by data repositories, as noted in Groth et al.'s discussion of FAIR data reuse and data citation (2020). The team is currently investigating how the MetaFAIR AP might be integrated into a data repository system. This repository would serve not only to host the GenBank Metadata Analytics project data collection, but also to develop new ways of disambiguating contributor names of the type that are central to the aforementioned project and big metadata analytics. These efforts will take advantage of the emphasis that the MetaFAIR AP places on the use of name identifier schemas such as ORCID and ROR. A repository with the capability to identify entities in large datasets would be an important contribution not only to network science and scientometrics, but to the wider ongoing initiatives towards named entity disambiguation (Smith-Yoshimura, 2020; Wang & Iwaihara, 2019).

CONCLUSION

The MetaFAIR AP will help to make the data collection of the GenBank Metadata Analytics project findable, accessible, interoperable, and reusable for research communities beyond the GenBank Metadata Analytics project team. On a broader level, it is the authors' hope that the MetaFAIR AP can serve as a model for future work in managing research data generated from computational social sciences. The furtherance of the FAIR principles for RDM is of significance not only for the support of individual projects across research domains but also for the development of institutional, national, and international policies and initiatives (Reiser et al., 2018). The FAIRification of RDM has the potential to shape the future of data sharing and reuse, facilitating new developments in many different kinds of research (GO FAIR Initiative 2021).

ACKNOWLEDGMENTS

The GenBank Metadata Analytics project is supported by grants from National Science Foundation (award # 1262535 and #1561348) and National Institute of General Medical Sciences (award #1R01GM137409-01). The authors thank the assistance of the project team in developing the MetaFAIR AP.

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A Mixed-Method Usability Study on User Experience with Systematic Review Software

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ABSTRACT

Systematic reviews are widely used in evidence-based medicine. Conducting a systematic review requires intensive mental efforts, especially during the study screening process. This challenge has motivated the development of intelligent software. This study examined and compared the performance, workload, and user experience of two systematic review tools – Colandr with Artificial Intelligence (AI) features and Covidence without AI features by conducting a mixed-method usability study. The results showed that reviewers had higher precision in citation screening using Colandr than using Covidence. However, the user experience with Colandr was not optimal due to problems in its user interface design. Therefore, we suggest that the design and development of AI-enabled SR software emphasize the usability of the interface and apply user-centered design principles.

KEYWORDS

Human-computer interaction, subjective workload, gaze fixation, user-interface design, systematic review

INTRODUCTION

A systematic review (SR) attempts to exhaustively collate all eligible empirical evidence to answer a specific research question through literature search, evidence evaluation, and results synthesis (Higgins et al., 2011). Widely adopted across disciplines, SRs are particularly important in evidence-based medicine in healthcare settings (Ganeshkumar & Gopalakrishnan, 2013; Kohl et al., 2018; I. J. Marshall & Wallace, 2019). However, conducting SRs is time- and labor-intensive as it must follow a rigorous research protocol that aims to reduce bias, increase transparency, and present the highest level of evidence from the included studies. To ensure reproducible and accurate findings, a systematic review usually takes at least six months to a year and three to five team members to complete (Borah et al., 2017; Howard et al., 2016), which covers a range of research activities such as formulating the research question, searching the literature, managing citations, developing inclusion/exclusion criteria, screening studies, synthesizing evidence, and writing and publishing manuscript (Khan et al., 2003; Muka et al., 2020).

Among all the stages in an SR research protocol, screening studies is particularly tedious due to the overwhelming workload associated with manual selection of relevant studies from thousands of articles (Bramer et al., 2017; Przybyła et al., 2018; Wallace et al., 2010, 2012). To minimize bias, at least two reviewers must independently identify eligible studies by going through the title and abstract of each article with their pre-defined inclusion/exclusion criteria. Once titles and abstracts have been screened, reviewers will move to the full-text screening of candidate articles and finally decide whether they should be included. Due to a significant amount of time and human resources consumed by study screening, SR software applications have been developed to relieve the burden on researchers (Gates et al., 2019; Wallace et al., 2010, 2012). Some solutions are embedded with Artificial Intelligence (AI) features such as text mining and machine learning techniques (I. J. Marshall & Wallace, 2019; O'Mara-Eves et al., 2015; Olofsson et al., 2017), aiming to expedite the study screening process by reducing SR workload and time.

Research has shown that SR software with AI features can significantly reduce workload and save screening time, but at a high risk of mistakenly excluding relevant records (Gates et al., 2018; Giummarra et al., 2020; Ouzzani et al., 2016). In addition, the performance and usability of the SR software varied depending on the algorithm, size of the review, complexity of the study, and specific research domains (Rathbone et al., 2015). The International Collaboration for Automation of Systematic Reviews (ICASR) recently identified “a shortage of studies showing the benefits of screening systems in a variety of scientific disciplines” and called for better understanding and validating

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available automated tools (O'Connor et al., 2018). Therefore, to continue building empirical evidence for SR software assessment, this study investigated two software applications (i.e., Colandr and Covidence) that can facilitate SR reviewers with citation screening. While Colandr is equipped with machine-learning features, Covidence is not. The research questions (RQs) include:

RQ1: Can Colandr improve reviewers' performance and reduce their workload during the SR screening process compared to Covidence?

RQ2: How is the user experience with Colandr compared with Covidence?

RELATED WORK

SR Tools

ICASR used "tool" to refer to a software application with a user interface that fully or partially automates a task conducted by systematic reviewers" (O'Connor et al., 2018). Among more than 30 SR tools developed to streamline study selection (C. Marshall & Sutton, 2014), Abstrackr (Giummarra et al., 2020; Rathbone et al., 2015; Wallace et al., 2012), Colandr (Cheng et al., 2018), Covidence (Couban, 2016), DistillerSR (Gates et al., 2019), Rayyan (Cleo et al., 2019; Ouzzani et al., 2016), and RobotAnalyst (Przybyła et al., 2018) have been reported publicly for their features supporting collaborative citation screening, in which "multiple reviewers can simultaneously screen citations" (Wallace et al., 2012). All these six tools are web-based, while Rayyan provides an additional mobile app that reviewers can use offline. DistillerSR and Covidence are pay-for-use tools, while the other four tools are free to access. Except for Covidence, the other five tools adopted AI features that primarily prioritize the citations that are most likely to be relevant so that they can be screened first (Gates et al., 2018). This means that reviewers can better focus on study screening and selection and potentially save workload and time (Shemilt et al., 2014).

SR Tool Testing

Since many SR tools with AI features were developed in recent years, studies associated with validation and usability testing of the tools are very limited. The available publications are mostly about publicizing the novelty of the tools, explaining AI algorithms, and providing small-scale empirical data to substantiate their effectiveness.

Performance

The performance in SR tool testing included sensitivity/recall (true positive rate), specificity (true negative rate), precision, false-negative rate, proportion missed, and workload savings (i.e., the proportion that would not need to be screened manually) (Gates et al., 2018, 2019; Giummarra et al., 2020; Rathbone et al., 2015; Shemilt et al., 2016). Wallace (2012) introduced Abstrackr's machine-learning techniques – active learning and dual supervision and reported some empirical results from a small validation study. Abstrackr was found to be able to reduce the workload of citation screening with a high sensitivity score. Rathbone (2015) found Abstrackr had the potential to reduce SR screening workload, but it depended on the complexity and size of the review. Gates and colleagues (2018) ran a one-year screening testing for Abstrackr, and revealed that the workload savings and reliability varied by screening tasks. The most recent testing is Giummarra's study (2020), in which injury-focused SR citations and full-text articles were screened using Abstrackr. Researchers found that although the tool offered excellent workload and time savings, it cannot replace a human reviewer for full-text screening. In addition to Abstrackr, Ouzzani (2016) introduced Rayyan as a semi-automation tool for abstract screening. However, no quantitative performance measures were reported except qualitative comments from participants in a pilot study. Olofsson's study (2017) showed Rayyan could help reviewers successfully identify relevant studies early in the screening process. Overall, the performance testing of many other SR tools for citation screening is still unknown.

Usability

Therefore the number of studies that formally examined the usability or user experience of SR tools is scarce. Gates's study (2019) explored user experience with Abstrackr in which 11 research staff took one month to complete a screening task and completed System Usability Scale (SUS) to report their experience at the end. Cleo (2019) conducted a qualitative study evaluating user experience with four SR tools. After three invited reviewers independently used the SR tools for self-paced citation screening, they completed a 12-item online questionnaire focusing on the usability and acceptability of the SR software.

With multiple SR tools automating or semi-automating citation screening, researchers compared some of them in terms of performance, usability, acceptance, and reliability. Couban (2016) analyzed the features, usability, and compatibility of Rayyan and Covidence from a librarian's experience and concluded that both tools were user-friendly and capable of supporting title-abstract screening. Gates (2019) used Abstrackr, DistillerSR, and RobotAnalyst in three SRs, respectively, to compare their performance and user experience. His study found that Abstrackr outperformed DistillerSR and RobotAnalyst in reducing the proportion missed and usability. Cleo (2019) assessed the usability and acceptability of Covidence, SRA-Helper for EndNote, Rayyan, and RobotAnalyst,

and concluded that all four tools were easy to learn and use, while SRA-Helper for EndNote was strongly preferred by reviewers.

Overall, the use of SR tools to save workload and time is considered promising. However, SR tool performance varies greatly on review size, topic, complexity, and reviewers' SR experience. Therefore, there is a need for more performance and usability testing of these tools (Gates et al., 2018; O'Mara-Eves et al., 2015).

METHODS

SR Tools

We chose two SR tools, Covidence (www.covidence.org) and Colandr (www.colandrapp.com) for this study. Covidence is one of the SR tools recommended by Cochrane Collaboration (Cochrane Community) and has "the world's largest user community" (Veritas Health Innovation, n.d.). To our best knowledge, when we were conducting this study, Covidence was not reported for adopting any AI algorithms to expedite citation screening, which means reviewers use Covidence to screen the entirety of citation records for study selection in the sequence of when citation records are imported into the software.

Colandr is a free and web-based application for collaborative SR teamwork. It supports title and abstract screening and data extraction powered by machine learning and natural language process algorithms (e.g., word2vec, & GloVE). The algorithms dynamically sort citations by relevance based on user input (i.e., decisions on inclusion/exclusion) and push the most relevant citations to the top for screening first. The developers claimed that Colandr could reduce the effort on identifying relevant citations by five times compared to manual screening (Cheng et al., 2018). However, the effectiveness of Colandr hasn't been clearly investigated or reported previously.

To investigate the two research questions in this study, we used the reviewers' performance and experience with Covidence as the benchmark for comparison with Colandr since Covidence is an established product and has a large user community.

Participants

After the University's Institutional Review Board approved the research protocol (#19-2937), eight participants with previous SR experiences were recruited, and each was compensated with \$20 after completing research tasks. All participants had either normal or corrected to normal vision. Among them, five conducted less than five SRs in the past, one conducted five to ten SRs, and two conducted more than ten SRs. Their previous SR topics were all related to biomedical and health sciences. All participants used Covidence before, while none of them used Colandr for SRs before this study.

Eye Tracking

Eye tracker records eye movements and produces a gaze path which is a sequential combination of fixations and saccades. Fixation is a relative stability of the eyes for a short period of time in a specific location, while a saccade captures a rapid motion of the eyes from one position to another. Eye-tracking technology has been used in the field of library and information science (Lund, 2016) along with many other fields like human-computer interaction, usability research, and psychology. Eye trackers reveal the features of eye movements in great detail and allow user experience researchers to observe eye positions and understand where an individual is looking (Schall & Bergstrom, 2014).

Since eye movement data can provide a powerful source of information regarding viewer's attention in online reading and cognitive load (Krejtz et al., 2018; Sharmin et al., 2015; Zu et al., 2018), in the mixed-method approach of our study, we also observed users' eye movements to understand their mental effort and cognitive load to some extent while they were navigating the user interfaces of Colandr and Covidence.

Apparatus

Each participant completed the usability study with both SR tools on a desktop PC with 1920 x 1080 resolution in a controlled lab environment with the same lighting conditions. A Chrome web browser was used to run the two web-based applications. Gazepoint GP3, a screen-mounted eye-tracking device with a sampling rate of 60Hz, was used to record participants' gaze fixation during the study sessions. The Gazepoint Analysis (User Experience Edition) software was used to review the recordings and generate fixation and heat maps. Gaze fixation data exported from the Gazepoint Analysis software were cleaned and preprocessed in R Studio (Version 1.3.1093) before conducting any statistical analysis in IBM SPSS Statistics (Version 26) (IBM Corp, 2019).

Material

This study produced two citation datasets by randomly sampling 5,217 citation records from an SR project about "biomedical text summarization" that the third author completed. Each testing dataset had 100 citation records. Although citation records in both datasets were mutually exclusive, each dataset contained the same number of relevant studies (i.e., 33). The design of the citation datasets for the usability study was two folds: (1) to avoid that

participants might carry their screening experience of using one SR tool to the second tool testing if they work on the same citation dataset; (2) SR tool performance and user experience can be distinctive and comparable.

Experiment Design and Procedure

We designed a mixed-method usability study by using both qualitative and quantitative research methods. A within-subject design with the SR software (Colandr vs. Covidence) as the independent variable was adopted. Each participant conducted title-abstract screening using both Colandr and Covidence, which resulted in 16 sessions in total. The sequences of tools and citation pools for each participant were counterbalanced. The dependent measures included performance, eye-tracking measures, and subjective workload. A semi-structured interview was conducted after each test session and at the end of the whole study.

During a test session, participants first answered a pre-test questionnaire (Table 1). Then, Gazepoint GP3 eye-tracking device was configured and calibrated while they were seated approximately 60cm away from the PC monitor. After eye calibration was done, a paper sheet with screening criteria was provided to the participants, and they were allowed sufficient time to read and ask questions. After the moderator (first author) confirmed that all settings were ready, participants started their screening activity with a citation dataset. At the end of the screening session, participants were asked to use a printed copy of the NASA-Task Load Index (NASA-TLX) questionnaire (Hart, 1986) to report their subjective workload on six dimensions: mental demand, physical demand, temporal demand, performance, effort, and frustration. Then, participants were interviewed with post-session questions related to their perception and user experience (Table 1). Each test session with an SR tool was about 60 minutes. Two sessions with each participant were scheduled on two different days to avoid testing fatigue. After both sessions were completed, participants were asked to provide their preferences towards and additional comments on both SR tools (Table 1).

Instrument	Question
Pre-test questionnaire	<ul style="list-style-type: none"> How many SRs have you conducted before? (select answer from: ≥ 10, ≤ 5, and 5~10) Please specify the primary field(s) of study related to the systematic reviews you did before. Have you used Covidence or Colandr to assist your systematic review prior to this study?
Post-session Interview	<ul style="list-style-type: none"> What do you think is the most helpful part of this software? What do you think is the least helpful part of this software? Do you have other comments on using this software?
Post-test Interview	<ul style="list-style-type: none"> Comparing the two software you have used, which one do you like better and why? Would you consider using Colandr or other software that has AI features in the future? Why? Is there anything you want to share that I did not have a chance to cover?

Table 1. Research Instrument

Data Analysis

Performance Metrics

Participants' performance using each SR tool was measured by time, screening accuracy, recall, and precision (Table 2). To compare the performance measures between two SR tools, we conducted paired samples *t*-test, which was also performed on participants' first and second sessions to identify any sequential effect or learning effect.

Performance Measure	Definition	Calculation
Time	The duration from the starting time of screening 100 citations using Covidence or Colandr until the ending time when the participant reported completion of the task.	Timestamp of screening task ending – Timestamp of screening task starting
Accuracy	The percentage of citation records correctly identified as relevant or irrelevant in the total number of screened citation records (O'Mara-Eves et al., 2015)	$\frac{T_{relevant} + T_{irrelevant}}{100}$
Recall (Sensitivity)	The percentage of citation records correctly identified in the total number of citation records deemed relevant (Gates et al., 2018; Giummarra et al., 2020; O'Mara-Eves et al., 2015)	$\frac{T_{relevant}}{N_{relevant}}$
Precision	The percentage of citation records correctly identified as relevant in the total number of citation marked as relevant by the participant (Gates et al., 2018; Giummarra et al., 2020; Rathbone et al., 2015)	$\frac{T_{relevant}}{I_{relevant}}$

Table 2. SR Tool Performance Measures

(Note: Timestamps were retrieved from the screen recordings. $T_{relevant}$ = the number of citation records **correctly** identified as relevant by the participant using an SR tool; $T_{irrelevant}$ = the number of citations correctly identified as irrelevant by the participant using an SR tool; $N_{relevant}$ = the number of relevant citations in the citation dataset (i.e., 33); $I_{relevant}$ = the total number of citation records that were marked as relevant by the participant using an SR tool.)

Subjective Workload

The overall workload for each participant was calculated by the weighted average score for six dimensions, as instructed by the NASA-TLX manual (Hart, 1986). In addition, a paired samples t -test was conducted to detect the statistically significant difference of the overall NASA-TLX scores between two SR tools and between participants' two sessions.

Eye-tracking Measures

Two participants were removed from the analysis on eye-tracking measures due to a low percentage of valid gaze data (i.e., < 70%) identified by the eye-tracking device in both sessions. We chose standard eye-tracking measures for this study: fixation count, total fixation duration, and average fixation duration (Olmsted-Hawala et al., 2014). Fixation count was the total number of valid fixation points identified by the eye-tracking device. Total fixation duration was the summary of the duration for each valid fixation. Average fixation duration was calculated using total fixation duration divided by fixation count. A paired samples t -test was performed to examine the difference of these three eye-tracking measures between two SR tools and between participants' first and second sessions.

User Experience

User experience was summarized from the qualitative data collected through the semi-structured interviews (Table 1). An affinity diagram (AD), the simplest way to reveal common issues and themes across all participants (Holtzblatt & Beyer, 2017), was used to organize participants' responses to those questions. Miro (<https://miro.com/>), an online whiteboard platform, was used to build the diagram.

RESULTS

Performance

The average time that participants spent in screening 100 citations was 1,632 seconds (i.e., 27.20 minutes) using Covidence, and 2,111 seconds (i.e., 35.18 minutes) using Colandr. There was a significant difference in screening time between two tools: $t(7) = 2.31, p = .05$, Cohen's $d = .082$. Participants spent less time in screening with Covidence than Colandr (Figure 1). For all participants, the average time they spent in screening was 2,055 seconds (i.e., 34.25 minutes) for session 1 and 1,689 seconds (i.e., 28.15 minutes) for session 2 (Figure 1). There was no sequential effect between two sessions: $t(7) = 1.54, p = .17$. Figure 2 breaks down the average time on tasks between two tools by session. Participants spent similar time in screening using both tools in their first session, but spent less time screening using Covidence than Colandr in the second session.

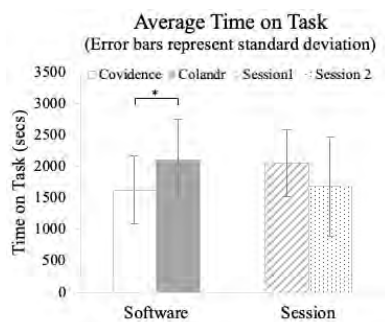


Figure 1. Average Time on Task by SR Tool and by Session

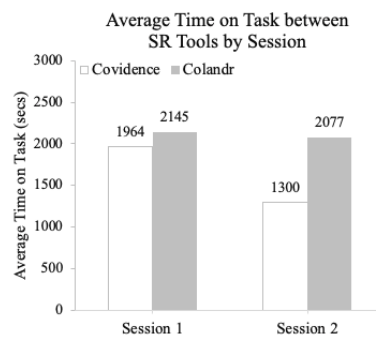


Figure 2. Average Time on Tasks between SR Tools in Two Sessions

Figure 3 shows the average scores of the accuracy, recall, and precision of two SR tools. Participants had a significantly higher precision using Colandr than Covidence: $t(7) = 3.72, p < .01$, Cohen's $d = 1.32$ (Figure 3), while their accuracy [$t(7) = .45, p = .67$] and recall [$t(7) = .46, p = .66$] between two tools were similar. A breakdown by session found that participants had greater precision using Colandr than Covidence in both sessions (Figure 4). There was no significant sequential effect for accuracy [$t(7) = .26, p = .80$], recall [$t(7) = .28, p = .78$], or precision [$t(7) = .09, p = .93$].

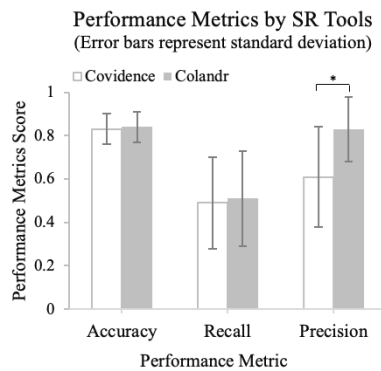


Figure 3. Accuracy, Recall, and Precision between Covidence and Colandr

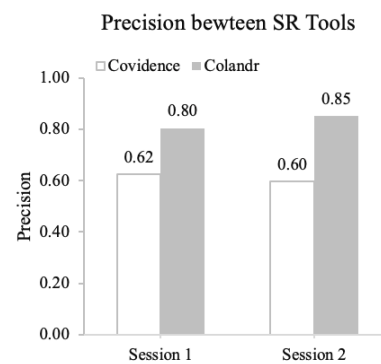


Figure 4. Precision between Covidence and Colandr in Two Sessions

Subjective Workload

The average subjective workload measured by NASA-TLX was 50.23 with Covidence and 50.38 with Colandr. There was no significant difference in subjective workload between the two SR tools ($p = .99$) (Figure 5). The average subjective workload in session 1 was 60.29, and in session 2 was 40.31. A significant sequential effect was detected: $t(7) = 3.23, p < .05$, Cohen's $d = 1.14$. Participants rated their subjective workload higher in session 1 than in session 2 (Figure 5). In addition, other than mental demand, participants rated higher scores in the other five dimensions with Colandr than Covidence (Figure 6).

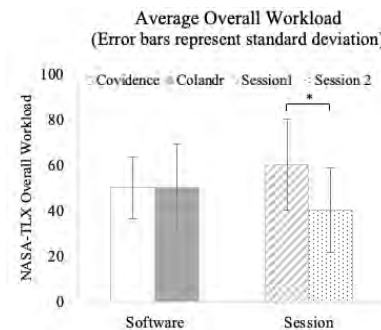


Figure 5. Overall Subjective Workload (NASA-TLX) by SR Tools and Sessions

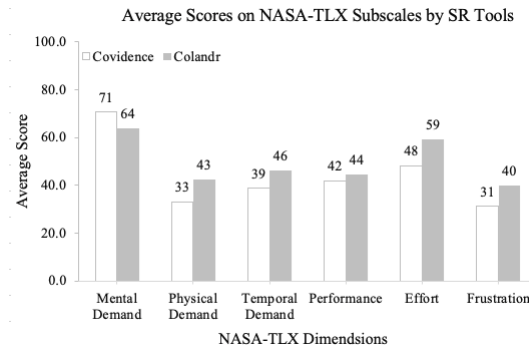


Figure 6. Scores on NASA-TLX Six Dimensions by SR Tools

Eye-tracking Measures

Table 3 summarizes the eye-tracking measures. Results from the paired-sample t -test showed that there was a significant difference in fixation count [$t(5) = 2.60, p < .05$, Cohen's $d = 1.06$] and in total fixation duration [$t(5) = 3.35, p < .05$, Cohen's $d = 1.37$] between two SR tools. Participants had a longer total fixation duration and more fixation count when using Colandr than Covidence. There was no significant difference in average fixation duration between the tools. No sequential effect was found in any of the eye-tracking measures.

Eye-tracking Measures [Mean (SD)]	SR Tool	
	Covidence	Colandr
Fixation count	2871(1301)	4202 (1373)
Total fixation duration in secs	1140.236 (625.216)	1683.718 (577.826)
Average fixation duration	0.40 (0.06)	0.40 (0.04)

Table 3. Eye-tracking measures by SR tools

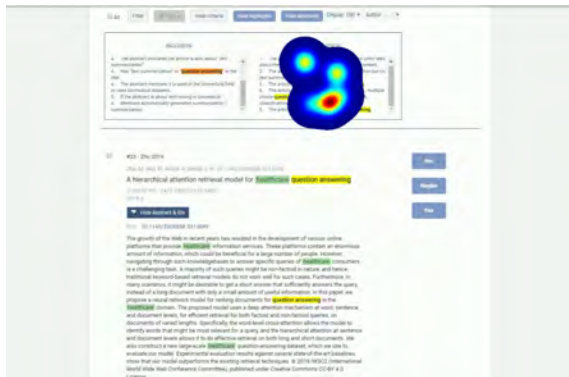
Heatmap

Heatmaps were generated in the Gazepoint Analysis software. Figures 7 and 8 are two samples from the usability testing. Most of the time, participants were focusing on the title and abstract text area (Figure 7a and Figure 8a). In addition, participants also spent some time focusing on the unique features in Covidence and Colandr, such as the

pop-up box for inclusion and exclusion criteria in Covidence (Figure 7a and Figure 7b) and the mandatory process of selecting reasons for exclusion in Colandr (Figure 8b).



a



b

Figure 7. Sample Heatmap From Covidence Testing. (a) Attention on the title area; (b) The participant was reading the exclusion criteria



a



b

Figure 8. Sample Heatmap from Colandr Testing. (a) Attention on the abstract area; (b) The participant was making an exclusion decision

User Experience

The AD of this usability study consisted of four themes – Visual Design, Information/Contents, emotional interactive design, and system functionality (in pink). The themes of “Visual Design” and “Information/Contents” were further categorized into a larger topic – User interface design (in green) (Figure 9).

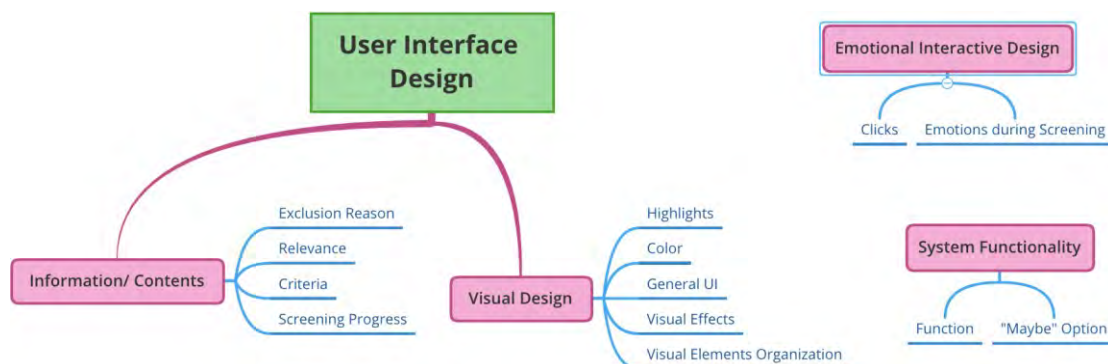


Figure 9. Simplified Affinity Diagram Hierarchy (Blue: Grouped User Feedback; Red: Categories of User Feedback; Green: Overall Theme)

Four participants said that they liked Covidence more than Colandr. Two participants preferred Colandr over Covidence due to Colandr’s AI feature of relevance ranking. One participant liked both tools equally. One participant did not like either tools. The liked and disliked features of both tools were summarized below in Table 4.

	Covidence	Colandr
Likes	<ol style="list-style-type: none"> 1. Color highlights on key terms 2. Screening criteria displayed at the top 3. Color palette 	<ol style="list-style-type: none"> 1. Bold highlights (but not as effective as the color highlights in Covidence) 2. Automatic ranking by relevance 3. Separate buttons for inclusion and exclusion (but some participants didn't like it)
Dislikes	<ol style="list-style-type: none"> 1. Lack of information on the screening progress 2. The boring process with boring pages 	<ol style="list-style-type: none"> 1. Lack of information on the screening progress 2. Extra clicks (clicks to expand abstract, clicks to select exclusion reasons in order to move forward) 3. Unreasonable setting to force an exclusion reason selection

Table 4. User perception towards Covidence and Colandr

In addition, when being asked about whether they would use Colandr or other AI-featured SR tools in the future, half of the participants (i.e., four participants) said “yes” because these tools could potentially save time and improve efficiency. However, they expressed major concerns regarding the performance and usability of AI-featured SR tools and mentioned the need to weigh their pros and cons. Among the four participants who would not use Colandr or other AI-featured SR tools in the future, their reasons included “not sure about Colandr’s data extraction function,” “bad user interface design,” and “non-transparent AI algorithms.”

DISCUSSION

This study found significant performance differences between Colandr and Covidence in terms of precision and screening time in both test sessions. Participants had greater precision while using Colandr, in which AI features enable relevance ranking for citation screening compared to Covidence, which does not provide similar AI features. However, the differences between the two tools were not significant regarding screening accuracy, recall, and subjective workload. Even though all our participants were familiar with Covidence but never used Colandr before this study, Colandr demonstrated a higher probability of helping participants identify truly relevant citation records than Covidence. This finding somehow clarified the low-precision concern in previous studies with other SR tools (Gates et al., 2018; Giummarra et al., 2020), corroborating the promising potential of using AI-featured SR tools. In addition, we confide in the great potential of Colandr and believe user performance will improve after they acquire more experience with this tool. However, different from previous studies, our data from both time on screening task and eye-tracking measures suggest that participants spent more time screening the same number of citation records using Colandr than using Covidence, which can be explained in three aspects. First, participants in this study were more familiar with Covidence, which may result in less time completing screening tasks. Second, Colandr requires reviewers to select reasons for excluding citation records, leading to more mouse clicks and screening time, which was cross-validated by the heatmap (Figure 8b). Third, reviewers in previous studies using AI-featured SR tools usually stopped their screening process when the AI algorithm predicted the remaining records as irrelevant, while participants in this study screened the entirety of 100 citations with each SR tool for each session. Therefore, the results from the comparison of the amount of time on screening were different. Overall, our empirical results resonate with the promising potential of using AI-featured SR tools to improve user performance and reduce their workload (Olofsson et al., 2017; Wallace et al., 2012).

Comparing the user experience with both SR tools, more participants liked Covidence than Colandr. Participants’ valuable feedback provided insights for SR software design and development. First, SR tool developers need to acquire a holistic understanding of users, practical workflow, and review types. For example, the process of unnecessary prompts for selecting an exclusion reason in Colandr does not match with a typical SR workflow, where exclusion reasons are not required in title-abstract screening. Additionally, this procedure prolongs screening time. The heatmaps generated from the eye-tracking analysis clearly showed that participants had to go through this extra step in Colandr and spent more time in screening a record than in Covidence, resulting in a longer fixation duration and higher fixation count. Therefore, integrating eye tracking to the user centered contextual design will enhance the understanding of human cognition and information processing during SR screening activities. User research methods like contextual inquiries and in-depth interviews also can help SR tool developers to get to know more about user needs, challenges, and their workflow (Sharp et al., 2019). Particularly, librarians and information professionals are at the forefront of SR studies including selecting, reviewing, using, teaching, and recommending SR tools to the research communities they serve (Spencer & Eldredge, 2018). They should be included in the full design and development cycle of SR tools.

Second, although AI algorithms have the potential to help reviewers with decision-making, reviewers still need to go through the entire citation records and confirm the accuracy of the AI suggested decisions, which can be time-consuming as well. In addition, we found participants only took the relevance ranking provided by Colandr as a reference, not used it for their final decision. This finding is relevant to the distrust mentioned in a previous study

(Gates et al., 2019). Further, our findings echo the call for transparency of AI algorithms because it's related to users' trust and acceptance of the software.

Third, the affinity diagram showed user interface design was the major focus of participants' experience with two tools. The usability of the user interface of Covidence was favored much more than that of Colandr. An example of the suboptimal design is the wide paragraphs in Colandr. The heatmap (Figure 8a) indicated that participants had difficulties covering the paragraphs in their fixation area due to the width. Compared to the narrower paragraph in Covidence, the wide paragraph in Colandr could slow down participants' reading speed since they had longer return sweeps from one line of text to the next. The long return sweep usually requires additional fixation (Beymer et al., 2005), which also explains the significantly greater number of fixation count with Colandr than with Covidence. In addition to slower reading speed, such wide paragraphs may prevent participants from retaining information and ultimately cause them to abandon the end of longer paragraphs (Beymer et al., 2005). Since user interface design can greatly influence people's decision making (Gunaratne & Nov, 2015; Speier & Morris, 2003) and well-designed user interfaces are associated with reduced mental workload (Longo et al., 2012), the developers of SR tools shall constantly inspect and improve the usability and accessibility of the user interfaces.

Finally, SR tool development can take an emotional-design approach because positive emotional design can influence learning (Mayer & Estrella, 2014; Miller, 2011; Um et al., 2012). The process of citation screening is a learning process in which reviewers update their knowledge about the research topic and try to make an accurate decision. Fostering reviewers' positive emotions during the tedious screening process will increase their efficiency, effectiveness, satisfaction, and further relieve their mental workload and fatigue.

This is the first study investigating the usability of SR tools in a controlled research lab setting. Unlike previous studies that tested SR tools based on one or two reviewers' self-paced activities, this study brought a new research design and method to the field of SR software development. In addition, for the first time, this study assessed the reviewers' subjective workload and eye movement associated with the SR screening process, producing empirical data for the usability study of SR software. Furthermore, it is one of the few studies that compared an SR tool with AI features to an established SR tool without any AI feature (benchmark) through a formal usability experiment. Our research experience and data will provide insights to future investigations in this area.

Nevertheless, this study has a couple of limitations. (1) For quantitative analysis, although we reached statistical significance with medium to large effect size, which can determine the importance and the power of the quantitative data analysis (Fritz et al., 2012), our results were still based on a relatively small number of participants. In terms of the qualitative analysis, previous research showed that the first five participants could reveal about 85% of the problems in a formative usability study (Lewis, 2014). Though this study tested two software applications in production, the purpose was to identify usability problems instead of serving as quality assurance. Therefore, qualitative data collected from our participants can yield valuable insights to inform future SR tool development. In fact, the study reached code saturation, which is "the point when no additional issues are identified" (Hennink et al., 2017) when the research moderator received similar information or feedback about both SR tools starting from the seventh participant. (2) This study only compared two software tools due to time and research funding constraints. Therefore, the results should be carefully generalized to other SR software. In the future, a more systematic evaluation of AI-featured tools would help deeply understand their performance and effectiveness. For example, additional eye-tracking measures such as pupil diameter changes can be combined with fixation measures to enhance the understanding of mental workload (Bergstrom et al., 2014; Zu et al., 2018) experienced by SR reviewers. Information acquired through these physiological responses can support designers and developers in better addressing the high mental effort during the SR screening process.

CONCLUSION

This study examined and compared the performance, workload, and user experience of an SR tool with AI features (i.e., Colandr) and an SR tool without AI features (i.e., Covidence) by conducting a mixed-method usability study in a controlled research lab setting. Even though participants were more familiar with Covidence than Colandr, Colandr helped reviewers with higher precision in citation screening, substantiating the potential of AI-featured SR tools. However, user experience with Colandr was not satisfactory due to problems in its user interface design. Therefore, the development of SR software shall apply a user-centered design approach and accentuate the usability of the user interface.

ACKNOWLEDGMENTS

We thank the Biobehavioral Lab at the University School of Nursing for providing the usability testing equipment and space so that we were able to complete the usability study before the campus closure due to COVID-19.

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COVID-19 Apps and Privacy Protections from Users' Perspective

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ABSTRACT

As the spread of the novel coronavirus (COVID-19) continues to be a global challenge, there have been numerous efforts and actions from both government and private organizations towards keeping their community members healthy and safe. One of the approaches is to use mobile apps to trace contacts and update the status of the infected individuals efficiently and conveniently so that the spread of COVID-19 can be minimized and contained. While these apps could offer many advantages, it also raises serious privacy concerns for many users and hence possibly refusing to adopt it. In this study, we aim to understand the users' expectations on the privacy protections and the provisions under which they are willing to use COVID-19 apps. We believe our study results can guide policymakers and app developers on the design, deployment, and acceptability of the COVID-19 apps that can be widely adopted.

KEYWORDS

COVID-19; Mobile Applications; Privacy Concerns, Privacy Protections.

INTRODUCTION

In December 2019, a novel coronavirus was first identified in Wuhan, China, and it quickly became a global challenge with over 10 million cases worldwide being confirmed within six months according to WHO's situation report (2020). The coronavirus disease in 2019 was further named COVID-19 by WHO, and the WHO Director General declared it as a public health emergency of international concern in January 2020 (R&D Blue Print, 2020). The COVID-19 pandemic has had serious negative consequences on individuals around the world, not only by threatening their physical health but also by changing their lifestyles and daily routines. Because of the pandemic lockdown and social distance restrictions, people are forced to start self-quarantine, gatherings are limited, and telecommuting is encouraged instead of meeting in person. Therefore, it has been critical that the governments/health organizations swiftly respond to the pandemic and assist the ones most in need.

As one of the solutions to deal with the COVID-19 pandemic, mobile technologies have been applied by governments and private organizations around the world to control infectious diseases and promote public health. Numerous mobile apps have been developed as an important tool during the outbreak to help with controlling the COVID-19 outbreak. Mainly, there are two types of COVID-19 apps: the status app, which is used to show the user's current disease status, and the contact tracing app, which is used to identify and track the ones that may be in contact with infected individuals. Traditionally, tracing of contacts is done by a public health department, which includes interviewing patients and then calling people who have come into contact with those patients. These recent COVID-19 apps could potentially offer many advantages comparing with the traditional methods. Not only that the tracing cost is much lower since the cases are automatically detected with individuals reporting their information, but it also could identify the infected individuals more efficiently and quickly considering a large number of mobile users (Rowe, 2020). Many governments from different regions have developed their official COVID-19 apps. For example, the COVIDSafe developed by the Australian Government Department of Health is an in-use contact tracing app that helps to keep the community safe during the ongoing pandemic (Cartwright, 2020). By deploying these tracing apps, the governments/organizations devote themselves to minimize the level of exposure to the COVID-19, and limiting the spread of the virus (Abbas & Michael, 2020).

However, even though these apps could help with reducing the community's vulnerability to the COVID-19 by sharing up-to-date information, using these apps may also raise serious privacy concerns for users' data. For example, a previous study found that although many of the current COVID-19 apps did not appropriately protect user's data in an anonymous, encrypted, and secured way, these apps also required or allowed different types of access to user's personal and sensitive information (Sharma & Bashir, 2020). Another case study also found that privacy protections have not been effectively addressed in most of the COVID-19 apps. For example, 60% of the apps selected didn't have explicit data retention controls, and 69% of the apps didn't provide options for users to opt-in/opt-out (Sharma et al., 2020). These privacy breaches from the apps may not only violate users' human rights but

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also makes individuals more concerned and hesitant to use such apps. In addition, results from a prior study indicated that the risks of privacy violations may lead to a lower willingness of individuals to install the apps (Chan & Saqib, 2021).

While privacy considerations for COVID-19 apps have been a global concern, people in the U.S. and western regions are especially demanding the need for privacy protections if they were to use such apps. For instance, according to a study conducted in June 2019, about 79% of Americans in the study said that they were concerned about how the government or the companies used their personal information (Auxier, 2020). Also, a previous research study found that the U.S. public are more willing to accept the contact tracing apps that use decentralized data storage, which preserves a higher degree of privacy, instead of the ones using centralized data storage (Zhang et al., 2020). Given the severity of the pandemic and the cost-effective and timely resolution that the mobile apps can provide in curbing the pandemic it is ever more critical that governments/policymakers, health care providers, and app developers in the U.S. and around the world understand users' need and expectation for privacy protections when it comes to their health data and sensitive information if they are to use COVID-19 apps.

In this study, we aim to understand individuals' perspectives on the privacy considerations for the COVID-19 apps in the United States. While people may be willing to use relevant apps to track new cases or monitor the COVID-19 trends, they may also be cautious about the information they share with the apps considering the amount of personal and sensitive data it involves. On the other hand, a previous survey study found that two-thirds of Americans stated their willingness to install a COVID-19 app to help with controlling the outbreak, even if such an app would collect their location data and health information (Hargittai & Redmiles, 2020). Therefore, the goal of this study is to learn the trade-off when individuals choose to use such an app: what types of privacy protections are people looking for, and what types of information do they agree to provide to the apps. Specifically, the study will identify the privacy considerations that both privacy advocates and privacy opponents expects from three aspects: information collection and sharing, implementation of privacy protections, and trust and surveillance. By studying individuals' needs of privacy protection provided by the app, results from this study could provide privacy design recommendations to policymakers and app developers so that the future development of relevant apps could be more appropriately aligned with users expectations and therefore leading to wider deployment and adoption in the future.

LITERATURE REVIEW

A variety of mobile apps have been developed during the COVID-19 pandemic, and these apps have been very helpful and have become an important part of the strategies to control the outbreak. A prior review study considered the COVID-19 apps as a valuable tool for both individuals and policymakers to overcome the challenges such as reducing the burden on hospitals, providing access to credible information, and tracking the symptoms of individuals (Kondylakis et al., 2020). However, although the new development of COVID-19 apps could potentially help with controlling the outbreak and promoting public health, previous studies also identified various privacy violations by these apps. Especially when the existing privacy law does not exactly prevent companies from developing apps that are not compliant with the data protection regulation (Newlands et al., 2020), a lot of those apps only include initial risk assessment without fully being compliant. For example, a prior research study examined the lack of privacy for a Singaporean government's contact tracing mobile app, which allowed the ministry of health to access the patient's data and track whom they have been near (Cho et al., 2020). Also, it is possible that the COVID-19 apps could be hacked because of security risks (Boutet et al., 2020), and the data collected could be vulnerable to cyberattack and misuse (Open letter, 2020).

While it is evident that users are concerned about privacy protections when it comes to mobile apps, they are particularly concerned when their data is being watched and recorded, or when they lose control over their data, and when collected information is being used for other purposes without notice (Xu et al., 2012). In addition, a recent survey study found that users in the U.S. did have privacy protection expectations when it came to COVID-19 apps even before any such apps were in use. For example, they expressed a preference for having control over their data such as being able to delete their data at any time (Sharma et al., 2020). These privacy expectations tend to be similar from different regions of the world with a research study from the UK reporting that users were worried about increased surveillance by governments, as well as personal data being accessed by third parties (Williams et al., 2020).

Nevertheless, it is also important to consider that there is various conceptualization when it comes to privacy protections and while there are those that are advocates of such protections there are others that oppose it. Thus, we aimed to understand views and expectations for privacy in COVID-19 apps from both advocates of privacy as well as those who are opposed to such protections. We believe this approach provides a balanced assessment on the importance of privacy protections in these types of apps while taking account and considering users' differing baseline views on the role of privacy in society. This additional insight can guide governments, policymakers, and app developing companies the awareness and the critical role that privacy protections plays if wider adoption of

such apps is the goal. Cho et al. (2020) argued that a strong guarantee of privacy is essential to encourage the common use of a COVID-19 contact tracing app. Tang (2020) also recommended that app developers should seek privacy-preserving contact tracing solutions to encourage potential users to install contact-tracing apps. Furthermore, since there seems to be a direct link between the public's decision of using COVID19 apps and their perception of how their health data is being protected, more effort and emphasis need to be in place for these users' expectations. It is shown that such accommodations can be made by some app developers (Ahmed et al. 2020) when they chose to implement decentralized architecture for their COVID-tracing apps over the centralized architecture in order to enhance the privacy protections on users' data. Another example is the COVID-19 app SwissCovid developed by the Swiss Federal Office of Public Health, which requires user's consent to process their data, and only keeps user's ID for 14 days as for data retention (Martin et al., 2020).

METHOD

To understand individuals' privacy perspectives towards the COVID-19 apps, we designed and sent a survey with questions related to COVID-19 experiences to 10,000 students at a midwestern university in the United States in June, 2020. Participants in this survey have a variety of backgrounds. Since we recruited the participants through university emails, majority of participants are students under 29 years old. For those who indicate their ethnicities, 56% of the participants are white, and there are also other ethnic groups (25% Asian, 9% Hispanic/Latino, and 4% Black). While the survey was designed as a comprehensive questionnaire including questions related to different fields, in this study, we only focused on analyzing participants' attitudes towards the two types of COVID-19 apps: the tracing app and the status app. The scenario of using these two apps were described as follows:

- Tracing app: The app is used to trace the contacts of people who have been diagnosed with COVID-19. The tracing app is expected to document where you've been and whom you've been close to.
- Status app: The app is used to keep track of whether the smartphone's owner has had COVID-19, whether he or she has been tested for COVID-19 and is disease-free, and other indicators of disease status, like current temperature. The status app is expected to show the user's current disease status and could be used to allow people more freedom of movement, such as going back to work and school.

Besides surveying the attitudes towards the COVID-19 apps, we also asked participants to respond on their personal view of privacy protections provided by these apps in three aspects: 1) information collection and sharing, 2) implementation of privacy protections, 3) trust and surveillance. In addition, we assessed participant's baseline views on the role of privacy protections in society and classified users as either Advocates or Opponents in order to better understand privacy expectations from a diverse point of view. After collecting and pre-processing the data, a total of 729 participants who fully completed the survey were selected. We conducted descriptive statistical analysis on the collected data based on participants' privacy preferences, and also analyzed their inclination on the privacy protections for the two applications. The following section presents our results in two parts: participants' willingness to use the two apps, and their privacy concerns towards the COVID-19 apps.

RESULTS

Willingness to Use the App

Tracing App

As shown in Table 1, 62% of the participants are willing to use the tracing app. For those participants who chose "Maybe", many of them exhibit privacy as the major concern. Also, 79% of the participants care about the provider of the tracing app. From their preferences, the CDC ranks the highest, followed by the university and WHO. In other words, they are more comfortable to use the app if it is provided by health-related authorities or the university.

Selected Survey Question	Participants Response
Would you be willing to use an tracing app?	
• Yes, I would be willing to use the COVID-19 tracing app.	455 (62%)
• No, I would prefer the traditional approach to tracing	153 (21%)
• Maybe.	121 (17%)
If such an app were available for use, would it matter to you who offered the app and controlled your data?	
• Yes, it would matter to me who offered the app and who had access to my data.	574 (79%)
• No, I'd use the tracing app regardless of who offered it.	106 (15%)
• Maybe.	49 (7%)
Which one of the following options would you prefer (to be the provider of the app)?	
• CDC or any health center	379 (52%)
• My university	306 (42%)
• World Health Organization (WHO)	286 (39%)
• Government	69 (9%)
• My employer	49 (7%)
• Private company	33 (5%)
• Other	32 (4%)

Table 1. Willingness to use a tracing app

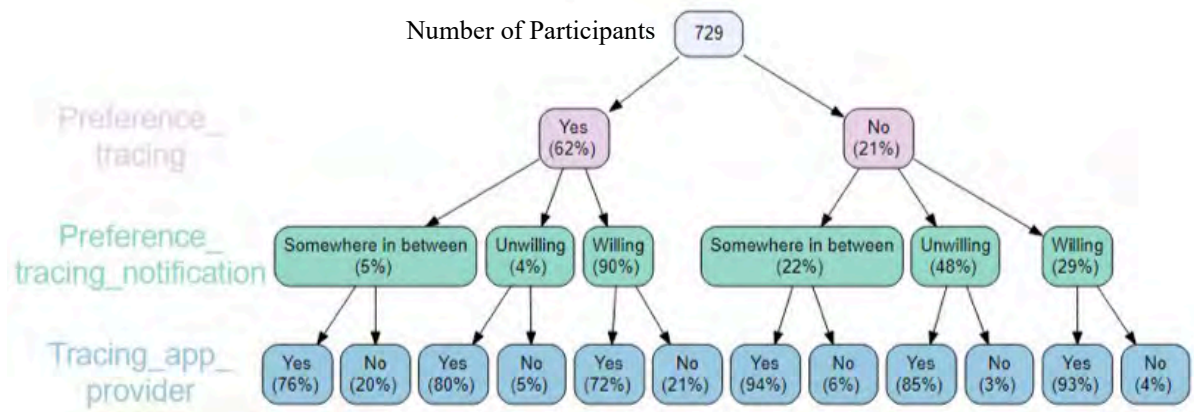


Figure 1. Tree plot (Top: Willingness to use the tracing app; Middle: Willingness to be noticed their contact with COVID-19 cases; Bottom: If who offers the tracing app matters)

From the tree plot in Figure 1, we find that 90% of those who express willingness to use the app, are also willing to receive notifications about contact with COVID-19 cases. In addition, the app provider generally matters more for those who chose unwilling to use the app, implying that these participants are more concerned about their private information and tend to choose the app more carefully based on the provider.

Status App

Similar to the tracing app, as shown in Table 2, 69% of the participants would like to use the status app. Also, for those who chose the answer “Maybe”, many of them express their concerns on data safety and privacy. 77% of the participants believed that who offers the app matters. Similar to the tracing app, the medical provider and the university are more trustworthy as the app providers.

Selected Survey Question	Participants Response
Would you be willing to use a status app?	
• Yes, I would be willing to use the COVID-19 status app.	464 (64%)
• No.	101 (14%)
• Maybe.	164 (22%)
If such an app were available for use, would it matter to you who offered the app and controlled your data?	
• Yes, it would matter to me who offered the app and who had access to my data.	566 (78%)
• No, I'd use the status app regardless of who offered it.	118 (16%)
• Maybe.	45 (6%)

Table 2. Willingness to use a status app

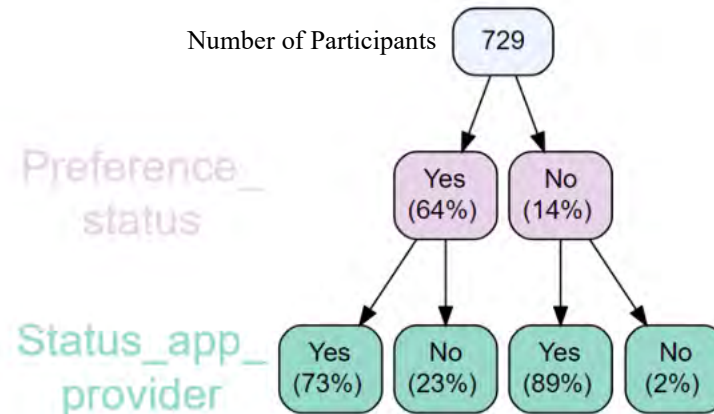


Figure 2. Tree plot (Top: Willingness to use Status APP; Bottom: If who offers Status APP matter)

Also similar to the tracing app, the tree plot shown in Figure 2 could tell that the provider of the status app generally matters more for those who chose unwilling to use the app.

Privacy Concerns

In general, when participants being asked which is more important for the app, 61% of them (444 participants) chose both Privacy and Safety as the important factors of the app. Comparing the two factors, the Safety of the app (21%) got more attention than the Privacy of the app (17%). Further analysis revealed that those who felt like both safety and privacy are important also showed their concerns on the provider of the status app (as shown in Figure 3). The results also found that if the participant cares about the provider of one of the apps, they are likely to care about provider of the other one as well.

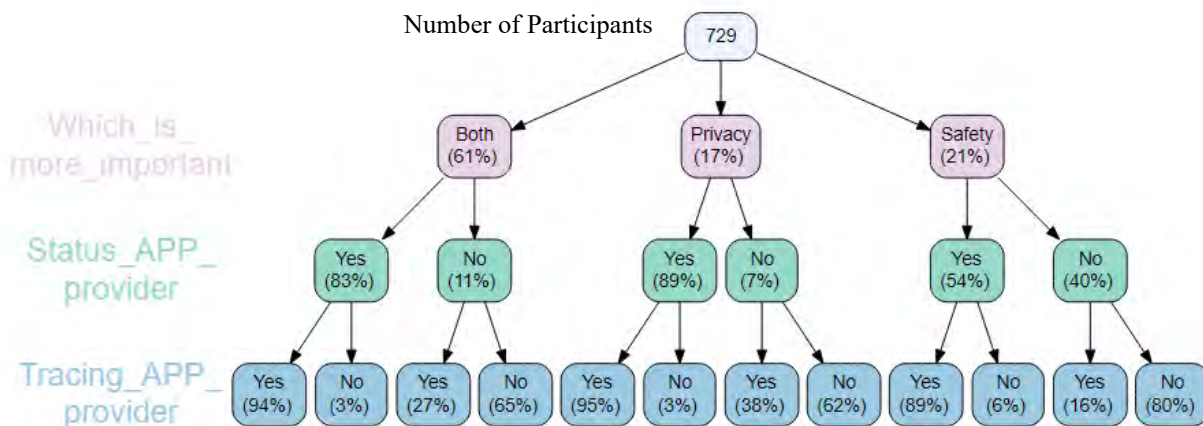


Figure 3. Tree plot (Top: Which is more important for the APP; Middle: If who offers Status APP matter; Bottom: If who offers Tracing APP matter)

To understand if individuals' view of privacy relate to their privacy concerns towards the COVID-19 apps, we divided the participants into two groups based on their answers on the view of privacy: privacy advocate (people who view privacy as a human right, civil liberty, constitutional right, or people's right to make themselves inaccessible to others) and privacy opponent (people who view privacy as negative freedom within society, a mechanism that allows people to keep unfavorable information secretly, or believe privacy invasion on individuals is necessary to ensure national security). After collecting the answers, there are 603 participants in the privacy advocate group and 112 participants in the privacy opponent group.

Information Collection and Sharing

Table 3 shows the types of information that participants are comfortable or uncomfortable to share with the COVID-19 apps. We found that the location (60%), personal information such as name (54%), health information (52%), and phone number (42%) are the types of information that participants felt most comfortable to share with the apps. Meanwhile, we also recorded the types of information that participants are uncomfortable to reveal. For example, about 83% of the participants are not willing to share their browsing history, and 80% of them do not want to give the app access to their photos.

For the two different groups, we found that participants in the privacy advocate group are more reserved on sharing sensitive data with the COVID-19 apps, and they may feel more uncomfortable sharing personal information such as browsing history, photos, phone information, and location, comparing with the privacy opponent group.

Selected Survey Question	Overall Responses	Privacy Advocate	Privacy Opponent
What type of information are you comfortable to share?			
• Your location	434 (60%)	339 (56.2%)	88 (78.6%)
• Personal information such as name	395 (54%)	320 (53.1%)	67 (59.8%)
• Health information	376 (52%)	308 (51.1%)	62 (55.4%)
• Phone number	303 (42%)	234 (38.8%)	61 (54.5%)
• Your contacts	119 (16%)	82 (13.6%)	35 (31.3%)
• Bluetooth	94 (13%)	73 (12.1%)	21 (18.8%)
What type of information are you uncomfortable to share?			
• Browsing history	604 (83%)	512 (84.9%)	83 (74.1%)
• Photos	586 (80%)	495 (82.1%)	81 (72.3%)
• Contacts	468 (64%)	406 (67.3%)	57 (50.9%)
• Machine address	373 (51%)	327 (54.2%)	41 (36.6%)
• Device's operating system	309 (42%)	268 (44.4%)	37 (33.0%)
• Screen size	268 (37%)	232 (38.5%)	34 (30.4%)
• Geographical location	232 (32%)	210 (34.8%)	19 (17.0%)
• Email address	208 (29%)	183 (30.3%)	24 (31.4%)
• Username	158 (22%)	139 (23.1%)	18 (16.1%)

Table 3. Attitude on types of information shared with the app

Implementation of Privacy Protections

Table 4 presents participants' preferences on the implementation of privacy protections by the app. As the results showed, over half of the participants (62%) believe that all the privacy protections listed in the survey is necessary for the COVID-19 apps. Among all the choices, participants value the protection of sensitive information more over the others. In addition, participants in the privacy advocate group demand more privacy protections than the privacy opponent group (more of them choose all the protections as their preference instead of a single answer).

Selected Survey Question	Overall Responses	Privacy Advocate	Privacy Opponent
What's your preference on the privacy protections provided by the app?			
• All of them	453 (62%)	398 (66%)	46 (41.1%)
• Protect sensitive information	138 (19%)	98 (16.3%)	38 (33.9%)
• Preventing unauthorized functionality	78 (11%)	58 (9.6%)	18 (16.1%)
• Limit permissions	36 (5%)	30 (5%)	6 (5.4%)
• Regulate mobile app data collection	24 (3%)	19 (3.2%)	4 (3.6%)

Table 4. Preferences on privacy protections

Trust and Surveillance

Table 5 shows the different app providers that participants trust to protect their privacy. The top two ranked providers are participants' medical providers (29%) and the university (28%). It is noticeable that the federal government and the state government are only trusted by 6% and 5% of the participants accordingly. From the results, we also found that the privacy opponent group is more likely to build trust with any of the app providers (only 4.5% of them choose not to trust anyone to protect their data privacy, comparing to the 10.9% for the privacy advocate group).

Selected Survey Question	Overall Responses	Privacy Advocate	Privacy Opponent
If such a COVID-19 app were offered, who would you trust most to protect your privacy?			
• My medical provider	210 (29%)	187 (31%)	20 (17.9%)
• My university	204 (28%)	165 (27.4%)	36 (32.1%)
• I would not trust anyone to protect my data privacy	73 (10%)	66 (10.9%)	5 (4.5%)
• A non-profit organization	67 (9%)	58 (9.6%)	8 (7.1%)
• Privacy company (e.g. Google, Apple)	46 (6%)	31 (5.1%)	15 (13.4%)
• Federal government	41 (6%)	32 (5.3%)	9 (8%)
• State government	38 (5%)	26 (4.3%)	9 (8%)
• My health insurer	34 (5%)	24 (4%)	8 (7.1%)
• My employer	16 (2%)	14 (2.3%)	2 (1.8%)

Table 5. Trust on app providers

The participants' attitudes towards tracking of their information are shown in Table 6. While a lot of the participants (63%) felt acceptable if the government is tracking the location of COVID-19 cases, a larger number of them are not comfortable if everyone using the app is under the surveillance of the app providers. Similar to the previous results, people who view privacy as an important right (privacy advocate group) are more against the tracking on location of COVID-19 cases or individuals, while people who view privacy negatively (privacy opponent group) are more supportive on tracking from the government.

Selected Survey Question	Overall Responses	Privacy Advocate	Privacy Opponent
Is government tracking on location of COVID-19 cases acceptable?			
• Very acceptable	203 (28%)	142 (23.5%)	56 (50%)
• Somewhat acceptable	253 (35%)	214 (35.5%)	36 (32.1%)
• Not sure	97 (13%)	84 (13.9%)	11 (9.8%)
• Somewhat unacceptable	76 (10%)	69 (11.4%)	4 (3.6%)
• Very unacceptable	100 (14%)	94 (15.6%)	5 (4.5%)
Is government tracking for everyone acceptable?			
• Very acceptable	31 (4%)	21 (3.5%)	9 (8%)
• Somewhat acceptable	82 (11%)	56 (9.3%)	26 (23.2%)
• Not sure	110 (15%)	83 (13.8%)	24 (21.4%)
• Somewhat unacceptable	167 (23%)	133 (22.1%)	32 (28.6%)
• Very unacceptable	339 (47%)	310 (51.4%)	21 (18.8%)

Table 6. Attitudes on information tracking by the apps

DISCUSSION

In this research study, we found that most users are willing to use COVID-19 status and tracing apps if certain privacy and security protections are designed and implemented. For example, over half of the participants view both safety and privacy as an important factor of the COVID-19 apps while knowing that they need to provide their personal and sensitive information to the apps while using it. In addition, users are more willing to use tracing and status apps to help with contact tracing if the apps had privacy protections. About 78% of participants who viewed safety and privacy as important factors agreed to use both the status app and tracing app. Based on the results from this study, policymakers and app developers need to take privacy protections more seriously and make those features more explicit if their goal is to encourage more users to adopt the COVID-19 apps.

If we are to address users' privacy concerns and place appropriate protections in order to satisfy users' needs, it is important to understand users' expectations for privacy protections and provide the protections in the COVID-19 apps to increase the usage. According to many survey results, most participants are reserved on providing their sensitive information to the COVID-19 apps, while only a small percentage are open to give their health and personal data to the app. For example, only 16% of our study participants feel comfortable in share their contacts. In addition, participants worry about the level of surveillance and lack trust in certain entities that may provide the COVID-19 app. In our survey, 70% of participants reported that it was unacceptable if the government is tracking everyone, instead, they are more comfortable if the app only tracks users' locations (73% rated acceptable). Also, participants tend to have more trust towards some entities that they are more familiar with instead of the governments. Since the survey was sent to college students, about one-third of our participants chose the University as the one entity that they would trust the most to protect their privacy. These results imply that policymakers still need to consider trust with individuals as an important factor when asking them to use relevant apps.

The study also found that most participants prefer and expects privacy protections for COVID-19 apps regardless of whether they are Advocates or Opponents of privacy protections in general. While privacy advocate participants are more reserved to share their personal and sensitive information with the COVID-19 apps, they still demand more comprehensive privacy protections from the apps and are less likely to trust the app providers to protect their information. In contrast, privacy opponent participants who view privacy as negative freedom or believe privacy invasion is necessary report being more acceptable of a government tracking location or personal information during the COVID-19 pandemic. Nonetheless, the results of this study shows that while there are differing views on the role of privacy protections in society when it comes to COVID-19 apps privacy protections are critical to users adoption of such apps and therefore app providers and designers are encouraged to implement comprehensive privacy protections and make it explicit in order to satisfy users' needs.

Furthermore, the above findings regarding users' privacy protection expectations even when accounting for their baseline views regarding privacy in general reveals another vital aspect that needs further examination. This aspect is considering privacy expectations from an underrepresented population. Previous research shows that under-represented minority individuals distrust such collection of information and worry about how that information may be used to discriminate or exclude them in some way (Ringelheim, 2008). For example, a previous report revealed that ethnic minority groups are at higher risk of oversurveillance after protests (Privacy International, 2020). Because of the possible risks of privacy violations and discriminations, minority groups might seek more privacy protections and be more careful about sharing their information. As shown by our study results, participants from minority groups such as the Hispanic/Latino participants are more concerned about providing their personal information with COVID-19 apps comparing with White participants, especially when it comes to sharing their health information (61% for Hispanic/Latino, 48.8% for White) and phone number (47.5% for Hispanic/Latino, 40.5% for White). Therefore, it is critical to consider all of these individual differences when designing relevant apps in order to minimize the risk of discrimination and mistrust.

LIMITATIONS

While our study only recruited participants from a public midwestern university, it is necessary to involve people in different age groups and with different backgrounds to have a more comprehensive understanding of individuals' privacy concerns in future studies. Also, since the survey was conducted and sent out during the early stage of the COVID-19 outbreak (July 2020), the results are mostly a reflection of participants' expectations of the COVID-19 apps in the first six months of the pandemic and their perspectives may have changed after they have used the apps.

CONCLUSION

In conclusion, our study results show that while many people are willing to use COVID-19 status and tracing apps, they also have concerns about the information that is being collected and expect appropriate privacy protections for the use of their personal and health data. We believe these findings are essential when designing, developing, and deploying pandemic-related apps. If users' expectations are met, then adoption of technology often increases and

since the ultimate goal is to have more users adopt such apps in times of a health crisis, we cannot afford to ignore such expectations.

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Why Do You Trust Siri?: The Factors Affecting Trustworthiness of Intelligent Personal Assistant

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ABSTRACT

Trust greatly contributes to human-AI collaboration, however, human's trust to IPA is hard to establish and lacks exploration. The purpose of this paper is to recognize the factors that affect the trustworthiness of IPA. 358 questionnaires were analyzed by PLS-SEM to construct the model, while thematic analysis was used to discover expectation of IPA. Chi-square tests and T-test were used to distinguish the difference between two user groups. Three factors that capability of system, personality of agent, and availability of interface have a significant impact on the trustworthiness of IPA. The capability of system is the most essential as the threshold with users' plenty of expectations. Most users pay less attention to the availability of interface and the personality of agent has a great impact on the trustworthiness of IPA. The factors found enrich the trusted AI research and inspire insights of design of IPA.

KEYWORDS

Trusted AI; Intelligent Personal Assistant; Human Computer Interaction; Voice Interaction; Models

INTRODUCTION

Communicating with the machine by voice has gradually become a widespread way of human-machine interaction. According to the report from Voicebot.ai (2018) near 1 in 4 U.S. adults have used Intelligent Personal Assistant (IPA), a kind of Artificial Intelligence (AI), such as Siri, Google Assistant, Amazon Alexa, defined as "an application that uses input such as the user's voice and contextual information to assist by answering questions in natural language, making recommendations and performing actions" (Cowan et al., 2017).

Trust building has become the key to develop human-AI deep collaboration. Building people's trust towards IPA can truly realize human-machine collaboration (Siau & Wang, 2018) and enhance human performance to achieve a more efficient life and work (Shneiderman, 2020a; Shneiderman, 2020b). On the other hand, the potential risk requires a trusted IPA. AI products such as IPA have been involved in human life, but people still find it hard to trust them (Paay et al., 2020; Gillath et al., 2021). Thus, the European Commission (2019) has developed Ethics Guidelines for Trustworthy AI. The issue of trust in human-machine has become a common concern.

Interaction with IPA similar to communicating with a person by voice can lead to some issue of a different dimension than the general results of HCI (Kim et al., 2020). Recent researches have discussed the trust in conversation agent (Clark et al., 2019), voice assistant in car (Pitardi & Marriott, 2021) and smart home devices (Ziefle et al., 2011; Yang et al., 2017; Cannizzaro et al., 2020), however quantitative study lacks in this field (He, 2019; Ahmad, 2020) and an integrative model is required. Edwards & Sanoubari (2019) found it necessary to differentiate different aspects of trust. Focusing on trustworthiness is more helpful to get practical insights to improve the design of IPA. These gaps can imply that the model of the trustworthiness of IPA would have distinct features from the previous trust model and therefore it is very necessary to build a model about a trustworthy IPA.

Thus, in this article, the trustworthiness of the IPA was focused, aiming to answer the two research questions:

- RQ1. What are the factors affecting the trustworthiness of IPAs?
- RQ2. How do these factors affect the trustworthiness of IPAs?

The research makes two contributions: First, a comprehensive theoretical model about the trustworthiness of IPAs was constructed. To our knowledge, the study is the first trying to develop a model about the trust between human and intelligent personal assistants. The study aims to develop AI from the perspective of human rather than algorithm (Lv et al., 2020), contributing to the human-center thinking of AI research (Shneiderman, 2020b). Second, identification of the three factors that the capability of system, the availability of interface and the personality of

agent affecting the trustworthiness of IPA, especially verifying the importance of personality of agent is great evidence for results in the recent study proposing factors theoretically (Thiebes & Sunyaev, 2020; Rheu et al., 2021). And the elements in the model are practical that can inspire insights into the future product design of IPA.

LITERATURE REVIEW

Trust between human and AI

The factors contributing to trust are a common concern. In general, researchers mainly studied the affecting factors of four types of trust, that is, interpersonal trust, online trust, trust in human-robot interaction and trust in human-AI. The origin of trust study focuses on interpersonal trust. Deutsch (1958) found that the personality traits of the trustor and trustee were important factors to promote trust. Mayer et al. (1995) thought that the trust offered by the trustor was determined by four factors that were the perceived capability, integrity, kindness of the trustee, and internal propensity of the trustor. And face played an important role in establishing trust (Todorov et al., 2008).

Trust online was studied mostly in the factors affecting e-commerce (Zhai & Xue, 2014) and it was positively related to customers' online purchase intention (Ling et al., 2010). Especially among the sharing economy these years rising, members on both sides must trust each other to act good faith, that was the trust relationship between users and service appliers was crucial to the transaction (Cheng et al., 2019).

As for human-robot interaction, Hancock et al. (2011) figured out the greatest factors related to trust in human-robot interaction were the performance of the robot and environmental factors were moderately associated. Some robots with obvious human characteristics even made people too scared to interact with them (Ho et al., 2008). Individual differences, knowledge on technology and context would greatly influence users trust on robots (Oksanen et al., 2020). Wagner et al. (2018) designed a model of human-robot trust that three interrelated factors influenced trust decisions, i.e., situation, trustee, and trustor. Human Computer Trust (HTC) (Madsen & Gregor, 2000) and The Trust Perception Scale-HRI (Schaefer et al., 2016) were important tools to measure trust in human-robot.

The trusted AI and its "dark side" are necessary to be studied (Malhotra et al., 2013; Yan, 2019; Meske et al., 2020). Technology characteristics, especially the performance of the technology, its process and purpose contribute to its difference from other type trust (Siau & Wang, 2018). The features of trustworthy AI were discussed, such as transparency, reliability, beneficence (Schmidt et al., 2020; Ryan, 2020; Thiebes et al., 2020). Nowadays human-center study has developed to explore trust building in human-AI. Trust building in various systems was considered to gain insights into future AI product design (Hengstler et al., 2016; Qin et al., 2020). Difficulty, performance and results of tasks contributed to the perceived trust evaluation (Bitkina et al., 2020). The formation of AI representation, communication in human-AI, intelligence level of machine and the emotion produced in the interaction were important to shape users' cognitive and emotional trust (Glikson & Woolley, 2020; Troshani et al., 2020;).

Voice Interaction between Human and Machine

Studies about the interaction of IPA involves user-related, system-related, interaction-related, situation-related four different aspects. Hou & Chen (2018) investigated 622 Chinese adults who have used IPA and found that the percent of those using IPA continuously was lower than 29.74%. Users' familiarity with the system, ease of use, speed, trustworthiness, comfort, level of interest, the novelty would affect people's perception of the voice-interaction system (Begany et al., 2016). For elders, the voice-based device was important to access online information, especially health-related information (Pradhan et al., 2020).

The system has impacted user experience a lot. Keeping user informed and clarify system's doubts were important for voice interface design (Santos et al., 2019). When interacting with different interfaces, what people input was affected by different types of tasks (Yuan & Sa, 2017). The current speech recognition technique was hard to satisfy users' need (Guy, 2018). Different classifiers for voice queries were proposed to understand user intent accurately (Mukherjee et al., 2013; Qu et al., 2019; Voskarides, 2020). And playing with a voice assistant without a body and figure was perceived as a less entertainment experience comparing with a robot (Pollmann et al., 2020).

Interaction session was focused. Researchers found that voice query was longer than text query (Ab Aziz et al., 2016) and voice query was considered to be verbose (Gupta & Bendersky, 2015; Bentley et al., 2018). Speech recognition quality, pronunciation characteristics, speed, volume and pitch were adopted to measure voice query (Hassan et al., 2015). Performance expectancy and compatibility positively influenced users' intentions to adopt a voice-base system (Wang, 2020). Recall rate, precision rate, MRR, user perception of usefulness and user satisfaction were important indicator of performance of voice-based system (Arnold et al, 2020). Compared to the search results of different IPAs, Boyd & Wilson (2018) pointed out that Siri was the worst at offering smoking cessation advice.

Information users input with different interfaces was determined by social circumstances (Easwara & Vu, 2015). Location would affect users' willingness to use the system with voice interaction function (Efthymiou & Halvey,

2016). When interacting by voice, users preferred to use IPA at private places such as at home, stay alone, or stay with friends (Dubiel et al., 2018). When interacting with an IPA in car, social presence and social cognition would greatly affect users' attitude (Pitardi & Marriott, 2021). Users would avoid voice interaction in public places (Ho et al., 2008; Jeng et al., 2013), mainly due to social embarrassment. For instance, in Ireland, talking on the phone when in public was a violation of citizens' rules as a behavior to disturb public order (Cowan et al., 2017).

THEORETICAL MODEL AND HYPOTHESIS

Researchers have discussed the possible factors affecting trust in human-machine and use experience in voice-based system. To answer the research questions, three hypotheses were proposed and a theoretical model of trustworthiness of IPA was constructed (Figure 1), based on the Three-Factor Model of Human-Robot Trust (Hancock et al., 2011; Sanders et al., 2011; Schaefer, 2016). The model was analyzed through available literature on trust and human-robot interaction by meta-analysis method (Hancock et al., 2011). Later when researchers explored its application in various scenarios, the model is developed (Hoff & Bashir, 2013; Ab Aziz et al., 2016; Wagner et al., 2018; Lewis et al., 2018) and expand as basis of trust in human-technology (Siau & Wang, 2018).

Capability of System

While the system is the basic component of Artificial Intelligence, the system of capability is an essential element of IPA. As the trustee in the human-computer interaction, perceived ability of IPA is an important element in the promotion of trust (Mayer et al., 1995). And performance of the robot strongly supports the trust in human-robot interaction (Sanders et al., 2011; Lewis et al., 2018), similar to the system property in human-IPA interaction. The performance of robot had the greatest association with trust actually (Hancock et al., 2011). Wherever automation system or robot domain, system property contributes to the trust (Ab Aziz et al., 2016). The level of capability was one of the antecedents to trust development in human-AI (Glikson & Woolley, 2020). Thus, we infer that the capability of system of IPA is an important factor to improve the trustworthiness of IPA.

- Hypothesis 1: The capability of system has a significant impact on the trustworthiness of IPA.

It can be measured by five sub-elements. Reliability typically refers to the system with few faults and secure for personal information protection. Reduced reliability can lead to decline in trust and trust expectations (Moray et al., 2000). And a form of reliance would be reach when AI meets all the requirements of the rational account of trust (Ryan, 2020). Intelligence requires the system was able to explain the reasoning with flexible answers to meet users need (Lewis et al., 2018). Availability of voice activation refer to the use experience when user activate the system. With the availability of multimodal, user can interact with the system by different modes, such as voice, text, image, video etc. Performance of feedback contains the quality and quantity of results that the system presents after user input voice query. The performance level's effect on trust has been test from various aspects such as accuracy in task completion, quality of search results, task performance (Rheu et al., 2021).

Availability of Interface

The interface is the appearance of IPA. The face of the trustee can affect the accuracy of trust judgment when people communicate with others (Todorov, 2008). Similarly, a robot with a more humanized face is considered with better personality (Broadbent et al., 2013). The interface was also crucial in information retrieval (Saracevic, 1997). Rational interface communicating users and engineers was important for explainable AI (Guo, 2020), which was the antecedent of trust development (Doran et al., 2017). Invisible interface led to problems and was considered to be the reason of distrust to IPA (Paay et al., 2020). Thus, we infer that trust develops influenced by interface.

- Hypothesis 2: The availability of interface has a significant impact on the trustworthiness of IPA.

To measure it, three elements were adopted (Zhao et al., 2018). Among it, two variables were selected from Technology Acceptance Model (Lee et al., 2003). Perceived usefulness referred to the system can help users improve work efficiency. An IPA helping user successfully completing tasks were considered trustworthy (Rheu et al., 2021). Perceived ease of use is that users learn to use the system quickly, even if they are new to it. It would have great impact on driver consumer's trust on IPA (Pitardi & Marriott, 2021). Visual comfort is a kind of feeling toward the surface plane of the system which greatly influences use experience (Garrett, 2010). An interface ought to look simple, structured and beautiful to be visual comfort.

Personality of Agent

Users would perceive IPA's personality when interaction through voice embodiment, visual virtual figure or physical representation. A survey by Baidu Artificial Intelligence Interaction Design Institute (2018) found that while more than 60% of users think IPA should have personality, over 90% can perceive its personality. Anthropomorphism is considered to be a factor affected trust. In interpersonal trust, the personality of a trustee is the most important factor (Deutsch, 1958). When presented as a human, it can increase the trust between human and conversational agent (Rheu et al., 2021). Users nowadays can create their own AI beings by personalize the voice,

avatar, age, gender, skills, conversational style, etc (Braun et al., 2019; Borak, 2020). Thus, we believe it necessary to confirm the influence of the personality of agent in the improvement of trustworthiness of IPA.

- Hypothesis 3: The personality has a significant impact on the trustworthiness of IPA.

The factor contains five sub-elements. Goodness of character refers to the mental and moral qualities of agent perceived. The agent behaving generously, socio-emotional, more trust showed by users (Lohani et al., 2016; Torre et al., 2018). Ease of relationship is the role defined by owners that the agent plays in life, such as servant, partner, even perfect self (Braun et al., 2019). Voice comfort means that the sound is perceived comfortable. Voice characteristics is important in establishing the perception of trust (Rheu et al., 2021). For Perceived gender comfort, the gender of IPA is supposed to be easily accepted and good for daily use, which would affect the trustworthiness of IPA in specific context (Nunamaker et al., 2011). Same as Perceived age comfort. Gender and age can strengthen or weaken the trust in AI through factors of anthropomorphism and intelligence (Troshani et al., 2020).

Trustworthiness of Intelligent Personal Assistant

Five variables were adopted from the Human Computer Trust Scale to measure the trustworthiness of IPA. It was specially designed to measure human-computer trust and shown empirically to be valid and reliable (Madsen & Gregor, 2000). Now it has been applied to measure trust between human and various machines (Choi & Ji, 2015; Schraagen et al, 2020), even trust on IPA (Lee et al., 2021). Thus, as a computer system, a trustworthy IPA is suitable to be measure by the scale.

Perceived reliability is the reliability of the system from the user perspective that can respond the same way under the same conditions. A trustworthy AI tends to reach enough reliance first (Ryan, 2020). Perceived technical competence refers to the ability to help users to complete tasks. Whatever query input, the system gives useful information to make decision and correspond to users' expectation. Perceived understandability refers to that human and the system can understand each other and communicate smoothly. The system is able to understand what users input and uses appropriate methods to reach decisions after. Faith is a belief embodied. While cognitive and affective ways are two main routes to boost trust in AI (Johnson & Grayson, 2005), strengthening faith is cognitive. Users are certain and confident about the feedback IPA return is good and useful. Personal attachment is a kind of human emotional feeling and behavior. Users tend to develop affective relationships in long-term interaction with IPA. Exposure to attachment security cues can lead to increased trust (Gillath et al., 2021), such as love, loss, anxiety.

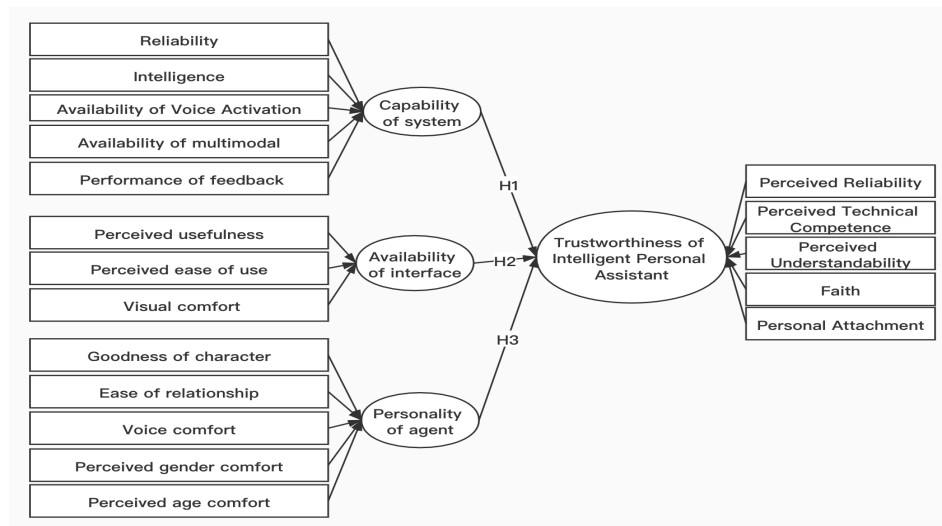


Figure 1 Theoretical Model of Trustworthiness of Intelligent Personal Assistant

METHODOLOGY

Data Collection

The study used the questionnaire to collect data, including a preliminary study and the formal study. Based on the theoretical model, the initial questionnaire was designed. The final questionnaire was formed after modifying the questions' description with the suggestion from five participants. A four-Point Likert Scale was chosen (Lei, 1994) to force them to show their real preference. Chyung et al. (2017) pointed out that using a Likert Scale omitting a midpoint is reasonable helping to eliminate the possibility that respondents misuse the midpoint. The four-point Likert Scale has been applied to many fields, such as tourism, health, marketing (Muskat et al., 2019; Reich & Yuan, 2019; Hayotte et al., 2020). Considered the small number of frequent users of IPA and the people's tendency to

prefer good, it's suitable to adopt a four-point scale to avoid participants' neutral attitude, which would block us to explore users' real experience. The final questionnaire contains four parts: the demographic characteristics, the questions for people who have used IPA, the questions for people never used, and an open-end question to explore people's expectations of IPA. The part for those who new to IPA had been designed a scenario in that participants can imagine the factors that might affect their use.

Participants

The formal study lasted from February 21 to March 17, 2020. The target group is those who are interested in the use of IPA, including those who have used and never used it. The questionnaires were mainly distributed through WeChat. As the mainstream Internet platform in China with thousands of active users, it is easier to collect enough data by WeChat. On the other hand, since the small number of IPA users, distributing questionnaires by snowball sampling methods relying on the social relationship in WeChat is more likely to access enough valid data.

358 questionnaires were collected eventually. Considered the feasibility of the study, the distribution coverage of the questionnaire was limited to China. All of these participants were distributed widely to get rid of the interference of location factors, which is from 29 different provinces of China. As for gender, women (232, 64.8%) who have used IPA was higher than men (126, 35.2%). The distribution of age showed that most users were in 18~35 (248, 69.3%) and 36~60 (84, 23.5%). Meanwhile, people with advanced education performed better in the use of IPA, which were dominated by undergraduate (157, 43.9%) and postgraduate (149, 41.6%). The results were in accordance with the conclusion of the survey by Walter Thompson (2017) about the use of IPA in China.

Two parts were divided. 265 (74%) participants had ever used IPAs, while the remaining 93 had never used it. On one hand, the data of those with IPA using experience was ready to recognize the elements affecting the trustworthiness of IPA in the part of Verification of Model. Among it, 68 people rarely used it or have used it (25.66%), 156 people used it occasionally or less frequently (58.87%), 28 people used it a lot at some time (10.57%), and the group of frequent use was only 13 (4.91%). The results that IPA is used widely but in a low-frequency was in line with reality. On the other hand, the rest of the data of those non-users was used is there for comparison. Considering the number of USERS of IPA is extremely small all over the world, researchers compared the users who have used IPA with those who have not used IPA to draw a more comprehensive conclusion, as detailed in the part of The Difference between the Two Groups. Diversely, the data from open questions of questionnaires would be analyzed to understand people's expectations for IPA, that is to say, 358 questionnaires were valid for analysis in the part of User Expectation to IPA.

Analysis Method

To analyze comprehensively, quantitative analysis and qualitative analysis were adopted. The main data of the questionnaire adopted Partial Least Square Structural Equation Modeling (PLS-SEM) to verify factors and effects contributing to the trustworthiness of IPA, shown in the part of Verification of Model. The primary purpose of the study was to explore and predict the indicators, so PLS-SEM is more suitable than CB-SEM, which is fit for theory confirmation or comparison of alternative theories (Hair et al., 2011). And value of path coefficient was adopted to show the intensity of the effect. The P-Value can be calculated from the value of T-Statistic, indicating the significance of the effect.

Divided by the experience of using the IPA, the data of users and nonusers were compared in the part of The Difference between the Two Groups. The relationship between whether users use IPA or not and gender, age, and education was conducted separately by Chi-square test, because the independent variables are categorical variables. Since the independent variables are binary variables and numerical variables, T-test was adopted to examine the relationship between whether users use IPA or not and the three variables from the theoretical model.

In the part of User Expectation to IPA, the qualitative data of the answer to the open-end question was analyzed by thematic analysis, aiming to explore people's suggestions and feedback of IPA. Thematic analysis was conducted to identify themes embodied in users' answers. The study used inductive approaches to closely examine the questionnaire data, absolutely based on the text from users. Rigidly following the 6 steps of thematic analysis (Nowell et al., 2017) that were familiarization, coding, generating themes, reviewing themes, defining and naming themes and writing up, the result was produced in Table 2. After finishing data collection, individual coding was conducted by two researchers. Codes were recognized based on the idea or feeling expressed by participants in that part of the text so that the code schema was developed. After it, researchers looked over the codes created and discussed the results of coding until reaching an agreement. Similarly, researchers started coming up with themes individually first and then discuss the disagreement together. Finally, Cohen's kappa coefficient was 0.67, representing substantial agreement of inter-rater reliability (Landis & Koch, 1977). All disagreement themes were discussed and being solved to get 100% agreement (DeCuir-Gunby et al., 2011) in the end.

DATA ANALYSIS

Verification of Model

Take the 265 data that people who have used IPA to do a test. To avoid the non-normal distribution caused by a small sample size and reduce the influence of multi-collinearity among variables, Partial Least Square Structural Equation Modeling (PLS-SEM) was adopted.

The reliability and validity tests were conducted. Cronbach's Alpha and Composite Reliability were used as the reliability evaluation indexes. Each value of Cronbach's Alpha was greater than 0.70 (Tavakol & Dennick, 2011), and Composite Reliability values were 0.995 (Bagozzi & Yi, 1988), indicating that reliability is good. Factor analysis was carried out to determine the construct validity. Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was calculated to be 0.985, and the value of Approx. Chi-Square in Bartlett's Test of Sphericity was large, reaching the significance level (Sig.<0.001), so the construct validity was good too (Malhotra et al., 2010). When the Average Variance Extracted (AVE) value of the first-order latent variable was measured, it was found that the AVE values reached 0.9, all of which are above 0.60 (Bagozzi & Yi, 1988), so the convergent validity was fine. The value of the square root of the AVE of each latent variable was greater than the correlation coefficient between the variable and other latent variables, so discriminant validity was good (Fornell & Larcker, 1981). Although the value of the square root of AVE of the capability was slightly less than the correlation coefficient with the interface, because the two values were very close and the variable was supported by the literature, thus the latent variable was retained.

The model parameter values were first calculated by PLS Algorithm, and then the significance of parameters was determined by Bootstrapping to conclude whether hypotheses pass or not and their impact toughness. Bootstrapping was set to conduct 2000 repeated sampling, and the significance of three hypotheses were all true, shown in Table 1. In other words, the capability of system ($T=5.396$, $p<0.001$), the personality of agent ($T=3.263$, $p=0.001$), the availability of interface ($T=2.627$, $p=0.009$) all have a great impact on the trustworthiness of Intelligent Personal Assistant, and the impact toughness is from high to low ($0.501>0.204>0.286$).

Hypothesizes	Value of Path Coefficient	T-Statistic	P-Value	Significance
H1: Capability of System -> Trustworthiness of IPA	0.501	5.396	0.000	True
H2: Availability of Interface -> Trustworthiness of IPA	0.204	2.627	0.009	True
H3: Personality of Agent -> Trustworthiness of IPA	0.286	3.263	0.001	True

Table 1 Results of Path Coefficients and Significance

User Expectation to IPA

Thematic analysis was adopted to deeply explore the expectation of users toward IPA. The procedure was shown in Analysis Method, and the results shown in Table 2. Users' expectations of IPA can be included into 4 facets almost corresponding to the affecting factors in the model.

The Difference between the Two Groups

The perceptions of two groups were compared to conclude comprehensively explanation, which can predict the dynamic change of the trustworthiness of IPA after those who never used IPA have used it.

The chi-square test of whether the IPA has been used and gender, age, and education finally found that there was no significant difference in educational background and gender. As the expected number in the chi-square test for people over 60 years old was less than 5, fisher's exact test was adopted (sig.=0.034<0.05), indicating the significant difference in age. Today those who have an obstacle to using IPA are those who need it, such as elders, children, and minorities. After that, conducted a T-test for whether users use IPA or not and the three variables from the theoretical model. It concluded that the two groups had significant differences in capability of system (sig. <0.001), availability of interface (sig. =0.003), however, personality of agent was similar (sig. =0.980). According to mean of two groups, the non-user group think highly of IPA's capability (2.90) and interface (2.85), while capability and interface perception of those who have used IPA respectively were 2.54 and 2.58. It indicates that users with high expectation before use but end with great disappointment in practice. The personality both were 2.61 of two groups, indicating the personality now can satisfy users' needs. From the non-user group, the proportion of personality was lowest, while it was the first place on the eye of those who have used it. As Hancock et al. (2011) pointed out, the impact of human-related factors was limited. Generally, people still view IPA as a machine so that they wouldn't demand more about the human characteristic of IPA even they know it has some.

Facets	Themes	Codes	Facets	Themes	Codes
Capability of system	Assign system attributes	more accurate	Availability of interface	Improvement of humanization	easy to use
		more flexible			simple to use
		more intelligent			more beautiful
		more automatic			enhanced humanization
		more interactive		Improvement of the interaction with IPA	improvement of interaction efficiency
		more stable			better interaction by voice
		faster response			able to give satisfactory feedback
	Broaden the scope of the functions	offline available	Improvement of personalization	No touch screen interaction assistance	
		improvement of the accuracy of the translation		optimization the way results represented	
		optimization of the function of recommendation	improvement of personalization		
		able to chat with people	Natural sounds	with de-mechanizing voice	
		able to carry out complex operations		able to change the voice	
		more apps available		optimization of the tone of voice	
		deeply integration and cooperation with other apps	Distinctive personification	be interesting	
	Optimization of multi-rounds interaction	smoothly communication		be smart	
		able to interact with people several rounds		be humorous	
		able to answer based on context		be sweet	
		improvement of the response speed of continuous conversations		optimization of personality	
	Improvement of quality of answer	more resources available		improvement of personification	
		enhanced semantic comprehension ability	as a virtual lover		
		improvement of the accuracy of answers	able to understand human emotions		
		improvement of the comprehensiveness of answers	able to provide companion and interaction		
		improvement of the depth of answers	Meet the needs of different user groups	meet the needs of the elderly	
	Improvement of speech recognition	improvement of speech recognition accuracy		meet the needs of middle-aged people	
		accurate recognition of language with heavy accents		meet the needs of the minorities	
		support the recognition of more dialects	Being applied to more scenarios	work well at long distance	
	Improvement of voice activation	reduction of voice activation accidentally		work well when noisy	
		easier to activate by voice		applicable to more scenarios when commands are released	
		more intelligent to activate it	Users' satisfaction in daily life	meet needs in users' everyday life	
				helpful to make life easier	
	helpful to improve efficacy in life				
	improvement of user experience				
		Privacy and security concerns	privacy and security concerns		
			legal protection		

Table 2 Results of Thematic Analysis

RESULTS

Through the data analysis, the answer to two research questions shows (Figure 2).

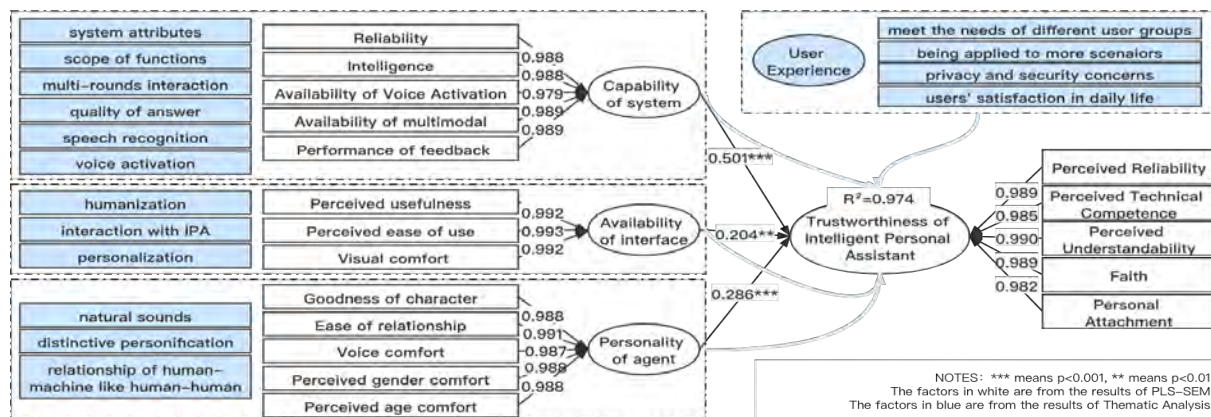


Figure 2 The Integrative Model of Trustworthiness of Intelligent Personal Assistant

Capability of System

The capability of the system has the strongest impact on the trustworthiness of IPA, whose value of T-statistic is 5.396. It corresponds to the conclusion pointed out by Hancock et al. (2011) that the performance of AI is the most important factor. Combined with the results above that IPA is spread widely but has low user frequency, it can be concluded that people still have an adequate space to explore IPA. Just as a participant pointed out: *"I think I will consider using it if this Intelligent Personal Assistant is more convenient to use and its functions can meet my daily needs closely."* Therefore, IPA developers must make its capability of the system to reach the basic threshold, which is a prerequisite for the improvement of IPAs' other features. IPA was expected to be applied to more scenarios and meet the daily need in life. To some degree, only when people are willing to stick with IPA rather than swift to other tools immediately is possible for IPA to be good enough.

Additionally, the capability of the system can be fully explained by these 5 variables in the model, whose explanatory strength respectively were 0.988, 0.988, 0.979, 0.989, 0.989. The availability of multimodal and performance of feedback was the greatest (0.989). Users were thirsty for smooth communication with IPA with ease of multi-rounds interaction, improvement of the way of voice interaction without touching the screen as well as high-quality of the answer. It also indicated that interacting with IPA naturally like with a human was the first place when users decided whether they can trust IPA. Intelligence (0.988) was referred to most when participants talked about the future. From the view of users, to be more accurate, flexible, intelligent, automatic, interactive, stable and with faster response were their perception of IPA. Although the availability of voice activation (0.979) was the lowest observation factors, it was still important. Once users are disappointed about the availability of voice activation, they are very possible to give up trying using it even never use it again.

Availability of Interface

The availability of Interface was the weakest factor among three potential factors ($T=2.627$) but still play a big role. The improvement of voice activation, the way of interaction with IPA, humanization and personalization were expected by participants. Different from traditional interaction, they figured out interaction by voice was important when face to the interface. Perceived usefulness, perceived ease of use, and visual comfort can strongly explain the factor, but there were no significant differences among them, which were 0.992, 0.993, 0.992. The ease of use was most important for users, whose average number reached 2.66. Similar to interpersonal trust (Todorov, 2008), as the "face" of IPA, the interface would have an influence on people's interaction with it. The reason why the impact was lowest maybe that interface of mobile phone apps had a unified design standard. And when the user called the phone from a distance, the interface of IPA would hardly influence their experience to use it. A participant even expected that: *"I hope it can be true in the future that when I communicate with the Intelligent Personal Assistant without my hands touching its screen..."* Combined with the results of the capability of the system above, it can be concluded that when people use IPA, the basic need was voice control, though visual comfort was also important. When people designed an IPA, the capability of voice control was more important than visual comfort.

It is a pity that participants did not care much about the interface of IPA. They only required the IPA to be more humanized and personalized. For the voice-dominated interaction, users had an intense perception of the existence of the agent so that they took no notice of the ease of use of the interface. Only for those minorities, elders, children,

or people with disabilities, the interface still attached great importance to their usage. The design of the interface of IPA should take more consideration about the needs of vulnerable groups.

Personality of Agent

The hypothesis that the personality of the agent will influence the trustworthiness of IPA is true ($T=3.263$). Users perceived the personality from character, voice, age, gender, and relationship, whose explanatory strengths were 0.991, 0.987, 0.988, 0.988, 0.984, respectively. The result indicated that the designer should take these factors all into consideration. The personality of IPA makes it different from a robot (Parasuraman et al., 2008). The reason may be that IPA has no machine body and people prefer to judge its character (0.991) only by its voice (0.988), which are two of the strongest explanatory factors. It is generally believed that the sound of IPA is friendly, whose average reached 2.71. As the dominant voice of IPA is the voice of young women, some female participants said that they hope there were some IPA can have a male voice for them. Besides, the average value of the element of the relationship was lowest (2.35), which may be caused by the weakness of the capability of system.

As the Computers-Are-Social-Actors paradigm stated, when people interact with a computer, it shares some similar characteristics with interpersonal interaction, that is, people apply social rules, norms, and expectations to the computer (Sundar & Nass, 2000). People unconsciously personify IPA (Turtle, 2017), using words related to human to describe IPA, such as “*smart*”, “*sweet*”, “*humorous*” etc. Users even have emotional expectations toward IPA, said that “*would you love me*”, or “*it’s better that it can chat with me*”. They viewed IPA as a real person in the world!

DISCUSSION

The trust between human and IPA would be a long-term topic, as the technology is immature nowadays. The results of affecting factors to the trustworthiness would be helpful to improve the trust relationship. The practical suggestions for future IPA are discussed here. Generally, to develop swiftly, the capability of an IPA is the first place to be improved. Due to the low intelligence level of IPA, today users pay more attention to the feature and performance of the system whether it is available to complete users’ tasks (Clark et al., 2019). Combined with the comparison of user groups, the capability has a great impact on the transition urging non-users to turn to users. The quality of speech recognition, natural language understanding, quality of response, and available functions have to be improved to make it easy to use. Consider the need of those unfamiliar with intelligent devices is imperative, such as old people, etc.

Secondly, the interface should be taken care of. To be friendly use is the principle of interface design. The combination of screen and voice is perceived to be easily used, especially for those vulnerable groups. Also, an IPA with the high-quality answer can help them with filtering resources to mitigate information overload (Ndumu, 2020). Users demand a personalized interface, giving them freedom to personalize their own device, deciding the way to show the feedback. Virtual profile of IPA would be shown also in the future, strengthening the perception of trustworthiness due to the great influence of the anthropomorphic look of the agent toward trust in human-IPA (Qin et al., 2020; Rheu et al., 2021).

Although the basic need for the personality of the agent has been met, the factor is in great demand to develop. Social aspects of conversational interaction are currently absent from people’s perceptions of what IPA should be capable of performing (Clark et al., 2019). As the widespread loneliness of young people nowadays, they tend to develop an intimate relationship and social expectation with it (Turtle, 2017). They gradually offer cognitive trust, develop affective trust and love IPA (Gillath et al., 2021). It can be predicted that the personality of the agent may gradually increase its impact strength to the whole trustworthiness, especially when the personality of agent matching with users’. Nowadays, chatting with IPA is the most frequent interaction, and trust builds with conversation. Users have tended to view IPA as partners (Braun et al., 2019; Sayago et al., 2019), and demand its great characters, beautiful sound, and natural pronunciation.

On the other hand, the improvement of the trustworthiness of IPA should be cautious. The relationship of trust in human-IPA is easy to be manipulated and abused. Privacy risk significantly influenced perceived risk that influences individuals’ intention to adopt IPA (Wang et al., 2020). Trust is irreversible. Instead of being repaired or terminated, trust that has been broken continues to be maintained for a variety of reasons. For those who indulge in the web, the interaction in human-IPA would make them more resistant to the socialization of inter-people and even adopt a negative attitude to the real world (Turtle, 2017). For users, different types of risks should be taken into consideration.

CONCLUSION

The paper constructed a theoretical model about impact factors of the trustworthiness of IPA and finally figured out the affecting factors of the trustworthiness of IPA and explained how it affects. The capability of the system, personality of the agent, and availability of interface play significant roles in the trustworthiness of IPA from high to

low. There is still a large space for IPA to develop, and the capability is the first place, the level of which makes people unwilling to use it. The interface would be improved following the development of the capability of the system and the personality of the agent, especially considering the need for minority groups. Referring to the personality of the agent, the IPA nowadays has satisfied the current use need, but as an essential attribute, it would be paid more attention.

This study has important theoretical and practical implications. First, it explores a trustworthy IPA, beneficial for the AI research community shifting to emphasize Human-centered Artificial Intelligence (Shneiderman, 2020b). Second, it helps illuminating factors of trust-calibration that previous studies omitted (Rheu et al., 2021). Third, identification of the model is a great evidence for the factors that recent study proposed theoretically. For practical implications, the study can provide useful guidance toward a trustworthy IPA and assists users in building trust with IPA beneficial to support human self-efficacy. However, limitations such as small sample used and a lack of context variables considered exist in the study. Notwithstanding these limitations, it opens up interesting opportunities for future studies.

ACKNOWLEDGMENT

This research was funded by Special Project of Integration Research on Artificial Intelligence of Wuhan University “App Privacy Policy and User Trust under the Background of AI Research” (No. 2020AI020).

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Learning Outcomes during Information Search in Digital Archives

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ABSTRACT

A museum's digital archive system gathers information about cultural heritage and makes it accessible to the public. In this study we clarify the extent to which search behaviors reflect task outcome and foster users' knowledge of painting and calligraphy. Ten users participated who are special interest museum visitors. They joined in this evaluation of the Digital Archives of Chinese Painting and Calligraphy Search System (DA-PCSS) of the National Palace Museum in Taiwan. Participants' search activities and interactions with the DA-PCSS were recorded in two simulated tasks. The results show that the high-performance (HP) group who received high scores for their essays on the tasks formulated precise and relevant queries. Furthermore, the HP group were able to find information needed inside or outside the system to explore and synthesize the information, which was clearly reflected in their search move patterns, during the search process. Our results suggest that the criteria for learning at various stages of search suggested by Vakkari (2016) seem to validly reflect the quality of the search outcomes. In all, the results elucidate how the evaluated system supports users as they search for target items, as well as how learning occurs during the search process and in turn influences task outcomes.

KEYWORDS

Chinese painting and calligraphy; Digital archives search system; Information search process; Meaning making process; Search as learning

INTRODUCTION

Using information technology, museums can present their collections digitally and extend the benefits of physical museums to the public. These museums as culture heritage institutions attract wider and more diverse user groups, especially for general public and non-professional users (Skov, 2013; Walsh, Hall, Clough, & Foster, 2020). Following the trend of open digital collections in museums and libraries, the National Palace Museum (NPM) (<https://www.npm.gov.tw/>)—the most important and popular museum in Taiwan—established database searches in 2015. According to its annual report, as of December 31, 2020, the NPM had a total of 698,796 works in its collection. Among these, 80% of the works in the NPM's Chinese Painting and Calligraphy collection have been digitalized and put online for public use (<https://painting.npm.gov.tw/>). The NPM has not only cultivated excellent digital archive resources on the Internet but has also begun to display Taiwan's rich cultural assets and make them both searchable and available to the public (Chen, Hsang, Chiang, & Hong, 2002). Digitization of museum collections allows users to easily and accurately find information for further research and use, and has given the public access to data previously limited to museum professionals. However, even if museums digitize their collections and make them public, can users effectively access the data therein, and are they aware of what content is available in the resources? We seek to explore the users' museum online experience by examining learning outcomes during information search.

Skov and Ingwersen (2014) investigate characteristics of the web search behavior among visitors to the National Museum of Military History in Copenhagen. The authors identified four characteristics of online museum visitors: a high propensity for visual experiences, exploratory search behavior, broad known item and/or element searches, and meaning-making. Exploratory search behaviors generally occurred while completing topic search tasks, and the visual aspect of search behavior was shown to directly support those behaviors. In addition, the participants used their background knowledge of military history to help them to interpret new clues and engage in further meaning-making behaviors. By extension, their study inspired the design of tasks in our research and our exploration of special interest museum visitors' search behaviors.

To date, research in online museums has focused on evaluating the usability of the systems and users' characteristics and motivations for visiting digital museums (Falk, 2013; Pallas & Economides, 2008; Walsh et al, 2020). By

contrast, few studies have investigated how knowledge formation occurs as a result of information searches (Rieh, Gwizdka, Freund, & Collins-Thompson, 2014). We examine whether users learn during the search process and display meaning-making behaviors based on learning criteria derived from information searches as in Vakkari's (2016) study. To that purpose, we explored users' search and interaction patterns in three search stages (search formulation, source selection, and source interaction) between groups with different task-performance outcomes, to reveal which characteristics promote learning outcomes. We adopt zero-order state transition matrices (ZOSTs) and lag sequential analysis (LSA) to calculate the frequency (i.e., probabilities) of search behaviors for users with different task outcomes (Bakeman, & Gottman, 1999; Sackett, 1979; Wildemuth, 2004). In this study, we seek to determine the characteristics of users' search and interaction patterns in the three stages of searching for information for users with different task performance, and to understand which promote better or worse learning outcomes as reflected in the final stage of the process (i.e., synthesizing and presenting information).

INFORMATION SEARCH BEHAVIOR FOR ONLINE MUSEUMS

The growth of online museums in the 1990s was international and exponential as evidenced in research evaluating different types of online museums and their visitors' motivations and demographics (Falk, 2013; Skov & Ingwersen, 2014; Walsh et al., 2016). Previous studies regard physical and online museums as complementary; however, they are characterized by different collection information environments that motivate visitors to visit them for various different reasons (Goldman & Schaller, 2004; Marty, 2007; Ross & Terras, 2011). Here, we review the related research to understand the information needs of visitors to various types of online museums by attending to their motivation or search behaviors.

Goldman and Schaller (2004) survey the relationship between visitors' motivations for visiting museum websites and their meaning-making processes. Teachers and students who were selected by this study visited a website to find specific or meaningful information and used four different types of museums. There were 1166 respondents in total to the survey. General visitors were excluded from the research target. The research results show that the intent to search for specific information (20.4% of respondents on average for the four museums) and to explore interesting information (17.3% of respondents) are the main reasons to visit an online museum instead of planning a trip to its physical location, as documented also in previous research (Sarraf, 1999).

Ross and Terras (2011) conduct an online survey and two simulated search tasks to analyze the information-seeking behaviors of scholars utilizing the British Museums' Collection Online (COL). Their work explores the value of online museums from the perspective of visitors' characteristics, their search strategies, and the usability of the system. A total of 2657 responses were received from a random sample of visitors from 57 countries. Among these, more than 50% of visitors identified their motivation for using the COL as undertaking academic research or exploring personal interests, which shows the scholarly value of visiting online museum digital resources instead of a physical visit, as mentioned in other studies. The known object type and free text searches are important functions for exploring online collections. Interestingly, regardless of whether the respondents left positive comments about the content of the system, they were unable to achieve good performance on the simulated search tasks. That is, although scholars use precise search terms, there is a gap in their understanding of the search terms and the return of the system's content. They suggest that a user-friendly metadata schema is required for further development of the system.

Early studies of online museums focus on the usage motivations and information needs of academic users of digital museum resources. However, online museums serving as culture heritage institutions attract wider and more diverse user groups. This applies especially to special-interest museum visitors categorized by Skov's (2013) study or the general public and non-professional users, as investigated by Walsh, Hall, Clough, and Foster's (2020) study. Skov (2013) uses triangulation as a qualitative research method for investigating visitors' hobby-related information-seeking behaviors in the Military Museum's collection database in Denmark. Web questionnaires collected from 132 respondents were analyzed to gain a better understanding of their leisure context areas and how they used digital museum resources in their daily lives. Twenty-four participants were classified into two groups of hobbyists—collectors and enthusiasts—as described by Stebbins's (2007) taxonomy of types of leisure pursuit of hobbies, and were invited to a follow-up interview. The research finds that most collectors have specific known-item needs, whereas most liberal arts enthusiasts have exploratory topical information needs. The contribution of this work is to find out what type of visitors cross the two hobby types, that is, who conduct more than just general exploration of a hobby or interest search. Accordingly, the research characterizes participants as special-interest museum visitors pursuing a long-standing interest or hobby, i.e., everyday information-seeking behaviors.

Walsh, Clough, and Foster (2016) review articles to categorize users of a digital cultural heritage (DCH) system into six groups from the generic perspectives of domain knowledge, technical expertise, and motivation. Their study reveals that learning, leisure, and planning visits are major motivations of DCH system users. For example, users with a high level of domain knowledge and a medium level of technical skills are similar to visitors at a special

interest museum as characterized by Skov and Ingwersen (2014). The group of users who spent more time exploring the online museum as a personal hobby required more detailed information about the museum's collections. As such, the findings reveal that different types of users require different information or types of system support to fulfill their information-related needs.

Using survey or simulated search task methods, these studies provide insight into the information needs of different types of online museum visitors from the perspective of their motivation or search behaviors. However, there is still a paucity of empirical research into the issue of how learning occurs during the search process and in turn how it influences task outcomes for the general public or special-interest museum visitors. We seek to fill this research gap by conducting an empirical study based on learning criteria derived from information searches as in Vakkari's (2016) study via a simulated work task approach. We seek a better understanding of the extent to which the system supports visitors' learning while searching for information online.

METHODOLOGY

To observe the search processes, we used usability testing software to record participant's interactions with the Digital Archives of Chinese Painting and Calligraphy Search System (DA-PCSS). Two simulated tasks were designed based on two types of knowledge: tasks related to factual knowledge and conceptual knowledge respectively. Herein, we briefly explain the components of the evaluation framework in Figure 1.

Learning tasks and participants: We designed the two tasks based on Borlund (2003), as shown in Figure 2. Note that Task 1 concerns fact-based knowledge, for which the system provides less information support, whereas Task 2 concerns concept- and relationship-based information that can be retrieved from the system. We recruited ten users to participate in the DA-PCSS evaluation. We invited participants who were interested in painting and calligraphy to take the time to learn more about the paintings and calligraphy via the system. All of the participants had visited the museums at least twice during the preceding year and have been using the DA-PCSS system or NPM website to look for information. They also showed long-term personal interest in painting or calligraphy. After accomplishing the tasks, we also asked the participants to produce ratings for their perceived prior knowledge of each task (ranging from 0 to 100).

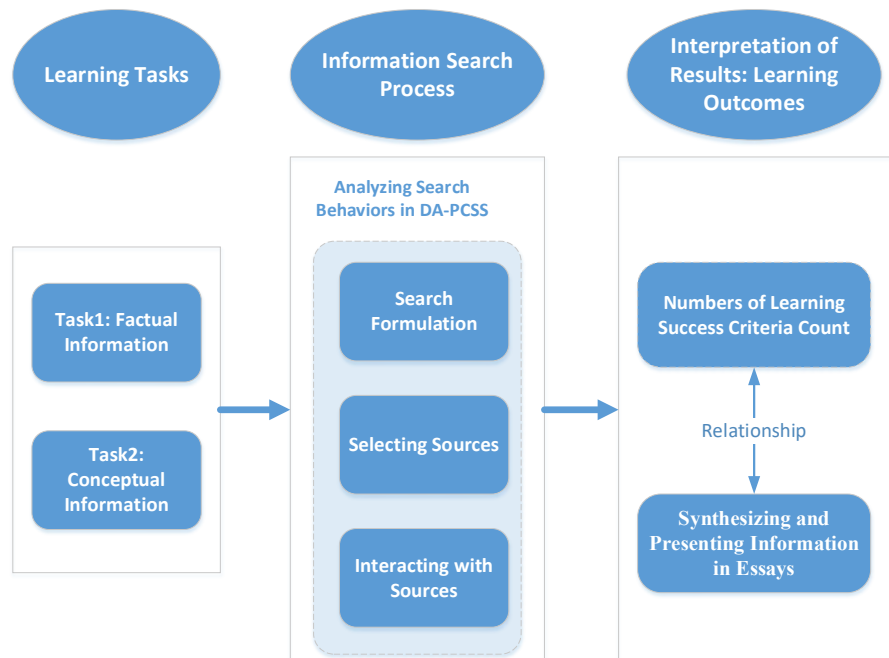


Figure 1. Evaluation Framework

Task Description

Task 1: While watching the flower painting exhibition, you see the "boneless" technique, which piques your interest in the characteristics of the boneless paintings and related works.

※Please record your learning outcome in writing: describe the characteristics of the "boneless" technique, for example, the author, works, topic and dynasties of the "boneless" style, the meaning of certain techniques, etc., or other content that you are interested in.

Task 2: As you browse the website, you find Fan Kuan's "Travellers among mountains and streams", which is one of the Three Treasures of the Palace Museum. The others are Guo Xi's "Early Spring" and Li Tang's "Wind in the Pines Among a Myriad Valleys". All three are landscape paintings, and you use the Antique digital archive retrieval system to learn more about these three works. The Three Treasures of the Palace Museum is shown in below.

※Please record the learning outcome in writing: similarities and differences, look for one to three paintings with the same techniques as the three paintings and the author, and other content you are interested in and describe the concepts you have learned.

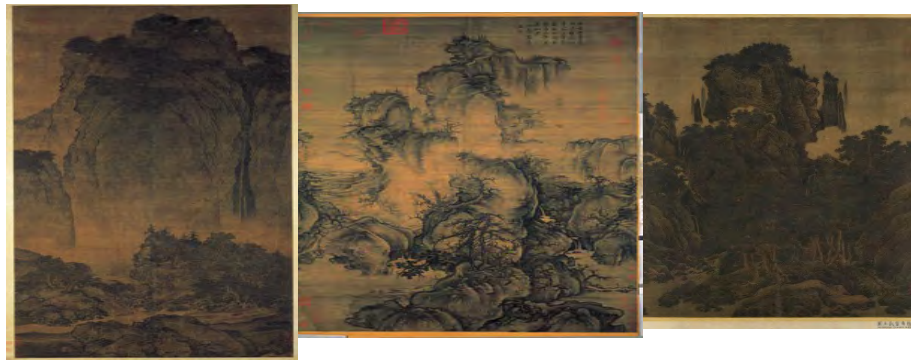


Figure 2. Task Description and Three Treasures in the Palace Museum
(Source: <https://painting.npm.gov.tw/>)

Online search behavior analysis: We used Morae software to record participants online search behaviors. Each task lasted around 40 minutes on average. Their task performance and learning outcomes were not only reflected in their synthesis of presenting information in essays but also reflected in the number of achieved learning criteria per Vakkari's (2016) study. Vakkari (2016) has hypothesized how increasing learning, i.e. the growth of knowledge, across search sessions is reflected in users' search behavior including search formulation, selecting sources and interacting with sources for task outcome. He proposes that the hypothesized changes in search behavior can be used as indicators of learning across sessions. Although the hypotheses concern changes between search sessions, we apply them within search sessions for inferring criteria of learning. After analyzing participants' search behavior and learning outcomes, we differentiated them into better and worse task-performance groups. We then adopted zero-order state transitions (ZOSTs) to calculate the frequency of search paths in the target system (reference). For the ZOSTs, the frequency of each transition and its proportion in each set of transitions were calculated in the ZOSTs table. We labeled the ZOST results based on the codes shown in Table 1. For the ZOSTs, the frequency of each transition and its proportion in each set of transitions were calculated in the zero-order state transition table. Furthermore, we used lag sequential analysis (LSA) to derive the significant repeating patterns from search paths. The LSA method explores, summarizes, and statistically tests cross dependencies between behaviors that occur in interactive sequences (Sackett, 1979). LSA results facilitate an understanding of paths that are significant in terms of path frequency and path transfer probability, allowing us to analyze participants' task behaviors beyond descriptive statistic information.

Information search process and learning criteria: We analyzed participants' search and interaction patterns over the three search stages (search formulation, source selection, and source interaction) while accomplishing the two tasks. The observed items are listed in Table 1. Each participant was to write a short essay to present the task results for scoring by an expert. The expert's field of expertise was fine art and he/she had engaged in art-related work for over ten years. The expert evaluated the essay of each task primarily based on the number of relevant concepts/topic that were addressed and the related knowledge on each concept/topic that was explained clearly. In addition, the smoothness, coherence, and completeness of the essay was important. If the content of the essay merely met the basic requirements of the assigned task and included no further clarifications, it was not given a high score. The

expert-assigned scores for the participant essays at the final interpretation stage are shown in the next section, in Table 2. For each task, the five participants with higher report scores were taken as the high-performance (*HP*) group, and the other five with poorer scores were taken as the lower-performance (*LP*) group. We further examined whether learning occurs in the search process as reflected in the final stage of the process (i.e., information synthesis and presentation) based on the learning criteria of Vakkari (2016). The number of learning criteria (*# of Criteria*) met by participants is shown in Table 2. We analyzed the relationship between the report scores and the number of achieved criteria. The learning success criteria adopted in the work and the details of the criteria met by the two groups for the two tasks are shown in the next section, in Table 3.

Code	Observation item	Description
Search formulation		
S	Keyword search	Enter keywords for search
F	Field search	Use the drop-down menu for search
B	Browse search	Switch to browse search and click on the search category
T	Tag cloud search	After clicking the tag, use the tag to search
Selecting sources		
R	Change display settings	Change display settings for search results
C	Click on data	Click on items on search results page
V	View data (SEarch Result Pages, SERPs)	View meta data, size and texture, inscription and imprint, theme technique, reference materials, or pictures
Interacting with sources		
O	Write essays	Paste content, write, and edit essay
Z	Other resources	Search and use resources other than the target DA-PCSS system. , such as: Wikipedia, NPM website, search engines, etc.

Table 1. Code Sheet of Observation Items When Conducting Tasks

PRELIMINARY RESULTS AND DISCUSSION

Discussion on information search process and task performance

Table 2 shows the evaluation results in the different task performance groups for the two tasks. Based on their short essays, in each task we differentiated them into a high-performance (*HP*) group and a lower-performance (*LP*) group, as shown in Table 2. The second column of Table 2 (*Prior K.*) shows the self-assigned user ratings of prior knowledge for the task (the higher the better). The third column (*# of Criteria*) shows the number of learning criteria met by participants based on Table 3 in the next section. Finally, *Scores* indicates the expert-assigned scores for participants' essays at the final interpretation stage.

Task 1—less information support by the system							
HP Group	Prior K.	# of Criteria	Scores	LP Group	Prior K.	# of Criteria	Scores
Average	32	9.2	8.6	Average	7	5.6	6.4
Task 2 -- more information support by the system							
HP Group	Prior K.	# of Criteria	Scores	LP Group	Prior K.	# of Criteria	Scores
Average	35	9.6	8.2	Average	17	5.0	6.8

Table 2. Learning Success Criteria Counting Versus Essay Scores

Discussion 1: Better-performing users scored 8.6 on average on the Task 1 report and 8.2 on that for Task 2, whereas lower-performers scored lower than the *HP* group. The latter met fewer search success criteria, such as learning across search stages, than the *HP* group, as shown in Table 2. That is, the *HP* group met 9.4 criteria on average, whereas the *LP* group only met 5.3 criteria. Overall, the evaluation results show that users learn during the search process as reflected both in report scores and in the number of success criteria met derived from search behavior. The notable association between scores for task outcomes and the number of search success criteria met hints that the latter can be used as indicators for the former. Our results suggest that Vakkari's (2016) criteria seem to validly reflect the quality of search outcomes. Furthermore, the prior knowledge in the *HP* groups was notably

higher than that in the *LP* group. This reflects the fact that the users' performance in Task 1 did not correlate with the performance in Task 2. The results provide a preliminary response to our research question. Below, we further discuss the characteristics of search and interaction patterns in the three search stages.

Discussion 2 (Formulating searches): In the querying stage, our statistical data shows that the *HP* group entered 11 distinct terms on average whereas the *LP* group entered 7 distinct terms on average for the two tasks. *HP* users submitted more queries and unique keywords than the *LP* users for each task, which suggests that the former were able to formulate keywords to achieve better results. Table 3 shows that nearly all of the users in the *HP* group met the “Increase in number and specificity of terms” and “Increase in number of terms with associative relations (facets) and synonyms” learning criteria. Users in the *HP* group all entered more types of keywords within and outside of the system. In addition to the name of the painting given by the task, they also formulated precise queries that expressed features of Chinese painting, such as “*wrinkle method*” and “*boundary painting*” and painting-related items related such as “*Chinese*”, “*Ping tree*”, and “*season*”. Participant *C*, who achieved better task performance, mentioned that “*I tried to search for information inside the system. But if I wanted to know more about a specific concept, I used a search engine to get its definition, like with the ‘wrinkle method’.*” He also remarked that “*I tried not to be limited by the search results when I synthesized the results and wrote the report by myself.*” Apparently, he sought out other sources to explore topics in a meaning-making process to link to his prior knowledge of art to write the essay. Participant *I*, with poorer task performance, mentioned, “*I copied phrases provided by the task description, for example, the name of the painting, to search for information using a search engine. Then I returned to the system to search for the painting.*” Apparently, she did not know how to select extended keywords and concepts beyond the task description. This shows that most users with better task performance had more prior knowledge of it. In summary, prior domain knowledge seems to play an important role in task performance.

Discussion 3 (Selection sources): In the second stage, *LP* users took more actions—for example, R (Change display settings), C (Click on data), and V (View data) (Table 1) but did not locate the information needed as compared to users in the *HP* group, especially for Task 1, as shown in Figure 3. This also shows that the *LP* group met far fewer learning criteria at this stage than the *HP* group for each task, as shown in Table 3. The *LP* group took more trial-and-error actions because they were exploring unknown subjects with more uncertainty (Borlund & Dreier, 2014). They had less prior knowledge for the two tasks than the *HP* group, as shown in Table 2. Furthermore, Table 3 shows no users in the *LP* group met the “The proportion of specific and factual information increases” learning criterion for both tasks. In contrast, the *HP* group met more learning criteria with fewer actions at this stage, which indicates a better ability to distinguish between relevant information and sources. Figure 3 compares the proportions of interactive actions with associated counts of actions between the two groups for each stage of the tasks.

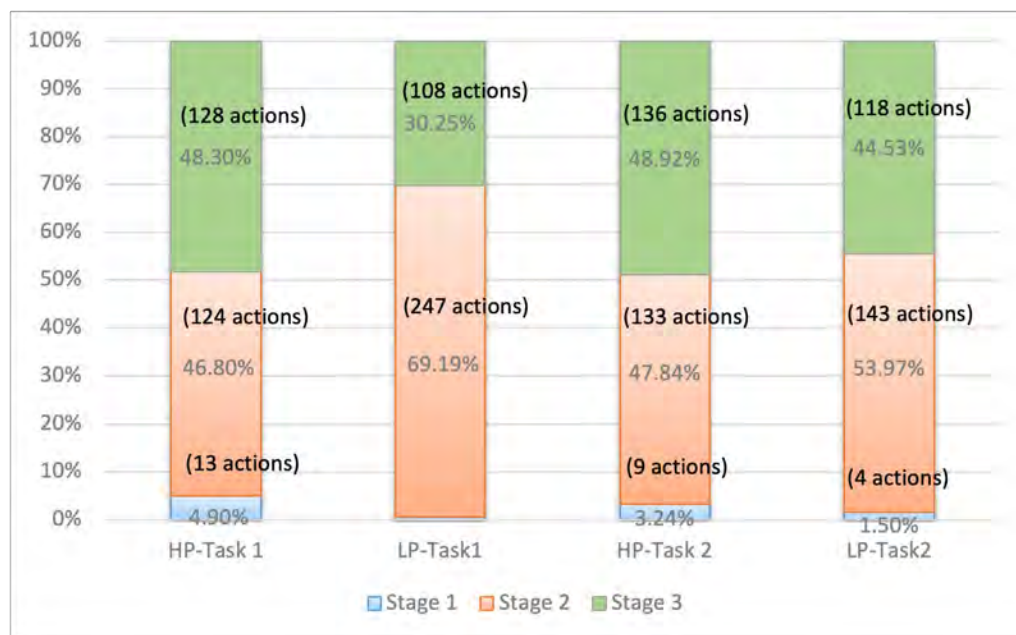


Figure 3. Proportions of Actions for Three Stages of Two User Groups

Discussion 4 (Interacting with sources): In the third stage, we observe that users with better task performance tended to actively seek information outside of the system more frequently. They were more successful during the search formulation stage and interacted with sources more than those in the *LP* group, as shown in Figure 3. The *HP* group took the time to write the essay and verify information iteratively, as reflected in the criteria of Table 3 and

the analysis of search paths in the next section. That is, users in the *HP* group all met the “Increase in number and specificity of concepts and their interrelations in the knowledge structure” criterion in Table 3. These results are in accordance with the findings of Borlund and Dreier’s (2014) study; that is, the *HP* group used more queries and interacted more with sources (information) since they knew the subject domain better than the *LP* group. As mentioned in earlier studies, this is the most crucial phase for search outcomes. During this phase of result inspection, when users take a longer time or when they take more actions, they do better at completing the task and restructuring task knowledge to produce the outcome (Liu & Belkin, 2012; Vakkari & Huuskonen, 2012). These behaviors suggest that they are making meaning of the assigned task, resulting in higher scores on their reports.

Search stage	Learning criteria	Task 1		Task 2	
		HP	LP	HP	LP
1st: Search formulation	Increase in number and specificity of terms	ACGLP	E	KLP	F
	Increase in number of terms with associative relations (facets) and synonyms	ACGLP	EF	ACKL	FG
	Decrease in number of reformulated queries and variability of tactics	AL	E	AL	F
	Decreased time use per search sessions (from keyword search to end of viewing data from SERPs)	ACGP	BFK	CKP	BEI
	Criteria met	16	7	12	7
2nd: Sources Selection	Increased clarity in relevance criteria = increased ability to distinguish between relevant and non-relevant sources	ALP	FK	CLP	I
	Decrease in the number of sources viewed in result list	AGLP	FI	K	BEG
	The proportion of sources selected of sources viewed decreases	AC	FK	CLK	E
	The number of sources selected decreases	ACP	EI	LP	B
	The proportion of general background information and theoretical information decreases	AL	KI	ACLKP	F
	The proportion of specific and factual information increases	L		LP	
	Average time used for assessing a source decreases	CP	KI	CLKP	GI
	Criteria met	17	12	20	9
3rd: Interaction with sources	Increasing share of sources viewed and selected used in outcome	C	FI	A	EFI
	Increase in number and specificity of concepts and their interrelations in the knowledge structure	ACGLP	EF	ACKLP	FG
	Decrease in the proportion of general background and theoretical information from sources used	C		AKL	G
	Increase in the proportion of specific and factual information utilized from sources for outcome	CGP	FI	AKLP	FG
	Rechecking sources for information initially overlooked	AL	BKI	LP	G
	Criteria met	12	9	15	9

Table 3. Learning Criteria Met by Participants within search sessions (Note: Letters denote user IDs)

Discussion on information search process in terms of search patterns

The above evaluation results of search process behaviors were also confirmed by analyzing the results of the ZOST and LSA methods, with which we seek to analyze users search patterns. The number above the line between each rectangle boxes denotes frequency of each search move in Figures 4(a), 4(b), 5(a) and 5(b).

Discussion 1 (ZOSTs): For Task 1, the *LP* group adopted fewer search formulation activities (Codes S, F, B, and T). The *HP* group conducted keyword searches more frequently, as shown in Figures 4(a) and 4(b). The *LP* group used more activities when examining and selecting resources (Codes R, C, and V) compared to the *HP* group. However, compared to the *LP* group, the *HP* group depended more on resources outside of those provided by the database. The ZOST analysis results make it easy to evaluate the impact of system support for different types of tasks; the *HP* group clearly knew where to find knowledge for the task. For Task 1, since the system contains little information related to the “boneless technique”, they sought information outside the system (Code Z) to better understand the technique and then write the report (Code O), in comparison to the *LP* group, as shown in Figures 4(a) and 4(b). For Task 2, the *HP* group spent more time within the system because more information was available. Compared to the *LP* group, the *HP* group viewed data more often (Code V) and then worked on the report (Code O), as shown in Figures 5(a) and 5(b). Furthermore, the *HP* group viewed data (V) 2.85 and 1.69 times per addition to the report (O) for Task 1 and 2 respectively, whereas the *LP* group viewed data 1.19 and 1.43 notes per addition for the two tasks. This suggests that the *HP* group explored more information than the *LP* group.

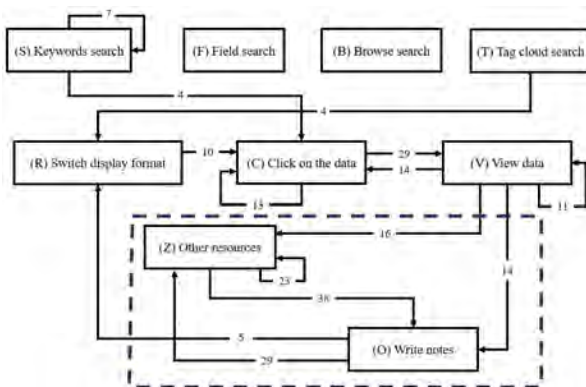


Figure 4(a). ZOSTs for HP group (Task 1)

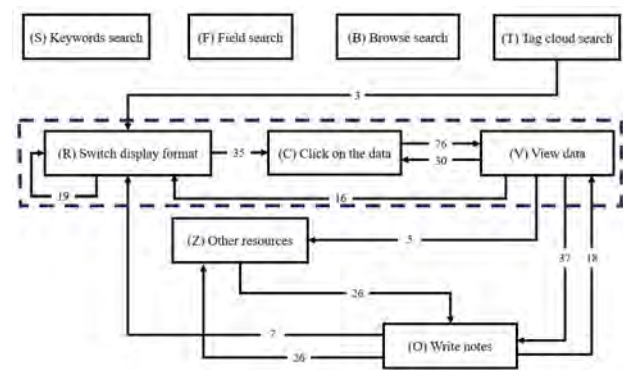


Figure 4(b). ZOSTs for LP group (Task 1)

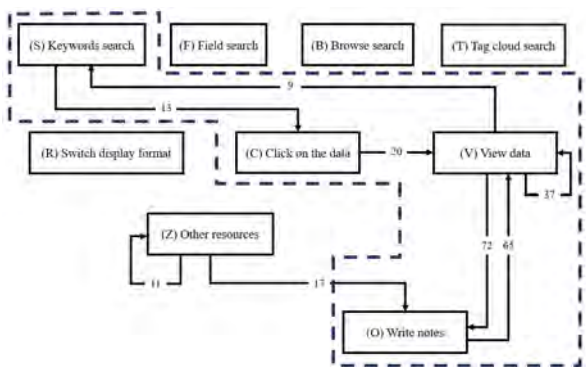


Figure 5(a). ZOSTs for HP group (Task 2)

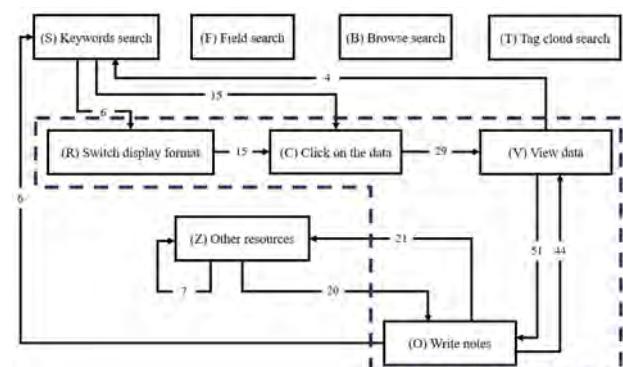


Figure 5(b). ZOSTs for LP group (Task 2)

Discussion 2 (LSA): Here, we focus on the significantly different search path with a length longer than one that are found for the two groups. We list the paths with a 95% significance level, that is, whose z-value is greater than 1.96, based on Bakeman and Gottman's (1997) study, and whose correlation value of the q is greater than 0.6. For Task 1, the *HP* group tended to explore information outside the system; that is, they used frequent and significant search paths of $O \rightarrow Z \rightarrow O$ for Task 1, as shown in Rule (1), but did not have these for Task 2. For Task 2, the *HP* group had significant search paths of $V \rightarrow O \rightarrow V$ and $C \rightarrow V \rightarrow S$, as shown in Rules (2) and (3). This shows that the *HP* group preferred to search and verify information inside the system, and that they were able to find the information needed for better scores. This is in accordance with the analyzed ZOST results. This shows if more information could be retrieved from the system, the *HP* group perceived this and explored and learned more from the system. Figure 6(a) shows the search page of the targeted system. However, the *LP* group did not use these paths. For the *LP* group, it was obvious that they changed the display settings frequently within the system for Task 1: $R \rightarrow C \rightarrow V$, as shown in Rule (4). Figure 6(b), which depicts the webpage for code R of the target system, shows that the *LP* group also spent

time on the system to find information. For Task 2, they also used one of the *HP* paths, i.e., $O \rightarrow V \rightarrow O$, as shown in Rule (5). Although they spent more time on the essay, they scored worse than the *HP* group.

Search paths of *HP* group:

Task 1: $O(\text{write essay}) \rightarrow Z(\text{other resources}) \rightarrow O(\text{write essay})$ $\{z = 9.159, q = 0.954\}$ (1)
 Task 2: $V(\text{view SERPs}) \rightarrow O \rightarrow V$ $\{z = 9.107, q = 0.937\}$ (2)
 $C(\text{click on data}) \rightarrow V \rightarrow S(\text{keyword search})$ $\{z = 2.791, q = 0.620\}$ (3)

Search paths of *LP* group:

Task 1: $R(\text{change display setting}) \rightarrow C \rightarrow V$ $\{z = 9.803, q = 1.000\}$ (4)
 Task 2: $O \rightarrow V(\text{view SERPs}) \rightarrow O$ $\{z = 6.162, q = 0.781\}$ (5)



Figure 6(a). Keyword Search Page



Figure 6(b). SERPs Display Setting Page

CONCLUSION AND FUTURE WORK

In this study we sought to understand how the NPM system fosters users' knowledge of paintings and calligraphy and to examine its effects on their learning. Our findings show that users' with different levels of task performance will have different keywords search and system interaction behaviors, which are all reflected in each search stage. The research results also indicate that learning occurs during searching and that users' task performance is reflected in learning criteria and search behaviors denoting that learning has occurred. Overall, we have better understanding of how the system supports visitors' learning while searching for information online. Furthermore, we found out the participants' prior knowledge seems to explain to a certain extent their search behavior in using the system provided and their task outcome. In line with these results, we will conduct a further investigation into how visitors actively involve themselves in meaning-making by linking their prior knowledge for the task (Skov & Ingwersen, 2014; Skov & Lykke, 2020). Accordingly, we will analyze the results of data collected via the retrospective talk-around research method and the follow-up interview with the aid of a qualitative tool to produce a comprehensive view on the issue. Although there are notable differences between the two groups, the significance of these differences has not been tested. In future work we will include more participants with more types of tasks to validate our empirical results. By examining the effectiveness of the system from the perspective of users' search processes and learning outcomes, this study has furnished a reference for practice.

ACKNOWLEDGEMENTS

This research was supported by the Ministry of Science and Technology, Taiwan under Grant No.108-2410-H-003-132-MY2 and the "Institute for Research Excellence in Learning Sciences" of National Taiwan Normal University (NTNU) from The Featured Areas Research Center Program within the framework of the Higher Education Sprout Project by the Ministry of Education (MOE) in Taiwan. We thank all the volunteers and all publications support.

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Research on Information Flow Mechanism of Manufacturing Enterprises from the Perspective of Innovation Value Chain

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ABSTRACT

Manufacturing enterprises always generate, acquire, and transform large amount of information which flows across every link of their innovation process and value chain. Information flow is one of the basic conditions for information to be reproduced, utilized and value added. Unreasonable paths and transmission methods of information flow will lead to problems such as poor flow efficiency, low information sharing and even information silos, which will further restrict the R&D innovation and service upgrade. Optimizing information flow mechanisms and paths is a vital part for improving the innovation capability of manufacturing enterprises. In order to reflect the interactions, flow-path differences and nonlinear laws among manufacturing enterprises' innovation units and to reveal relations between information-flowing efficiency and innovation capabilities, the paper divides innovation activities of manufacturing enterprises into three phases, such as information acquisition, information transformation and information value addition based on the theory of innovation value chain, and puts forward a mathematical model of information absorption and transformation to ultimately reveal the mechanisms for information flow across inside and outside units. Further, the paper takes a non-linear function for absorptive capacity based on level of experiential knowledge, continuous R&D intensity, and agent relation strength to quantify the information absorption and transformation process and takes index of innovation information amount and cumulative information amount to calculate innovation abilities and measure information value addition. Finally, the paper uses simulation tool to analyze the influencing factors of information absorption and transformation optimization.

KEYWORDS

manufacturing enterprises, information flow, innovation value chain, multi-agent simulation

INTRODUCTION

Manufacturing industry is the foundation of the national economy (Moschella & Robert, 2020). With the intensification of global competition and the appearance of COVID-19, the external environment faced by manufacturing enterprises is more complex. Manufacturing enterprises need to meet various internal and external challenges through continuous innovation. Due to the lack of effective cooperation among key departments of enterprises, especially the problems of resource and information allocation efficiency of different departments, such as R & D, production and policy planning department, many manufacturing enterprises fail to realize the value of digital investment (Stacey, Narsalay, Jiang, & Sen, 2020). Manufacturing enterprises always generate, acquire, and transform large amount of information which flows across every link of innovation process and value chain. Information flow is one of the basic conditions for information to be reproduced, utilized and value added. Unreasonable pathways and transmission methods of information flow will lead to problems such as poor efficiency, low information sharing and even information silos, which will further restrict (Liu, 2004). Optimizing information flow mechanisms and pathways is a critical for improving the innovation capability of manufacturing enterprises.

At present, scholars research on the mechanism of enterprise information flow through different perspectives. Deng (2009) put forward an information flow model of technological innovation which includes five stages as: tracking, discrimination, acquisition, application and innovation, and communication. They also discussed information transmission and feedback process among organizational nodes. Deng (2008) studied the cyberspace information diffusion mechanism based on information theory, cybernetics and system theory. Except model and mechanism, the influencing factors research on information flow and its relations with innovation chain is another trend. Li & Xuan (2006) used information stock as the quantitative index of information flow, and found that the more information stock an enterprise has, the stronger its learning acceptance ability, and the lower the cost of information flow. Gao (2009) and Cao (2010) explained the change of information flow through information diffusion speed, knowledge system and relationship. Gong, Peng, & Peng (2010) believed that knowledge potential is an important factor affecting knowledge flow of enterprise innovation network, and discussed the influence of knowledge potential on

absorptive capacity and innovation capacity. The study found that the effect of knowledge absorption and transformation among enterprises began to decrease near the optimal threshold of knowledge potential difference (Mi, Lin, Dong, & Song, 2016).

At present, theories on information flow mechanism mainly focuses on single lineal flow between industrial clusters and enterprises, and fail to reflect interactive relationship and different flow pathway among differences between different innovation agents of manufacturing enterprises. In addition, quantitative methods for information flow model do not include the amount of feedback information and the influencing factors of flow pathway, which makes the existing models fail to fully consider the non-linear pattern of information flow, resulting in the failure to truly reveal the internal causes of the complex problems such as the low efficiency and degree of information sharing, and the lack of innovation ability in the innovation system of manufacturing enterprises.

In view of the above problems, this paper proposes a mechanism of information flow in manufacturing enterprises from the perspective of innovation value chain. The model is mainly composed of three stages like information acquisition, information transformation and information, and value addition. Meanwhile, the new model takes a nonlinear function of absorptive capacity based on prior knowledge level, sustained R & D intensity and agent relation strength to quantitatively describe the process of information absorption and transformation, hoping to truly reflect the dynamic changes of real manufacturing enterprises' information absorption capacity. Finally, based on the above model, this paper uses multi-agent simulation tool to emulate the information flow of manufacturing enterprises, analyzes the relevant influencing factors, optimizes the flow pathways, and provides some solutions for solving the information problems for manufacturing enterprise innovation.

INFORMATION FLOW MODEL

Innovation value chain theory

Innovation Value Chain (IVC) is a comprehensive framework for enterprise innovation proposed by Hansen & Birkinshaw (2007) and Roper, Du, & Love (2008) supplemented and improved the concept, considering that the innovation process of knowledge can be defined with knowledge acquisition, knowledge transformation and knowledge utilization. Besides, the process of knowledge exchange among enterprises and external social agents as well as that among internal innovation agents run through the above stages.

The process of enterprise information flow is as follows: As the enterprise obtains information from the external agents, each innovation agent in the enterprise organizes and processes the information into new knowledge. Then, knowledge transfers and diffuses in the enterprise information space, offering support for the innovation of product, system and management.

Thus, considering that knowledge is a kind of processed and extracted information, this paper describes the information flow in enterprise with information acquisition, information transformation and information utilization among internal innovation agents and external social agents.

Mechanism of information flow

Based on the theory of innovation value chain, this paper proposes a information flow model for manufacturing enterprises. The model mainly includes three parts of internal and external flow pathway, information acquisition, information transformation and information value addition. Through in-depth interviews which did in October 2019 in five typical manufacturing enterprises (the scale of enterprises includes small, medium and large, and the business involves medical, automobile, water pump and communication fields and the information of interviewee is shown in Table 1), this paper finds information needs of manufacturing enterprises mainly include information involved with policies and regulations, industry reports, patent information, competitive intelligence, competitive product information, science and technology information, high-level talents and cutting-edge technology. In order to study economically, the information needs of enterprises can be divided into three types, i.e: policy information (policies and regulations), technical information (patent information, science and technology, cutting-edge technique and talents) and market information (industry report, competitive intelligence, competitive product, infrastructure information). The schematic diagram of information flow model is shown in Figure 1, and the specific description is as follows:

The enterprise obtains policy information, technical information and market information from external social agents, and then the above information enters into the internal agents of enterprise after being absorbed, and is transformed and applied in innovation activities by all innovation entities to promote the upgrading of products and services. At the same time, the same information flow mechanism will also affect the corresponding information value addition. Therefore, the information flow pathway forms a flow chain between the external social agents and the internal innovation agents within the enterprise. The above processes will provide new information for the social information environment, and these new information will be used again by the social agents, forming an information feedback process, so that the two kinds of information flow chains form a closed loop.

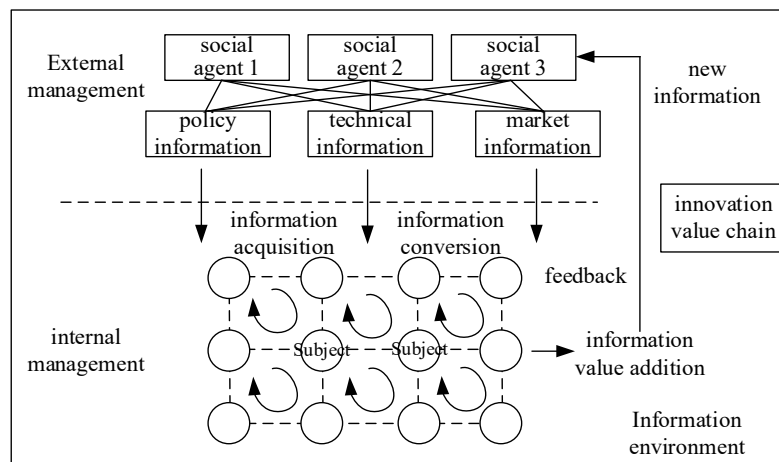


Figure 1. Information Flow Mechanism

Enterprise	Department	Post	Working years
A	R & D department	R & D personnel	5
B	R & D department	R & D personnel	3
C	Project department	Project manager	15
D	R & D department	R & D personnel	4
E	Sales department	Salesman	5

Table 1. Interviewee information

Model parameter

According to reference Song, Shang, Tong, & Lei (2018), Fang, Zhang, & Qin (2018) and Chen (2019), the influencing factors of manufacturing enterprises' knowledge absorptive capacity generally include the enterprise scale, R & D intensity, patent quantity, investment strength, operating profit, experience knowledge, educational degree, organizational structure and cross departmental communication. Among them, experience knowledge and educational degree represent the knowledge level of enterprise employees, which affects the ability of information absorption. R & D intensity is a factor that directly affects the innovation ability of enterprises, representing the investment intensity in R & D activities. The R & D of manufacturing enterprises often depends on the project arrangement and schedule, and has the characteristics of discontinuity which is not conducive to the improvement of enterprise innovation ability, so that the paper takes the continuous R & D intensity to reflect the actual innovation ability of the enterprise. According to the framework of innovation value chain, one of the ways to generate creativity is cross departmental communication, which not only represents the interaction among departments, but also reflects the information flow pathway and information sharing degree. The above relationship can be effectively reflected through agent relation strength. To sum up, this paper determines the level of prior knowledge, the intensity of continuous R & D, and the agent relation strength as the basic parameters of the information flow model, and the meaning of each parameter is shown in Table 2.

Information absorption and transformation model

This paper analyzes how information absorption capacity, information flow amount and innovation capability parameters are affected by prior knowledge level, continuous R & D intensity, agent relation strength and. Then, the information absorption and transformation model of manufacturing enterprises is established.

Taking $N=\{i, i=1,2,3,4,5\}$ as the set of innovation agent in manufacturing enterprises, $L=\{j, j=1,2,3\}$ the set of information, X_{ij} the information amount of information j in agent i , and A_{ij} the information absorption capacity of agent i to information j , A_{ij} is assumed to be positively correlated with X_{ij} . a_{ij} is the absorptive capacity parameter of the i agent to the information j . Then, the relation between A_{ij} and EK_level is described as (1).

Parameter	Function	Abbreviation
Experiential knowledge level	To control the size of absorptive capacity	EK_level
Continuous R&D intensity	To control the amount of innovation information	$CRD_intensity$
Agent relation strength	To control the amount of feedback information	RL

Table 2. Model parameter

$$A_{ij} = \frac{EK_level}{1 + e^{-a_{ij} * X_{ij}}} \quad (1)$$

Where a_{ij} is the empirical parameters; i and j represent innovation agent i and information j respectively.

As the input information depends on the information potential difference between the two innovation agents, the relation among absorption information amount Abs_ij , feedback information amount Fb_ij and agent relation strength $RL_intensity$ is shown in (2) and (3).

$$Abs_ij = \begin{cases} A_{ij}(inp_ij - X_{ij}), & inp_ij > X_{ij} \\ 0, & inp_ij \leq X_{ij} \end{cases} \quad (2)$$

$$Fb_ij = abs_ij + RL_intensity \quad (3)$$

According to the Principle of Logarithmic Perspective, which holds that the acquiring process and receiving process of information, knowledge and intelligence follow the logarithmic transformation mechanism, the change of innovation information (information output) of an innovation agent is assumed to follow the logarithm with the base of 10. Besides, innovation information $Inno_ij$ is considered to grow with the increase of absorption information amount Abs_ij on the basis of initial information amount Ini_ij . Then, the innovation information amount Tot_ij and cumulative information amount Inf_save_i of agent i can be described as (4).

$$Inno_ij = CRD_intensity * \lg(Abs_ij + 1) \quad (4)$$

$$Tot_ij = Ini_ij + Abs_ij + Fb_ij + Inno_ij \quad (5)$$

$$Inf_save_i = \sum_{1 \leq j < 3} Tot_ij \quad (6)$$

Further, the speed of information flow Inf_speed_i in agent i can be obtained by the derivation of cumulative information amount Inf_save_i to time.

$$Inf_speed_i = \frac{d}{dt} Inf_save_i \quad (7)$$

As in (8), the innovation capability IC of enterprise is defined as the ratio of current information amount to the ideal total information amount of the system, reflecting the process of information acquisition, transformation and value addition. The ideal total information amount refers to the maximum amount of a certain type of information in all innovation agents.

$$IC = (1 + \sum_{\substack{1 \leq i \leq 5 \\ 1 < j < 3}} X_{ij}) / (1 + 5 * \max(X_{ij})) \quad (8)$$

Multi-agent simulation

Interaction rules

The simulation agent includes five innovation agents and their three kinds of information. The five innovation agents are strategic planning department (AD), R & D department (RD), marketing department (MD), intellectual property department (IPD) and sales department (SD). The three kinds of information are policy information, technical information and market information. The interaction process between them is shown in Figure 2, the interaction rules corresponding to the above process are shown in Table 3.

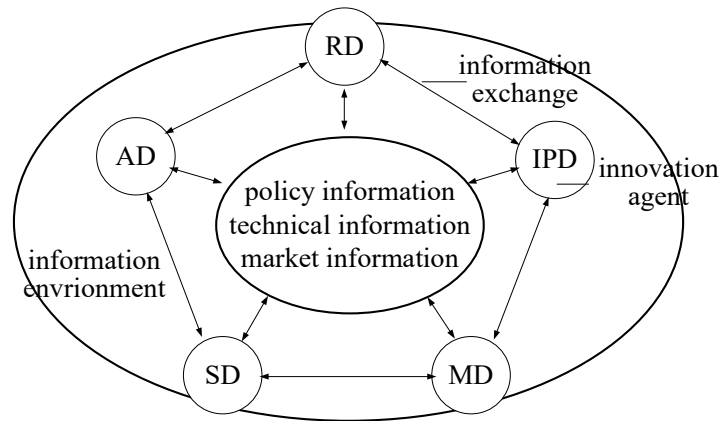


Figure 2. Interaction Process

Agent	AD, RD, MD, IPD, SD	
Information type	Policy information, technology information, market information	
Agent attributes	Initial information amount, information absorption amount, information transfer amount, information feedback amount, information innovation amount, total information amount	
Interaction rules	Agent relation rules:	Information transfer rules:
	Information transfer probability = innovation information/10	The amount of information transfer = the information potential difference between agents
	When the probability of information transfer is greater than a random floating-point number between (0-1], the information will start to be transferred.	

Table 3. Interaction Rules

The main attributes include the amount of initial information, the amount of information absorption, the amount of information transfer, the amount of information feedback, the amount of information innovation and the amount of information. The system randomly generates policy information, technical information and market information, whose values are random integers of [0-500]. In the initial stage, the AD gets the random policy information by default, the RD gets the random technical information, and the MD gets the random market information. After the three departments get the information, they transfer the information to another department according to the information demand. For agent relation rules, the initial information transfer probability changes dynamically and set to 1, the information transfer probability changes also dynamically, and depends on the agent innovation information. When the information transfer probability exceeds the random floating point number between (0-1], the information begins to flow. For information transfer rules, if the amount of information received by the information receiver is greater than that of the information sender, the amount of information transferred is equal to the difference between information receiver and sender.

Model validation

This paper selects the historical data of the international market development project of G firm in 2017 to verify the above model. The year of 2017 is the third year after the R & D of "PVC-O production technology" project of G firm is completed. In order to explore the international markets of Germany, Italy, Thailand and Malaysia, G firm actively search and gain PVC policy n, technology and market information from various countries. Among them, the policy information was obtained from the national development and Reform Commission, the Ministry of science and technology, the Ministry of water resources, the Ministry of construction, the Ministry of agriculture, and the General Administration of Quality supervision, Inspection and Quarantine of the people's Republic of China is taken as the quantitative index. Technical information is quantified by the patent data. Market information is quantified by the number of exhibitions and promotion meetings that attended G firm as well as the industry reports that G

obtained. Finally, 54 pieces of policy information, 179 pieces of technical information and 97 pieces of market information were obtained. The X-axis is the acquired inf_abs (absorptive capacity) of manufacturing firm, and the Y-axis is the number of invention patent applications IC (innovation capacity) that manufacturing firm applies for per unit time, which results in a scale of two-dimensional locating map. The actual results are shown in Figure 3. G firm is located between small manufacturing enterprises and medium-sized manufacturing enterprises according to the simulation data, which is consistent with the reality.

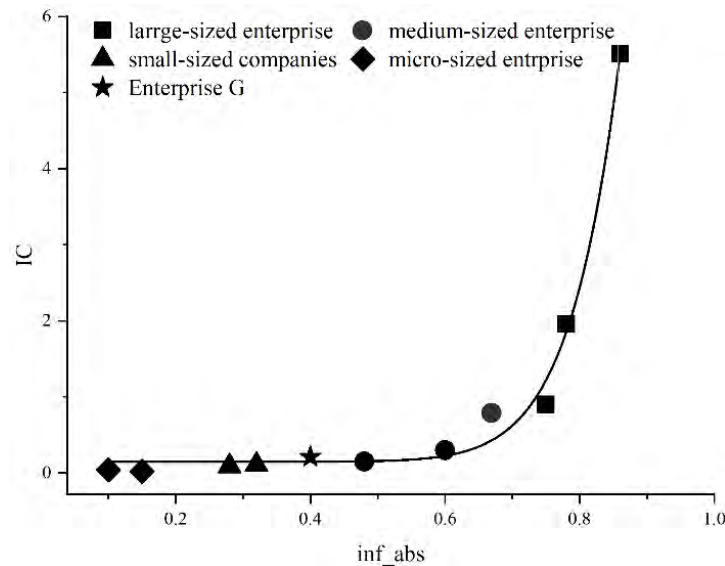


Figure 3. Innovation capacity of enterprises

FEATURES OF INFORMATION FLOW CHARACTERISTICS

Information absorption with different information flow pathway

The information created by each innovation agent are compared in Figure 4, then the difference between the traditional information flow pathway and the new information flow pathway are stimulated in this paper.

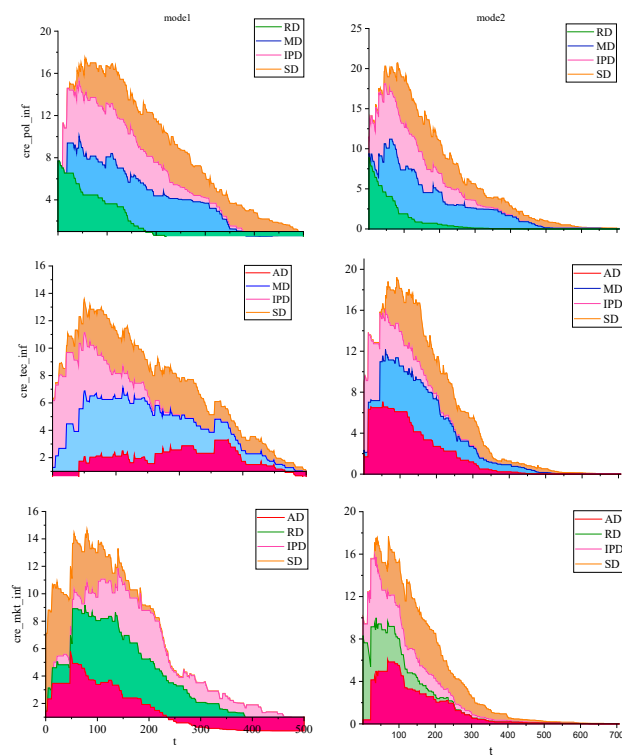


Figure 4. Information created by each innovation agent

Under the two paths, the order of the absorption speed of policy information of the five agents has not changed, and the specific order is as follows: RD > IPD > MD > SD. The order of the absorption speed of technical information of the five agents is as follows: the traditional path is IPD > MD > SD > AD, the new path is IPD > AD > MD > SD. In contrast, in the new information flow path proposed in this paper, the AD's absorption speed of technical information has increased. The speed of the five agents' absorption of market information is: the traditional route is SD>AD>RD >IPD, new path is RD>IPD>AD >SD. Compared with the traditional information flow path, the absorption speed of market information by RD and IPD under the new path is increased.

The influencing factors on the innovation capacity

Influence of prior knowledge level

Figure 5 shows the relation between innovation capability and prior knowledge level (*EK_level*). Results indicate that the innovation capability of enterprises grows with the increase of the innovation capability and the time of balance is shortened correspondingly, which means the speed of innovation is further accelerated. Obviously, the prior knowledge level affects the efficiency of information flow and innovation by changing the ability of information absorption. Specifically, the innovation speed and balance time of enterprises are quite different when *EK_level* is taken 0.01, 0.05 and 0.1. The innovation capacity has reached saturation near 1000 unit time and show an exponential growth trend when *EK_level* is taken 0.05 and 0.1 while the one under *EK_level*=0.01 still increases in a much lower speed. Besides, the innovation capacity under *EK_level*=0.05 exceeds that under *EK_level*=0.1 at 1500 unit time which indicates that the improvement of innovation ability will be limited if the prior knowledge level is too high. Thus, the prior knowledge level plays a dual role in manufacturing enterprises. Manufacturing enterprises should pay attention to the project background and the diversity personnel when carrying out innovation activities.

Influence of continuous R & D intensity

Figure 6 shows the growth trend of innovation capacity under different continuous R & D intensity. It can be seen from the results that the innovation capability under different continuous R & D intensity shows the change rule of saturation after increasing. The innovation capability and innovation speed of enterprises both increase with the rise of continuous R & D intensity, but the influence of continuous R & D intensity on saturation time is small. In practice, the intensity of continuous R&D mainly emphasizes the degree of R&D investment of a single innovation entity in innovation activities. Therefore, it mainly affects the depth of innovation of the enterprise.

Influence of agent relation strength

The relation between agent relation strength and innovation capacity is shown in Figure 7. Similar to the influence of continuous R & D intensity, the influence of agent relation strength also shows an increase-saturation trend. Figure 8 further compares the information amount of each enterprise innovation agent under different agent relation strength. Results show that when *RL_intensity* increases from 0.01 to 0.8, the maximum policy information amount and maximum technology information amount of each innovation agent change little, respectively at 1.6 and 1.4, while the maximum market information amount changes greatly. Specifically, the market information amount of RD increases from 1.4 to 1.6, and that of AD and IPD increases from 0.8 to 1.2, The market information amount innovated by the SD also increased slightly.

The public information (workshop system, R & D technology standards, performance appraisal system, et al) and hidden information (digital transformation scheme, intelligent manufacturing strategy, et al) in policy information show high relative stability, as there is less change in a short term in them. Besides, technical information (process flow, key technology, patent, intellectual property, et al) is highly professional and heterogeneous, leading to low application and conversion rate by other departments except RD. Therefore, the change of the agent relation strength among innovation agents has little impact on the policy information amount and technical information amount. As the amount of innovation information of each innovation agent has increased, the innovation breadth of enterprises has also increased.

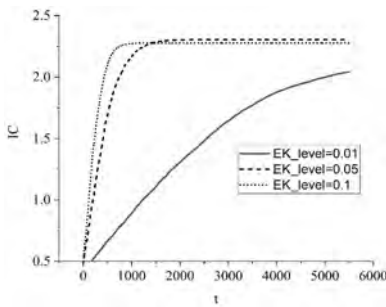


Figure 5. The level of prior knowledge

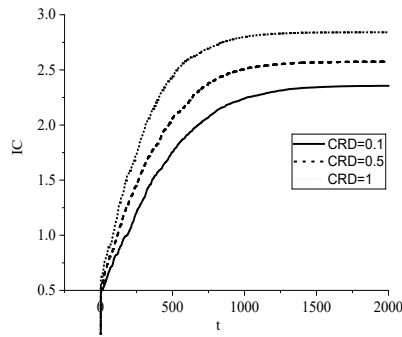


Figure 6. The intensity of continuous R & D

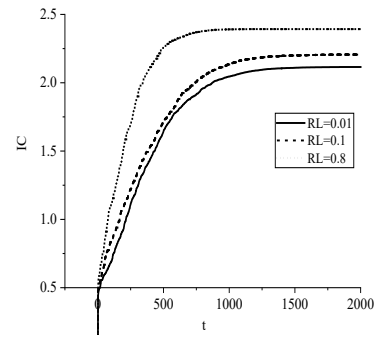


Fig. 7. The agent relation strength

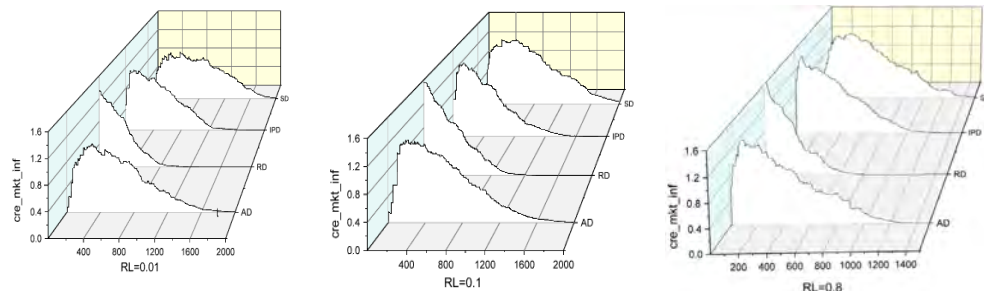


Figure 8. The amount of innovation information

Information flow path selection and optimization

Innovation ability of different information flow pathway

The parameters are set to the default values for simulation experiments, and the results of innovation ability of manufacturing enterprises under the two information flow paths shown in Figure 9 are obtained. The change of innovation ability can be divided into four stages and three turning points according to time, and the overall innovation ability of mode2 is greater than that of mode1.

The first stage is the planning stage of R & D activities (0-50), and the innovation ability of mode1 and mode2 is very close. The second stage is the development stage of R & D activities (50-125), and the innovation ability gap between mode1 and mode2 gradually widens. The third stage is the transformation stage of R & D activities (125-225). Due to the decline of innovation speed of mode2, the innovation ability gap between mode1 and mode2 is narrowed. In the fourth stage, the commercialization stage of R & D activities (225-500), the gap between the two innovation capabilities began to widen.

The overall change of innovation capability shows that the information flow pathway from the perspective of innovation value chain optimizes the traditional pathway. As mentioned above, most manufacturing enterprises belong to the field type with innovation as the core, rather than the regional type with radiation as the core. Therefore, R & D innovation is very important for manufacturing industry. Combined with the information flow mechanism of manufacturing enterprises from the perspective of innovation value chain, the first stage (the planning stage of R & D activities) is the strategic planning stage, the second stage (the development stage of R & D products) is the information acquisition stage, the third stage (the transformation stage of R & D products) is the information transformation stage, and the fourth stage (the commercialization stage of R & D products) is the information flow stage Value added stage. Each stage is described as follows:

1. Strategic planning stage

This stage is mainly for manufacturing enterprises to obtain and use policy information. This paper finds that the order of the absorption speed of policy information by the five innovation agents will not change, so if the premise that the innovation agents do not change, the efficiency of the two kinds of information flow will not change much at this stage. This can further explain why the innovation ability of mode1 and mode2 are close.

2. Information acquisition stage

Because pathway in model1 does not realize the interaction and sharing between multi-agent and the variety of information, there are few ways to obtain information, the information flow pathway is relatively linear and the speed of information flow is low, while pathway in model2 realizes the multi-agent information interaction and nonlinear growth appears. So this stage reflects the innovation ability gap between model1 and model2.

3. Information transformation stage

Although model2 obtains a large amount of information in the second stage, due to the high requirements of information quality, especially technical information in the information transformation stage, and the high degree of cooperation and information sharing in model2, the complexity of information processing in the information transformation stage of model2 is higher than that in the information acquisition stage, which leads to the rapid information flow in model2. Compared with the information acquisition stage, the degree of information acquisition is lower. However, due to the high efficiency of technical information transformation, the innovation ability of model2 is still greater than that of model1.

4. Information value added stage:

Due to the effective integration and continuous accumulation of policy information, technology information and market information in the stage of strategic planning, information acquisition and transformation, pathway in model2 determines the R & D innovation path, speeds up the R & D innovation process and reduces the innovation risk. Finally, the information flow speed and information conversion efficiency of the whole enterprise system are improved, and the innovation ability is greatly improved.

In a word, the stage with the biggest gap in innovation capability of the two paths is the information value addition stage, the least of which is the strategic planning stage. The two stages in the middle, especially the information transformation stage, are often the weakest link of manufacturing enterprises and a continuous accumulation process. Therefore, manufacturing enterprises should pay attention to this link and adjust them according to R & D activities to achieve optimization of innovation chain.

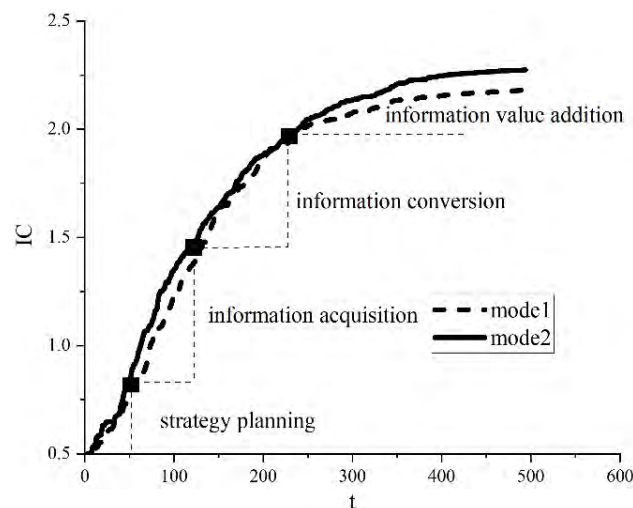


Fig. 9. The evolution of innovation abilities

CONCLUSION

In the past, the research of information science mainly focused on the research of individual information behavior, and seldom analyzed the information processing of social organizations composed of individuals and groups from the organizational level. Therefore, this study explores the issue of information flow at the organization level and explain how information flows affect organizational innovation.

Based on the perspective of innovation value chain, this paper divides the innovation activities of manufacturing enterprises into three stages, namely, information acquisition, information transformation and information value addition, establishes a mathematical model of information absorption and transformation, and reveals the mechanism of information flow inside and outside enterprises. The nonlinear function of absorptive capacity based on prior knowledge level, sustained R & D intensity and agent relation strength is used to quantify the process of information absorption and transformation. Besides, the amount of system innovation information and cumulative information are used as quantitative indicators to calculate innovation capacity and measure information value addition. Based on the experimental results, the influencing factors of information absorption and transformation are analyzed, and the optimization path of information flow is given. The main conclusions are as follows:

1. Based on the innovation value chain, the information flow efficiency of the information flow pathway with the core of information acquisition → information transformation → information appreciation is significantly improved.
2. When the difference of the initial information amount of different types of information in the innovation activities of manufacturing enterprises is smaller, the total information amount of enterprise system is larger, the information flow efficiency is higher, and the innovation ability is higher.
3. The technological information absorptive capacity of weak links is directly proportional to the innovation capacity. Improving the technological information absorptive capacity of weak links can effectively improve the innovation capacity of manufacturing enterprises. Manufacturing enterprises need to aim at the key core technology and "neck" technology which are urgently needed to upgrade and improve efficiency, carry out engineering and product integration verification research, and get through the key links from technology to product, so as to adjust the innovation structure and promote product upgrading.
4. The higher the intensity of sustained R & D and the degree of subject connection, the higher the innovation ability of enterprises. However, the level of prior knowledge plays a dual (promoting / restraining) role in the innovation ability of enterprises. When carrying out innovation activities, manufacturing enterprises should pay attention to consider the project background and the diversity of R & D personnel, increase R & D investment, and optimize the structure of R & D expenditure, so as to achieve the whole business information perception and the whole system collaborative control.

In the future, more influencing factors will be incorporated into the calculation model, taking into account the differences in the complexity of corporate innovation activities within the industry, between industries, and between domestic and foreign companies. The most challenging is how to optimize the data governance and innovation value chain according to the degree of information value added, and how to evaluate the effect of governance and optimization.

ACKNOWLEDGEMENTS

This work is a contribution towards Entrepreneur Ability Improvement based on Information Behaviour, which was supported by Social Science Foundation of Hebei Province (HB18TQ006)

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Digital Readiness Assessment of Countries in Africa: A Case Study Research

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ABSTRACT

There is an increasing uptake of digital technologies across African countries. Public, private, and government services have adopted and utilized digital technologies to improve work processes, productivity, create jobs, and better service delivery. This short paper seeks to answer these questions: What is the current state of digital readiness in African countries? Do existing digital readiness assessment tools, indicators, or metrics, help to assess the digital readiness of countries in Africa? Analysis of publicly available data from Cisco index of readiness score and Broadband speed ranking by cable.co.uk, reveal that: 1) African countries' digital readiness score is below the global average of 11.96, on a scale of 0 to 25 (except Tunisia with readiness average score of 12.05); and 2) African countries' broadband speed is below the global mean speed of 25Mbps (mean speed of 4.51 and 3.80 Mbps for sub-Saharan Africa and North Africa, respectively). Second, analysis of various assessment tools show that the existing metrics can't be used as is to diagnose and evaluate Africa's digital readiness. Instead factors such as availability of adequate infrastructure; last-mile connectivity to homes, schools, businesses, and government agencies; and skill gaps should be considered. The implications of this study are to show the need for an appropriate assessment tools so countries in Africa prioritize efforts to embrace digital readiness.

KEYWORDS

Digital readiness; digital maturity; digital readiness assessment; digital transformation; Africa.

INTRODUCTION

In organizational theory of change literature, readiness is broadly defined as the state of being fully ready to engage in a specific activity and it highlights the importance of timing, state, and the specificity of the activity that is getting ready for (Lokuge et al., 2019). This definition presupposes that the state of readiness (whether that be psychological, behavioral, and structural) is achieved prior to the commencement of the activity. Likewise, digital readiness, the preparedness of organizations and countries to adopt and use digital technology, can be seen from different determining factors such as structural, cultural, or capability. Assessing the level of preparedness before fully rolling out or deploying digital technologies is important to avoid failure down the road. It is often reported that while accessibility, adoption, and use of digital technologies are strongly associated with innovation and better performance, lack of readiness is equally attributable to innovation failures (Nylén & Holmström, 2015).

In this case study, a distinction is being made between digital technologies, digitization, digitalization, and digital transformation. Digital technologies are constrained as an all-encompassing term to describe products or services that are either embodied in information and communication technologies or enabled by them (Lyytinen et al., 2016), digitization is construed as the conversion of analog materials to digital (Kane et al., 2017), and digitalization is the use of digital technologies and digitized data to impact how work gets done, how customers and firms engage and interact, and how revenue streams are created (Lyytinen, et al., 2016). A comprehensive definition of digital transformation is given by i-SCOOP.eu (2016) as “the profound transformation of business and organizational activities, processes, competencies and models to fully leverage the changes and opportunities of a mix of digital technologies and their accelerating impact across society in a strategic and prioritized way, with present and future shifts in mind.”

Beyond digital technologies, beyond digitization and digitalization, digital transformation implies radical change, and it looks at the whole organization holistically vis-a-vis culture, skilled workforce, processes, policies, innovation culture, leadership, and relationships to the larger stakeholders. The path to digital transformation is not uniform across organizations and across countries in the world as many countries are at different stages of development. While advanced economies (broadly) are in the leading edge of adopting digital technologies and benefiting from it, least-developed economies are trailing behind and are often playing catch-up. Digital transformation impacts global inequity as the gap between the rich and the poor continues to widen. There are promising developments in Africa. In early 2020, the launch of the first phase of the ITU Digital Transformation Centers initiative, with four initial

centers in Africa and their national networks (Ghana, Côte d'Ivoire, Zambia and Rwanda) marked an important milestone in establishing and enhancing regional institutional capacity that is inclusive (ITU, 2021).

Current State of Digital Readiness in Africa

Africa is home to over one billion people. Almost 500 million or 50% subscribe to mobile services (ITU, 2021). Despite an increasing uptake in technology adoption and utilization, Africa still lags the rest of the world in digital technologies accessibility, use, infrastructure, and skills. For example, Internet penetration in Africa is estimated at 36% (United Nations, 2020). Infrastructure and human capital development are reported to be the most persistent challenges that prevented many African countries from enjoying the potential benefits of digital technologies. Two datasets were analyzed to showcase the current state of digital readiness in Africa—1) Cisco index that calculates 118 countries' (33 in Africa) readiness score on a scale of 0 to 25; 2) Worldwide broadband speed ranking of 221 countries and territories (54 in Africa) by cable.co.uk. The data for sub-Saharan Africa countries were extracted, prepared, and analyzed using R statistical package—the results are presented in Figures 1 and 2.

The global digital readiness score (for 118 countries) ranges from 5.9 to 20.1 with global average of 11.96 (the red horizontal line on Figure 1) based on a scale of 0 to 25. Only Tunisia with readiness score of 12.05 has above the average global score 11.96. The composite score is calculated out of 7 dimensions and 25 items/indicators, i.e.—1) technology adoption (3 items), 2) start-up environment (3 items), 3) human capital (4 items), 4) technology infrastructure (4 items), 5) business & government investment (3 items), 6) ease of doing business (4 items), and 7) basic needs (4 items). These countries are also grouped by the stage of their digital readiness from the lowest stage (Activate), middle stage (Accelerate), and highest stage (Amplify).

The 33 African countries analyzed separately for this study are all in the Activate (lowest) stage except Tunisia (12.05 score), Morocco & South Africa (both 11.5 score), Rwanda (10.96 score), and Egypt (10.83 score) that are in the accelerate stage. The average score for the 33 African countries is 8.31. The score in Africa ranges from the lowest 5.89 for Central African Republic to the highest 12.05 for Tunisia. Further grouping is shown in Figure 1 to account for minor differentiation between countries in the activate stage—thus activate5 is for countries with readiness score between 5.0 and 5.99, activate6 is for countries between 6.0 and 6.99, etc.

The data analyzed from cable.co.uk for global broadband speed (Figure 2) equally shows that all 54 African countries (48 Sub-Saharan and 6 North Africa) have below the global average broadband speed of ~25Mbps (shown by the red horizontal line in Figure 2). The average broadband speed for sub-Saharan Africa (SSA) is 4.51 Mbps, 3.80 for North Africa and with this speed it will take countries in SSA 4 hours and 12 minutes to download 5GB movie. While countries with the highest speed in Western Europe have 105 – 120 Mbps range (except the outliers that are in the 200 Mbps range), it will take them 5 to 6 minutes to download 5GB movie.

Existing Digital Readiness Assessment Tools

Digital readiness can be assessed at individual, workgroup, organization, industry, or country level. For example, digital readiness across different sectors, i.e., manufacturing (Pirola et al., 2019), healthcare (Mather & Cummings, 2019), agriculture (Basso & Antle, 2020), banking and financial sector (Balakrishnan & Shuib, 2021), higher education (Zalite & Zvirbule, 2020), or public service delivery (e-government) (Mergel et al., 2019), or by specific technologies, for example AI readiness (Holmstrom, 2021), IoT readiness (Atayero et al., 2016), or any combination of these technologies by country or industry, for example Cyber Security readiness of South Korea (Yang et al., 2017).

Regardless of the level of assessment, different methods, models, frameworks, tools, indexes are developed to gauge digital readiness. These assessment tools and indexes are used as a diagnostic tool to evaluate existing capability and gaps to identify areas of strength and weakness, as well as assist in setting goals, and in developing and evaluating targeted digital-improvement initiatives (Zhang et al., 2019). Since the introduction of the technology readiness level (TRL) methodology by NASA in 1970's, large numbers of assessment tools are developed. A comprehensive and appropriate assessment tools were reviewed, and the result is presented in Table 1.

While the descriptions of each of the dimensions and their items/indicators were not provided in the table above for space reasons, across the different assessment tools it is evident to note that organizational culture and digital skills are as equally important as technology adoption and use.

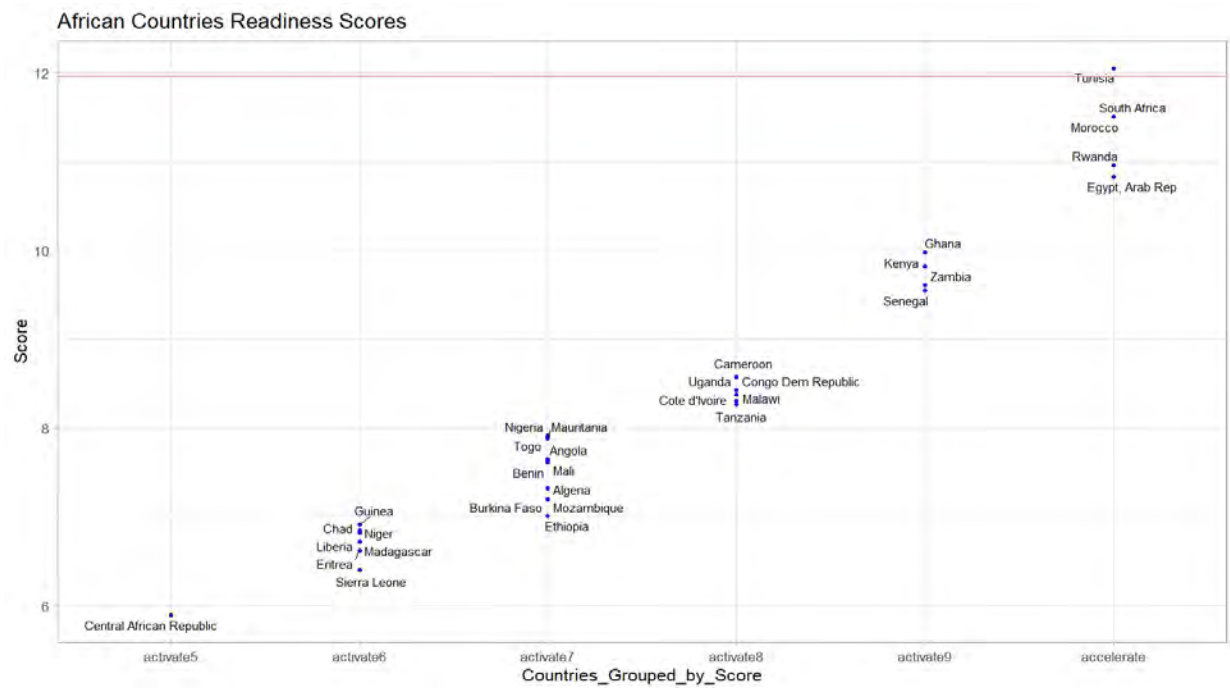


Figure 1. Africa's Readiness Score

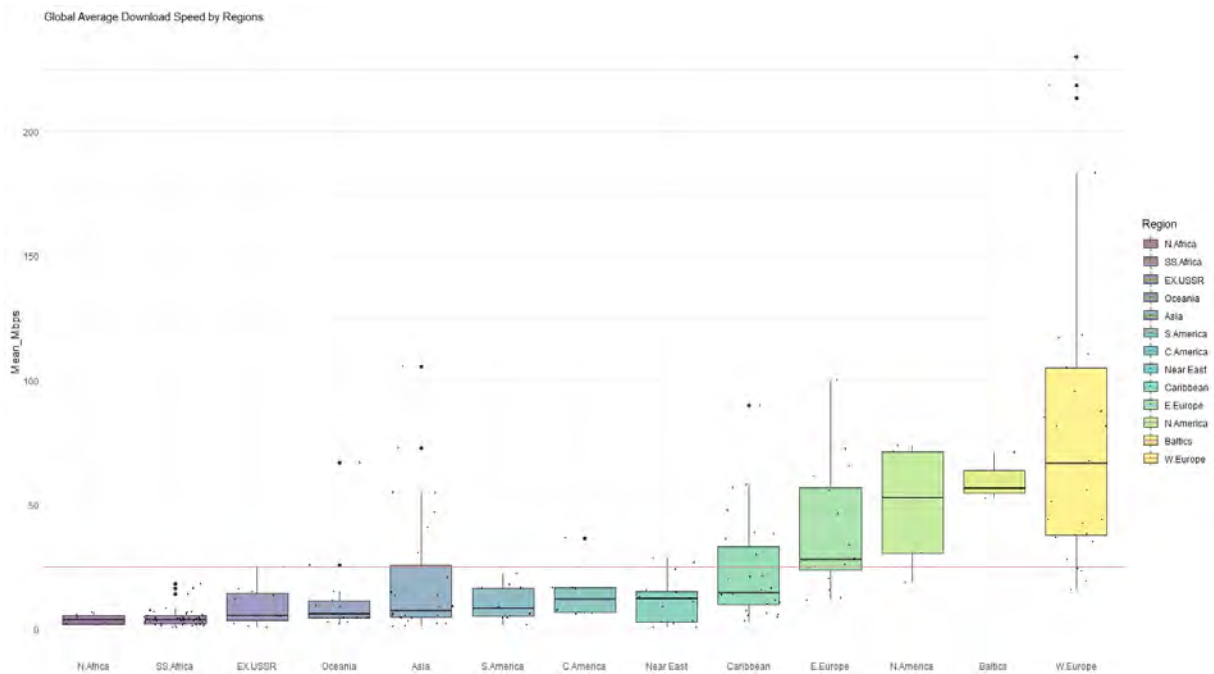


Figure 2. Global Broadband Speed in Mbps

Table 1 presents the result of a comprehensive review of the literature and only select relevant tools and indexes are presented here.

Name	Dimensions	Stages of Maturity
Network Readiness Index (NRI 2020. PORTULANS Institute)	Technology; people, Governance, Impact	N/A
Digital Maturity Assessment Tool (Government of South Australia, KPMG Australia, version 4.2)	Governance & leadership; People & culture; Capacity & capability; Innovation; Technology	Minimal; Informal & reactive; Transitional; Customer-driven; Transformed
Country Digital Readiness (CISCO, 2019)	Technology adoption; Start-up environment; Human Capital; Technology infrastructure; Business & government investment; Ease of doing business; Basic Needs	Activate; Accelerate; Amplify
E-government Development Index (UN, 2020)	Normalized composite index of 3 indices—Online Services Index (OSI); Telecommunications Infrastructure Index (TII); Human Capacity Index (HCI)	Low Middle High Very High
Digital Adoption Index (World Bank, 2016)	People; Government; Business	0 – 1 scale
DIGITAL Maturity Model 5.0 (Forrester, 2018)	Culture; Technology; Organization; Insights	Skeptics; Adopters; Collaborators; Differentiators

Table 1. Select List of Digital Readiness Assessment Tools

Key Indicators for Africa

One of the questions for this paper is to investigate how much existing tools and indicators can help gauge readiness in the context of Africa. When most of Africa, especially in sub-Saharan Africa, don't have adequate infrastructure such as electricity, prohibitive cost of devices and limited Internet service—last-mile connectivity issues to homes, schools, and businesses, government agencies, and skill gaps are the most important indicators that should be prioritized to assess Africa's readiness. Existing digital readiness assessment tools don't fully account for the situation on the ground in Africa. Even with the declining cost of technologies, still most of these devices are out of reach for tens of millions of citizens in Africa (ITU, 2021). Not all countries start from the same place when it comes to the history of digital technologies adoption and using existing models as is will not help much to determine the gaps and diagnose the real issues. Instead African countries need to take stock of its challenges and potentials, both short-term and long-term, to focus on its competitive advantage such as its 70% youth population for context-driven digital transformation to take root.

CONCLUSION

The use of digital technologies brought significant impact in work and day-to-day lives. When technologies are increasingly integrated into the workflow routines across organizations and businesses, and when that is coupled with relevant policies, culture, strategy, leadership, commitment, and technology-savvy populace, it can be safely argued that digital transformation will be achieved. As noted above, Africa still trails all regions of the world in accessing and using digital technologies. Even with increasing uptake in adoption of digital technologies in recent years, the best strategy to assess Africa's digital readiness is: 1) through in-country infrastructure such as electricity and connectivity to and between schools, hospitals, businesses, government agencies, industries, etc; 2) increased digitization effort to enhance machine readable, accessible, and integrated work flows (e.g., medical records, government IDs, driver's license, forms, business applications, tax documents, fintech transactions, etc.); and 3) increased digital skill of the workforce and citizens at large. We make the case that these upfront and critical steps are necessary for digital transformation to take root in Africa. In view of that, instead of adopting the existing readiness indicators, metrics, and/or maturity models as is, it is important to develop Africa's Readiness Metrics based on the above three big areas. Without digitization the accessibility of digital technologies (hence digitalization) alone will not bring digital transformation.

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Discrimination in Healthcare and LGBTQ+ Information and Care-seeking Behaviors

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ABSTRACT

Members of the Lesbian, Gay, Bisexual, Transgender, Queer/Questioning, plus (LGBTQ+) community may face discrimination in healthcare, which can subsequently impact information and care-seeking patterns. A tendency to avoid or delay health care is particularly concerning for LGBTQ+ people who face both physical and mental health disparities. This paper presents a literature review of literature on healthcare discrimination, LGBTQ+ care-seeking, and associated information behaviors in order to generate a preliminary model of LGBTQ+ decision-making around care and well-being, called the *Model of the Pathways to LGBTQ+ Well-Being*. This model can be used to investigate links between information behavior and relevant health behaviors and outcomes in a marginalized population.

KEYWORDS

LGBTQ+ populations; care-seeking; information seeking; information use; incidental information acquisition.

INTRODUCTION

Members of the Lesbian, Gay, Bisexual, Transgender, Queer/Questioning, plus (LGBTQ+) community may face discrimination in their daily lives, and specifically during their interactions with healthcare and healthcare professionals. Discriminatory interactions in healthcare can have negative impacts on LGBTQ+ people, including fear of discrimination and delays in, or avoidance of, care; this can lead to disparate health outcomes. This impact is particularly concerning given that LGBTQ+ individuals already face a variety of health and healthcare disparities. Therefore, it is important to develop greater understanding of the ways in which experienced or feared discrimination may impact information seeking around health and healthcare, and healthcare-seeking decisions. The following presents a literature review of multidisciplinary literature, and proposes a preliminary model, adapted from an existing general model from the field of medical sociology, as a theoretical framework for future research.

Health services and medical sociology research shows that care-seeking involves consciously deciding to seek care, and the means through which an individual moves from that decision to actualization by actually accessing care. Information acquisition (both conscious information seeking and incidental exposure to information; Williamson, 1998) and use can play critical roles in this decision-making process, such as deciding that one has a symptom of concern one would like to pursue in healthcare based on recommendations from one's personal network (lay referral, Sulz & Goodkin, 1994). Information can also be used in the actualization of care-seeking decisions, such as when selecting a suitable provider and scheduling an appointment. Various fields describe similar processes and concepts, such as help-seeking in psychology which describes the process of seeking assistance such as for mental health or other disabilities. However, these fields do not focus on information seeking in the same way that information science does, and the role of information is often left implicit in existing work (e.g. Cardol, et al., 2006; Schomerus & Angermeyer, 2008). Therefore, this paper synthesizes literature from these fields to propose a model which explores care-seeking, but with an explicit inclusion of the roles that information may play in this process, particularly for LGBTQ+ individuals who may have experienced and/or fear discrimination in healthcare.

Discrimination and its Consequences

Discrimination involves negative behavior towards a group or its members; this includes both judgements/decisions about group members and actions toward group members (Al Ramiah, Hewstone, Dovidio, & Penner, 2010). LGBTQ+ individuals are more likely to report experiencing discrimination in healthcare settings than their heterosexual and cisgender counterparts (Lambda Legal, 2010). This discrimination is experienced through a variety of means such as refusals to provide care due to a person's LGBTQ+ identity and making assumptions about patients (either based on negative stereotypes about LGBTQ+ communities or assumptions of cisgender/heterosexual identities) (Lambda Legal, 2010). Discrimination against LGBTQ+ individuals can also be less overt, such as providers being ill-trained to provide care relevant to the specific concerns and needs of LGBTQ+ patients, or unable to provide the most accurate, relevant information to them (Lambda Legal, 2010).

Given potential experiences and fears of discrimination, LGBTQ+ individuals may be less inclined to seek healthcare immediately upon recognizing a health need in order to avoid exposure to discrimination in healthcare settings (Turan, Rogers, Rice, Atkins, Cohen, Wilson, Adimora, et al., 2017; Jacobs, Rathouz, Karavolos, Everson-Rose, Janssen, Kravitz, et al., 2014; Hatzenbuehler, et al., 2013). These delays in care-seeking can lead to negative health outcomes as lack of: regular preventative care (Pace & Keating, 2014), prompt “sick care” (Ho, Eisenberg, Litwin, Schaffer, & Salkeld, 1998), and routine care for chronic illnesses like HIV (Montaner, Lima, Harrigan, et al., 2014) and depression (Greden, 1993) can lead to escalation of health concerns.

This prevalence of healthcare discrimination, combined with decreased willingness to seek care is particularly concerning given the health and healthcare disparities to which LGBTQ+ individuals are already exposed. Health disparities occur when population subgroups have worse health outcomes along certain metrics as compared to the general population (Veinot, Mitchell, & Ancker, 2018). LGBTQ+ individuals face a series of health disparities as compared to their heterosexual and cisgender counterparts, including physical disparities such as increased HIV transmission, increased exposure to violence, and obesity (Struble, Lindley, Montgomer, Hardin, & Burcin, 2010).

Care Seeking and its Determinants

Even for those willing to seek care, decisions around seeking care are influenced by a variety of factors, including: perceived severity/risk of illness, illness-related stigma (Schomerus & Angermeyer, 2008; Druss & Rosenheck, 1998; Britt et al., 2008), cost, access and availability of care. All of these factors may apply to many groups and individuals, including those that are LGBTQ+ identified. However, LGBTQ+ individuals may be more likely to run into these logistical barriers given increased rates of poverty and unemployment as compared to cisgender and heterosexual counterparts (DeFilippis, 2016) and increased likelihood of experiencing stigmatized illnesses like HIV (Golub & Gamarel, 2013) and mental illness (Clement, Schauman, Graham, Maggioni, Evans-Lacko, Bezborodovs, Morgan, et al., 2014).

Information Behavior, Discrimination and Care Seeking

Information behavior is likely integral to both LGBTQ+ peoples’ perceptions of the likelihood of discrimination in a given healthcare setting, and to judgements made about illness severity, stigmatization, and the availability and accessibility of care. Although information behavior research with LGBTQ people has shown resilient, community-based health information practices (Kitzie, 2021), mistrust in healthcare providers’ abilities to provide relevant healthcare information (Hawkins, 2017), and possible differences in information behaviors and needs among various subgroups of the LGBTQ+ population (Hawkins & Giesecking, 2017), little work has focused on the links between information seeking, discrimination and care-seeking. Therefore, we know little about the role of information behavior in the development of these perceptions and judgments, and ultimately decisions to seek, delay or forego healthcare. Therefore, as a platform for future research, this paper synthesizes multiple literatures to propose a preliminary conceptual model of the role of information behaviors in the context of care-seeking. Given the prevalence of discrimination, and the existence of the aforementioned disparities, LGBTQ+ people provide an important population in which to examine these issues.

Proposed Model and Associated Literature

Below we propose the *Model of the Pathways to LGBTQ+ Well-being (Figure 1)*. Though many models and mechanisms of health information behavior exist, including lay information intermediary behavior (i.e. Abrahamson, Fisher, Turner, Durrance, & Turner, 2008) and peer-based information exchange (i.e. Veinot, 2010; Hartzler & Pratt, 2011), these center information behavior rather than decision-making as a process, even if decision-making is ultimately connected to these information behaviors. By contrast, the proposed model places information seeking in its context so as to clarify relationships between information behavior, decision-making and healthcare and health outcomes. For the purposes of this proposed model, care-seeking (*Figure 1: 4b*) is limited to seeking care within the traditional, western biomedical system of healthcare. Alternative activities (*Figure 1: 2d-2e*), therefore, can involve any activities undertaken related to the identified concern or health risk as an alternative to this biomedical care-seeking. This may include seeking alternative medicine or therapy, such as holistic medicine, but it may also include less defined activities such as self-evaluation and -treatment, or even simply ignoring the concern altogether.

This proposed model is built upon the Model of the Pathways to Treatment (Scott, Walter, Webster, Sutton, & Emory, 2012) from the field of medical sociology. Scott and colleagues’ general model elaborates on how an individual moves from perceiving a possible need for care (i.e., a bodily change) to actually initiating treatment (i.e., the “pathway”). Features of Scott and colleagues’ model which were kept in the proposed model of LGBTQ+ well-being (*Figure 1*) include the overall layout of the model as well as any non-bolded text. The components of the model that we have added based on additional literature include row 1 (information behaviors) as well as 2c-2e (provider selection and alternative activities), 2g (persisting with care), 3b (searching for providers), and 5c (Concern factors). Scott and colleagues’ model is not without limitations, such as its dependence on bodily/somatic changes as a starting point, limiting applicability to preventative and well-being related care (e.g., HIV prevention or

gender-affirming care), Despite these limitations, the pathways to treatment model has some key strengths which may make it a useful tool for exploring care-seeking decisions, though with some modifications to tailor it to the specific needs and experiences of LGBTQ+ individuals and to emphasize the role of information behavior in the decision-making process as outlined above.

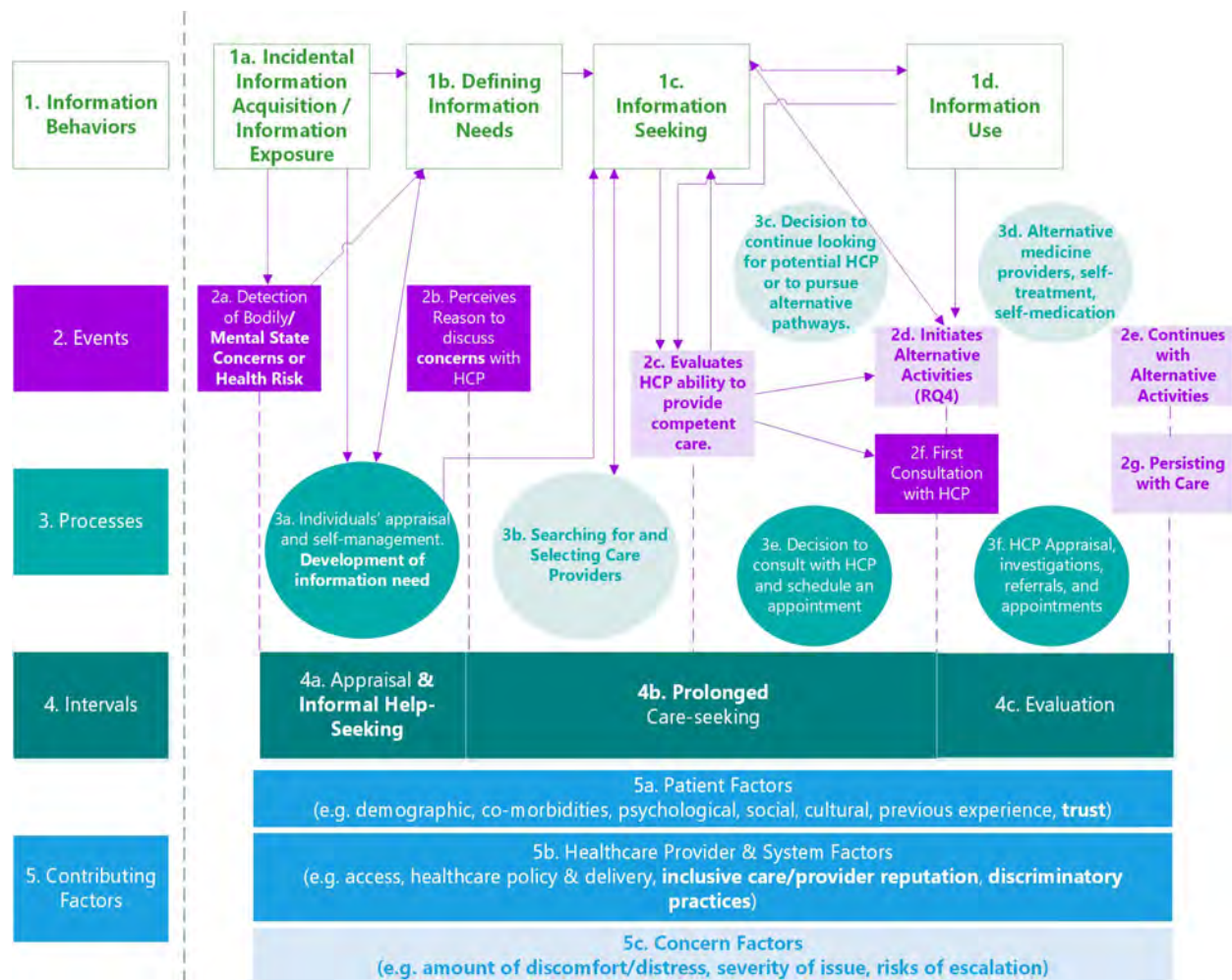


Figure 2. Proposed Model of the Pathways to LGBTQ+ Well-Being

As depicted in 1a-1d, individuals are likely to be exposed to, to seek, and to use information on the pathway to treatment. In the appraisal phase, for instance, the detection and appraisal of a bodily change (Scott, et al., 2014) can be understood as the development of an information need (i.e., “a recognition that your knowledge is inadequate to satisfy a goal that you have”; Case & Given, 2016) (*Figure 1: 1a-1b*). This may be developed by the individual alone or through information exposure and/or seeking through social networks, such as via lay referral networks (i.e., networks of personal influences such as friends, neighbors, and relatives; Suls & Goodkin, 1994) or peer networks (networks with whom an individual shares a common identity, activity, or interest). Peer-based information exchanges (e.g. Veinot, 2010) may be particularly valuable to LGBTQ+ individuals as other people who share this identity are more likely to understand the health care needs and concerns of fellow LGBTQ+ individuals (such as fears of discrimination) as compared to general networks (Civan, McDonald, Unruh, & Pratt, 2009), and hold given experiential knowledge about care-seeking (a combination of practical strategies and personal stories based on lived experience; Veinot, 2010). Additionally, socialization with peers, even before an individual recognizes a health concern or need, can expose LGBTQ+ individuals to incidentally acquired information (i.e., information discovered by accident, without intent; Williamson, 1998) about the health needs and concerns of the group at large, information which they can then appraise for its relevance to their own personal situation via social comparison (Ziebland & Wyke, 2012). Other ways in which an individual may become exposed to incidental information (*Figure 1: 1a*) about potential, non-symptom related health concerns could be through public health campaigns or marketing efforts by community organizations, such as LGBTQ+ specific non-profits or HIV service organizations.

Later phases of the process, such as after a need for care or treatment is identified (*Figure 1: 2b*), can also include informational behaviors such as active information seeking (i.e., seeking information with conscious intent; Case & Given, 2014) (*Figure 1: 1c*). This seeking can again be done individually, such as by searching online, or collectively through peer and/or lay referral networks, and in connection with local service organizations. Lay information mediaries, lay people who seek information on behalf of other individuals, given some understanding of those individuals' information needs (Abrahamson & Fischer, 2007) may also be sources of lay referral. This may be especially true in the later stages of the process, after an individual has already developed an informational need through other mechanisms (*Figure 1: 1b, 3a*), especially considering that lay information mediaries must actively seek information prior to sharing (e.g. Abrahamson & Fischer, 2007). For instance, if an LGBTQ+ individual has decided that they may be at risk for HIV, they may have conversations with a person in their network who decides to seek further information about HIV prevention. After this information seeking process, the lay information intermediary would return to the individual with the information need in order to share the information that was found. This information can then be used in order to decide whether or not to move forward with care-seeking in this area.

As stated, peer networks may be particularly valuable for LGBTQ+ individuals in the process of information acquisition (*Figure 1: 1a-1c*). However, such peer networks may not be easily accessed for all LGBTQ+ individuals given the relatively small population of LGBTQ+ individuals overall (Gallup, 2018) and even smaller numbers for each particular subgroup. Rural areas, for instance, with their smaller, more geographically dispersed populations will not always have easily accessible local peer groups, especially those areas which are particularly conservative and stigmatizing of LGBTQ+ identities. Online peer groups can bridge some gaps for those who may be less able to find local peer groups, particularly around types of care, therapy, and treatment that have worked well for others in one's peer groups, but these online peer groups are limited in their ability to provide specific practical information for care-seeking in a particular locality such as providing suggestions of inclusive providers (*Figure 1: 2c, 3b*). Local community organizations can meet many of these needs, such as helping individuals to connect to local peers through social events and providing lists of inclusive healthcare providers (e.g., Affirmations, 2020) as well as assistance with navigating care in a specific geographic area (e.g., Unified, 2020) (*Figure 1: 2c, 3b*). Again, however, these organizations may not be available in all geographic areas.

CONCLUSION AND NEXT STEPS

This paper presents a literature review of literature looking at the possible care-seeking practices of LGBTQ+ individuals given their increased exposure to discrimination in healthcare settings. In addition, this paper includes a preliminary model for LGBTQ+ well-being, incorporating perspectives and concepts primarily from research in the areas of medical sociology, health services, psychology, and information science. This proposed model utilizes these existing empirical and theoretical works to elaborate on care-seeking as a decision-making process, influenced heavily by information behaviors as well as other psychosocial factors, in order to better understand how members of this population make complex decisions around care-seeking in light of potential discrimination. This model, however, is preliminary, and requires empirical validation. We will conduct future mixed methods research, including initial surveys and interviews of diverse LGBTQ+ individuals regarding their discrimination concerns, and information and care-seeking behaviors in order to test and improve this model.

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Use of Bibliometrics Data to Understand the Citation Advantages of Different Open Access Categories in Covid-19 Related Studies

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ABSTRACT

The number of Open Access (OA) research articles is trending upward. This research aims to understand the correlations between different OA types and the impact of OA research articles evaluated based on the citation numbers. To avoid bias caused by the publication year, we chose to use COVID-19 studies in different fields to take advantage of this topic's quick turnaround of data. We analyzed the bibliometrics data and citation numbers (excluding self-citations) of around 42,000 English language articles published in 2020 related to COVID-19. We evaluated different types of OA categories such as Gold, Bronze, and Hybrid articles separately. Results show that amongst all OA categories, Hybrid/Green and Bronze/Green OA articles had significant citation advantages. Green OA articles returned more citations than articles with the other OA status. Gold OA articles have no citation advantages compared to non-OA articles. Gold/Green OA articles had the highest self-citation rates, followed by Non-OA articles. The results of the study can be used in understanding different OA categories and the reasons for OA choices. Certain strategies can be made accordingly to improve the awareness of OA in different fields and help OA publishers to improve the OA services.

KEYWORDS

Open Access; Bibliometrics analysis; Research impact; Self-citation; Covid-19.

INTRODUCTION

Open Access (OA) grants free access to academic information such as research publications and data. OA models for scholarly communication make research available to readers without any financial, legal, or technical barriers, unlike the subscription models, where the reader pays to access. According to several recent trends, OA articles can be classified as Gold, Green, Hybrid, and Bronze (Martín-Martín et al., 2018). This classification is also adapted by databases like Scopus and Web of Science. Gold OA refers to Open Access journals that provide immediate access to the articles published; Green OA are articles that are deposited in a repository and made publicly available by the authors; Hybrid OA articles are articles in subscription-based journals with an Article Processing Charge (APC); Bronze OA articles are articles that are made free-to-read on the publisher website, without an explicit open license. Most studies that investigated the citation advantages of OA articles focused on Green and Gold OA articles (Zhang & Watson, 2017; Dorta-González & Santana-Jiménez, 2017; Young & Brandes, 2020). Most recently, researchers started to pay attention to different types of OA articles and compare their citation advantages. For example, Zhang & Watson (2017) found that for the same citation period considered, both Non-OA article and Green OA articles have more citation numbers than Gold OA articles in the physical science field; hybrid OA articles had the highest citation rate compared to Gold OA, Green OA, and Non-OA article. Wang et al. (2015) discovered that within the same journal (Nature Communications), hybrid articles have a significant citation advantage over Non-OA articles for all time periods studied. Piwowar et al. (2018) found that Green OA articles had slightly more citations, followed closely by Hybrid OA. In all of these studies, major OA categories were introduced and compared; however, the more detailed OA data were not separately examined. For instance, a Gold OA article can be archived by the authors and made Green OA; these Gold/Green OA articles should be separately investigated to understand OA's citation advantage. In addition, the existing research often ignored the impacts of self-citation. A few studies had separately investigated articles with or without self-citation impacts (Norris et al., 2008; Gargouri et al., 2010; Clements, 2017; Basson, 2019). However, in these studies, self-citation was excluded to avoid the impact of self-citation to understand OA's real advantages; the correlation between self-citations and different types of OA was not studied.

In this study, we aimed to understand the citation advantages of different types of OA articles as well as the correlation between self-citation and different OA categories. We chose the articles related to the novel coronavirus, COVID-19 studies. The novel coronavirus caused an ongoing global pandemic of coronavirus illness. The virus was first identified in Wuhan (China) in December 2019. Because the COVID-19 was discovered in December 2019, the research related to this topic was published in January 2020 onward. We chose this topic to take advantage of its

short turnaround time period. It eliminates the citation advantages caused by various citation periods and allows the understanding of the citation advantage caused merely by different OA types.

METHOD

For this study, we aimed to find a good number of articles that represent all types of OA status to allow comparisons. We did not attempt to include as many publications as possible; instead, we believe that a good sample of articles would be sufficient. Therefore, the bibliometrics and citation data were acquired from the Scopus database, which includes most of the important publications. We defined the search terms were defined as “COVID-19 OR coronavirus OR sars-cov-2” to avoid exclusion of earlier publications before the name COVID-19 was defined by the WHO (World Health Organization). The search was also limited to English language publications only, “final” as the publication stage, and articles only (exclude review, letter, etc.). To avoid the gap due to download time and analysis, only the publications from 2020 were considered. With these search terms and criteria, 42,696 articles were found in 28 different subject areas. We then downloaded the bibliometrics data and citation data for all these articles from Scopus. Because Scopus only allowed to download the information for a maximum of 2,000 articles, these 42,696 articles were downloaded in 23 separate files. We also downloaded the full citation records and citation records excluding self-citation from Scopus in 23 separate files.

All the data were cleaned in Python after download. After removing duplication, 41,243 unique records based on title, author, and journal name were identified. Then, these records were merged with the citation files based on the article titles. Here, to avoid errors due to formatting, natural language processing packages were used to remove punctuations and tokenize the text. After merging, 41,897 records were matched with citation and self-citation excluded data. Resulted records were grouped by their open access categories shown in the bibliometrics data. Eight OA categories were identified: Gold; Gold and Green; Bronze; Bronze and Green; Hybrid; Hybrid and Green; Non-OA; Green. The citation data for each category were analyzed separately. Articles with the same number of citations were grouped together. The citation numbers with or without self-citations were analyzed separately to understand the impact of self-citations.

RESULTS AND DISCUSSION

Citation advantages of OA articles

Figure 1 shows the overall citation situation from eight OA or Non-OA categories. The values on the x-axis indicate the citation times, and the y-axis shows the ratio of OA articles to the total number of articles with the number of citations on the x-axis for each category. Note that the y axis is in a logarithmic scale to make the data more disguisable.

The results showed that all green OA articles had significantly more citations compared to articles with the other OA status. For example, Hybrid/Green OA articles generally had the highest citation rates, especially for articles with more than 100 citation times; however, Hybrid OA articles (without Green OA status) had much lower citation rates. Overall, Hybrid, Bronze, and Non-OA with additional Green OA status had higher citation rates. Regardless of having Green OA status, Gold OA articles had lower citation rates; this might be related to the OA journals' quality. In the subject fields studied, Gold OA journals tended to have lower impact factors, this might contribute to the lower citation numbers. Gold OA articles without Green OA status had similar citation rates with Non-OA articles. Results in Figure 2 also supported these conclusions. For all the articles that had been cited at least once, Gold OA and Non-OA articles had the lowest values. Gold/Green OA articles had a slight improvement than Gold OA only articles; however, the self-citation rate was comparatively high for this category.

For articles with a few citations, there were no significant differences between Hybrid/Green, Bronze/Green, and Non-OA/Green articles; however, Hybrid/Green and Bronze/Green OA articles were leading for articles with more than ten citations. This citation advantage was more significant for articles with more than 100 citations, for OA categories with Green OA or without Green OA status. A possible explanation for this is that authors might have made the final manuscript freely available through a repository with a link to the journal article. For the topic of COVID-19, these important works could quickly attract attention and result in more citation numbers. Similarly, many journal publishers made the COVID-19 related article freely available for everyone as their social responsibility through their website disregarding the availability of the final manuscript leading to more citations. It would be interesting to study the social impact of this research with the citation impact.

Previous research has discussed the reasons for a higher citation rate for Green OA articles in general. Authors might self-archive their better-quality work, and articles made available as preprints have an extended period to be cited (Kurtz et al., 2005; Davis & Fromerth, 2007). These arguments were supported by the results in our study: Green OA articles had notably more citations than their counterparts in the same OA category. In this study, because of the topic we chose and the restricted citation period only to 2020, the differences could be more significant. Articles that were not Green OA might not have been available on time to be cited.

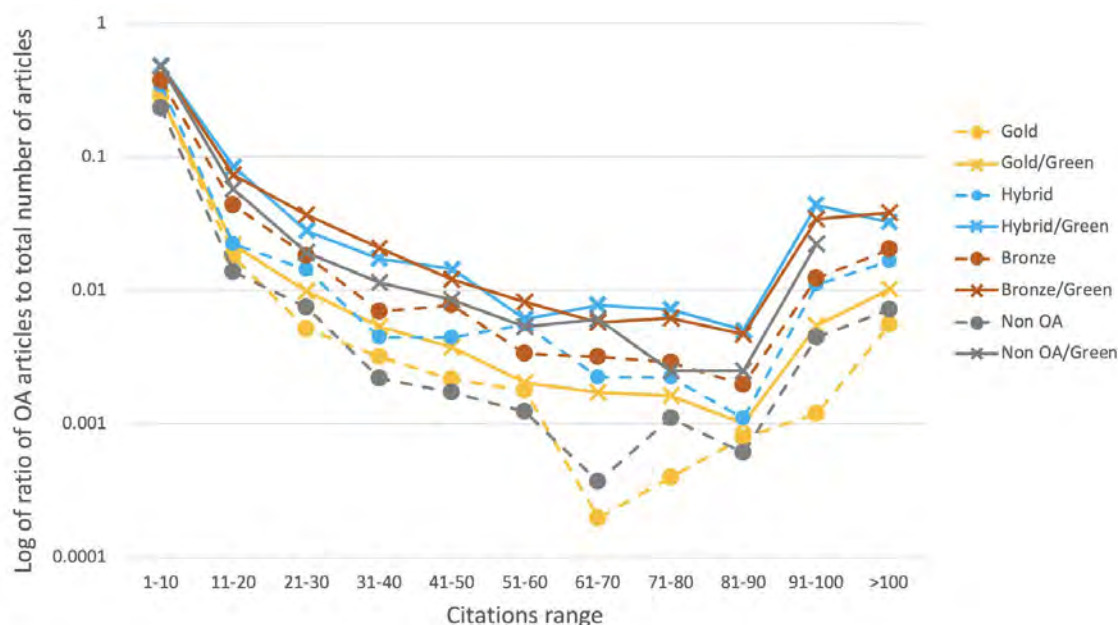


Figure 1. Overall citation numbers (without self-citation), in logarithmic scale

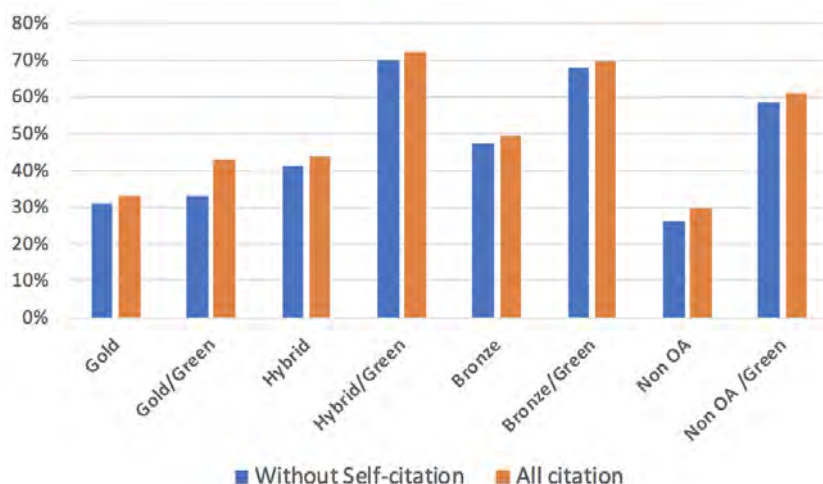


Figure 2. Articles that have been cited at least once

Self-citation

Table 1 shows the number of articles with self-citations. Each row shows the citation times; each row's entry represents the absolute difference between articles with self-citations and without self-citations. For example, the first entry for Gold/Green OA column shows that of the 9873 Gold/Green OA articles, 10.1% of these articles had zero citations if self-citation was not included. Similarly, the second row for the same column shows that 5.3% of the Gold/Green OA articles with 1 to 4 citations would not have as many citations if self-citations were excluded. The results from Table 1 show that Gold/Green OA articles had the highest rate of self-citations (the difference was approximately 10%). In contrast, other OA or Non-OA categories had similar self-citation rates (from 2% to 4%). Surprisingly, Gold OA without Green status had the lowest self-citation rate. The analysis indicates that OA categories were not a factor affecting self-citation.

Non-OA articles had slightly more self-citation than other categories except for Gold/Green. It was possibly because Non-OA articles had a similar number of self-citations compared to all other categories. Still, because the overall citation numbers were smaller, the self-citation rates were more significant than usual. It is unclear why Gold/Green OA had more self-citations, and Gold OA had the lowest self-citation rate.

Citation times	Gold	Gold/ Green	Hybrid	Hybrid/ Green	Bronze	Bronze/ Green	Non OA	Non OA/ Green
0	2.0%	10.1%	2.7%	2.2%	2.0%	1.9%	3.3%	2.7%
1-4	1.4%	5.3%	1.7%	0.6%	1.0%	0.3%	2.4%	1.1%
5-10	0.3%	2.4%	0.4%	1.0%	0.6%	0.8%	0.5%	0.7%
11-29	0.2%	1.5%	0.6%	0.2%	0.2%	0.5%	0.3%	0.6%
30-100	0.1%	1.0%	0.0%	0.4%	0.2%	0.3%	0.1%	0.3%
>100	0.0%	0.3%	0.0%	0.1%	0.0%	0.0%	0.0%	0.1%
Total number	5058	9873	900	1788	6582	6760	8142	2794

Table 1. Difference of citation rate without self-citations, represents the absolute difference between articles with self-citations and without self-citations

CONCLUSION

In this study, we used bibliometric analysis to understand the citation advantages of different OA types and their self-citation rates. Results showed that all green OA articles had significantly more citations compared to articles with the other OA status; regardless of having Green OA status, Gold OA articles had lower citation rates. For articles with a few citations, there were no significant differences between Hybrid/Green, Bronze/Green, and Non-OA/Green articles; however, Hybrid/Green and Bronze/Green OA articles were leading for articles with more than ten citations. In addition, we found that Gold/Green OA articles had the highest rate of self-citations. In contrast, other OA or Non-OA categories had similar lower self-citation rates. Surprisingly, Gold OA without Green status had the lowest self-citation rate. The analysis indicates that OA categories were not a factor affecting self-citation.

The preliminary results from this study showed citation advantages of Green OA articles; however, some questions remain unclear. Future work will involve understanding the reason why Gold/Green have more self-citation and Gold had the lowest self-citation rate. Also, we will consider other factors such as subject, journal quality and country of origin, aiming to find the true OA citation advantages and incentives of OA publishing in different fields. In future studies, we will also use statistic tests to verify the significance of the differences. The results of the study can be used to raise awareness of OA in different subject fields and help OA publishers to improve the OA services.

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Moods in Book Reviews: Text Mining Approach

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ABSTRACT

Spiteri and Pecoskie (2018) proposed a taxonomy of terms to describe emotion and tone in novels. We tested those terms against 5,144 full-text book reviews from the New York Times Book Review to discover whether the proposed terms were used in published reviews to describe books, and of those terms used, which were most used. The objective of this study is to explore whether emotional contents can be identified by a text mining approach without investing too much time and efforts of information professionals. Findings demonstrate that the terms chosen by Spiteri and Pecoskie are used in professional book reviews, though some may be used in multiple ways, rather than only related to emotional content. Results of this work contribute to a larger scale project of testing machine models of identifying emotional content in books and ultimately being able to create automated media recommendation systems that include emotion as an identifier.

KEYWORDS

Book reviews; text mining; affective terms; mood; emotion; tone.

INTRODUCTION

Mood (e.g., heart-warming, dark, gritty) has been recognized as a vital factor in recommending fiction in libraries (Ross & Chelton, 2001), separate from notions of topicality or the genre/form of a resource. Previous studies have investigated the challenge of finding the right mood of leisure materials; Ross (1999) emphasized the role of mood in pleasure reading, Lee et al. (2015) in video games, Bischoff et al. (2009) in music, and Winoto and Tang (2010) in films. Across different platforms and genres of leisure materials, mood acts as a primary *appeal* to audiences.

In library and information science, *appeals* or *appeal factors* are not a new concept. *Appeals* are foundational, internal gratifications that attract audiences to certain leisure materials, such as mood, character, story, or setting. Readers' associating a dystopian setting with dark and grim moods, for example, exemplifies how appeal can influence book selection. By understanding different appeals and developing recommendations for users, Readers' Advisory (RA) services in libraries have supported users' diverse pleasure reading needs. However, finding affective information about books in search systems is not easy. Appeal factors are not generally included as searchable fields in the library catalog and would only be present if aspects were captured as subject headings or as genre terms. However, bibliographic records do not systematically include mood metadata.

To support users' ability to identify fiction based on mood, librarians have developed a variety of tools. Librarians carry out this research using "professional texts or databases, ranked reading lists...professional reviews" and "informal sources such as corporate bookselling portals (e.g., Amazon) or 'word of mouth' social interactions" (Spiteri & Pecoskie, 2016, p. 1). Wyatt (2007) explained that it takes a librarian about an hour to write an annotation that is useful for RA. Lengthy to produce, such annotations will not be governed by standards and will not use controlled vocabularies, leaving the final product open to subjectivity on the part of the librarian.

This project focuses on professional book reviews, which might offer insight into mood that could be useful to libraries' RA services. In reality, librarians do not necessarily have time to identify, read, and digest from multiple sources. Alternative approaches to investigate mood of books that require less human labor, time, and cost might help. The objective of this research is to explore if a text mining approach can be helpful to parse emotions explored in books, and ultimately, used for identifying and recording mood information in future studies and applications. Particularly, using the existing mood terms identified and organized by Spiteri and Pecoskie (2018) to identify mood content, we look at contemporary book reviews and analyze the use of affective terms in that corpus. This exploratory research addresses the following question:

- From the taxonomies created/identified by Spiteri and Pecoski (2018), which emotion and tone words were most commonly used in book reviews? Which emotion and tone categories are most commonly used?

Spiteri and Pecoskie's (2018) taxonomies included terms derived from content analysis of the user reviews of the 22 fiction titles. Determining which of these words are most used in book reviews might reveal which of these terms are most resonant with contemporary reviewers and/or which of these terms has greater power for identifying emotional content in a book. By observing how Spiteri and Pecoskie's (2018) terms are applied in contemporary professional book reviews, we 1) confirm which mood terms can be used across different platforms and 2) identify what types of emotion categories tend to appear in book reviews. In the current exploratory study, we test book reviews' ability to identify books' mood content, using the existing mood taxonomy as a tool to locate mood information in reviews. Answers to these questions will support us as we investigate the deeper question of how to identify sources of machine-actionable content that describe books' mood, which may help developing a tool for information professionals to capture and provide mood information for future book recommendation services.

LITERATURE REVIEW

Existing studies suggest that readers select books that can help them have a positive mood (Mar et al, 2010) or satisfy their affective goals, such as aesthetic appreciation (Vorderer & Ritterfeld, 2009). Considering that readers' wanted experience or mood is one of the five factors of pleasure reading selection (Ross, 2000), it is a problem that mood of books is still not readily available information to users.

In other leisure material domains such as music and films, mood has been actively researched and adopted to recommend materials to users (Feng et al., 2003; Laurier et al., 2008; Winoto & Tang, 2010). Commercial recommendation services and streaming services-wise, too, the use of mood has been successful. Web or mobile app music services, such as *Spotify* (<https://www.spotify.com/us/>) and *Pandora* (<https://www.pandora.com/>), are good examples. Video recommendation services like *Netflix* (<https://www.netflix.com>) have also adopted similar tag systems where users can browse TV shows, documentaries, or films based on their mood. There has been a notable similar effort in finding books using moods and emotions, as well: *Whichbook* (<https://www.whichbook.net>). In their publicly available website, users can search for books based on moods and emotions. Their recommendations are based on an algorithm using a machine learning method that involved training readers and 54 libraries.

This study uses the term *mood* to represent affective content, to represent the concepts of *tone* and *emotion* together. Often *tone* is considered to describe the author's attitude (Purdue Online Writing Lab, n.d.), and *emotion* is considered to describe feelings of readers (or even characters), specifically, "how individuals deal with matters or situations they find personally significant" (UWA, 2019, June 27). The theoretical framework that this study adopts, Spiteri and Pecoskie (2018), also identifies three categories of moods: 1) emotions, 2) tones (that elicit emotions), and 3) associations (or memories elicited). Working from the extant literature and lists of synonyms, Spiteri and Pecoskie (2018) built out a taxonomy of seven basic emotions plus related emotions and presented a final "uncategorized" emotion to include related emotions identified that did not fit in the above categories. Next, they provide a taxonomy of 11 basic tones plus related tones based on work with a set of bibliographic records. Finally, seven basic associations were identified plus related associations, also based on the analysis of a set of bibliographic records. For application to this study, we focus on their terms on emotion and tone, not on associations.

Previous research attempted to create mood taxonomies, categories, and hierarchies utilizing research methods such as participant sorting, clustering, or labeling methods, asking individuals to create emotion domains (Cowie & Cornelius, 2003; Storm & Storm, 1987; Thomson & Crocker, 2013). By using a different approach, text mining, this exploratory research aims to apply the identified mood terms to a larger set of contemporary book reviews to observe how these terms are used.

METHOD

In this project, we use text mining methods on a large numbers of professional book reviews, to gain insight into how reviews might be used to identify the mood content of fiction narratives. We used 5,144 professional book reviews published in the *New York Times Book Review* between 2010 and 2019. This data set included reviews of all kinds of print and audio forms, though it was not a good source of mass-market fiction. Available metadata for these reviews included article title, article publication date, and a set of subject terms labeled "genre," which addressed form (Novels, Nonfiction, Short Stories, etc.), but which also included subject, or *aboutness* (Sports History, Feminism, etc.). We then identified a smaller subset of these reviews that were specifically identified as "Novels" and "Nonfiction" to investigate the role of fictional storytelling in mood terminology.

Through TDM Studio, a product of ProQuest, our research team was able to bring a text-mining approach to ProQuest content that had been purchased by our university library, including the *New York Times Book Review*. TDM Studio provided a secure environment for identifying reviews, aggregating them, and importing them into a Python environment for analysis. In the Python environment, we used a document term matrix to analyze each review individually for the occurrence of terms in the Spiteri and Pecoskie taxonomies (2018). We then downloaded the document term matrix for further analysis. In keeping with standards on non-consumptive use of copyrighted materials, we were not able to download the entire corpus of reviews, but only the derived data we created. After

downloading the document term matrix, we used OpenRefine to facet results based on genre terms such as “Novels” and “Nonfiction.” Analysis of results was performed using SPSS 26.

FINDINGS AND DISCUSSION

The 46 emotion terms were used a total of 10,059 times across the data set. As seen in *Table 1*, the most frequently used term was *love*, and the most frequently used emotion category was Love. All emotion terms were used at least once, with the exception of *bemusement*. Seventy percent of the reviews used at least one emotion word. One review, a non-fiction work with the subject term “empathy,” used 54 emotion terms. Each review used an average of 1.95 emotion words total. The most frequently used emotion term in the Anger category was *anger*; in the Disgust category, *disgust*; in the Engagement category, *reflection*; in the Fear category, *fear*; in the Happiness category, *pleasure*; in the Love category, *love*; in the Sadness category, *depression*; in the Surprise category, *surprise*; and in the Uncategorized category, *patience*.

The 139 tone terms were used a total of 24,751 times across the data set. *Table 1* shows the most frequently used word was *dark*, and the most frequently used tone category was Dramatic. All of the single-word tone terms were used at least once, and 94% of the reviews used at least one tone word. The review that used the most tone words was a non-fiction work with subjects “dinosaurs” and “universe.” The most frequently used emotion term in the Cerebral category was *profound*; in the Charming category, *beautiful*, in the Complex category, *complex*; in the Conventional category, *light*; in the Dramatic category, *emotional*; in the Frightening category, *violent*; in the Humorous category, *satirical*; in the Imaginative category, *original*; in the Optimistic category, *innocent*; in the Realistic category, *historical*; and in the Sad category, *dark*.

Emotion Term	Total Use	Tone Term	Total Use
<i>love</i> (from Love category)	3,825	<i>dark</i> (from Sad category)	1,135
<i>fear</i> (from Fear category)	782	<i>light</i> (from Conventional category)	1,070
<i>pleasure</i> (from Happiness category)	507	<i>historical</i> (from Realistic category)	1,069
<i>joy</i> (from Happiness category)	405	<i>familiar</i> (from Conventional category)	960
<i>depression</i> (from Sadness category)	393	<i>beautiful</i> (from Charming category)	881
<i>surprise</i> (from Surprise category)	379	<i>powerful</i> (from Dramatic category)	833
<i>anger</i> (from Anger category)	313	<i>emotional</i> (from Dramatic category)	733
<i>empathy</i> (from Love category)	276	<i>original</i> (from Imaginative category)	692

Table 1. Top ten emotion and tone terms used in reviews

A set of 3317 reviews (herein called the combined set), 1835 containing the descriptor “Nonfiction” and 1482 with the descriptor “Novel,” were compared using SPSS 26 for their use of emotion and tone terms as a way of focusing on titles which would be included in traditional RA.

An average of 1.99 emotion terms was used per review for combined set of Novels and Nonfiction ($SD = 2.753$), with a mean of 2.07 emotion words used for Novels ($SD = 2.364$) and a mean of 1.92 tone terms for Nonfiction ($SD = 3.029$). There was no statistically significant difference between groups as determined by one-way ANOVA ($F(1, 3315) = 2.588, p = .108$).

The most frequently used groups of emotion terms across the combined set were Love, Fear, and Happiness. When comparing emotion groups between Novels and Nonfiction, a Mann-Whitney U test found significant differences in distribution for emotion terms in the emotion categories Engagement ($U = 1305715, p = .000$), Love ($U = 1,548,844, p = .000$), and Uncategorized ($U = 1,336,245, p = .014$). Nonfiction had higher mean ranks in Engagement and Uncategorized, while Novels had higher mean rank for the term Love.

An average of 4.87 tone terms were used for the combined set ($SD = 3.614$), with a mean of 5.18 tone terms used for Novels ($SD 3.837$) and 4.61 tone terms for Nonfiction ($SD 3.403$). Assumptions of equality of variance were violated, so we used a non-parametric Mann-Whitney U test, which revealed that Novels had a higher mean rank in terms of Tone terms than Nonfiction ($U = 1,248,145, p = .000$).

The most frequently used groups of tone terms across the combined set were Dramatic, Imaginative, and Charming. When comparing tone groups between Novels and Nonfiction, Mann-Whitney U tests demonstrated significant differences in distributions for tone terms in the following categories: Charming ($U = 1,481,890, p = .000$), Frightening ($U = 1,454,718, p = .000$), Humorous ($U = 1,394,209, p = .000$), Imaginative ($U = 1,416,059, p = .019$),

and Sad ($U = 1,523,853, p = .000$). In each group, the Novels held higher mean ranks than the Nonfiction. Across the data set, it was rare for only one set of tone terms to be used. Forty-eight percent of reviews used tone terms from four or more different groups, and 81% used tone terms from two or more different groups.

Findings show that it is indeed possible to identify mood terms in book reviews. This suggests that professional (or general user-generated) book reviews can be used in the future to identify tones and emotions of a book in support of RA. For example, users can find books that help them feel certain way (emotion-based recommendations), or they can find books written with a language that carries particular atmosphere/attitude (tone-based recommendations).

LIMITATIONS

One limitation we found is with the data itself (the platform); for instance, some of the records were attached to text that was not analyzable. While there were 10,800 reviews published between 2010-2019, only 5,144 records were retrieved.

Polysemy is another limitation to this methodology; although the matches described (e.g., *depression* and *dark*) are based on the appearance of particular character strings in the text of the book review, the meaning of terms in context was not confirmed. *Depression* could for example relate to mood and affect, but could also pertain to economic or tropical depression.

Another limitation is associated with the corpus; mood is most often applied to fiction, but the corpus of book reviews both fiction and non-fiction. The pertinence to non-fiction has not been addressed in the literature. Next steps include reviewing a sample of reviews to estimate how large an effect polysemy has in the data set and examining a set of non-fiction reviews to qualitatively assess how mood is manifest in those reviews.

CONCLUSION AND FUTURE STUDY

Because tone terminology is more frequently used than emotion terminology, it seems that tone terminology might provide a better structure for seeking information on the mood of a book. Although tone terms are used slightly more frequently for Novels than for Nonfiction, this is not true across all tone categories. The findings suggest that some tone qualities may be more manifest in Nonfiction.

In this project, we intended to identify how emotional and tone content from published reviews is used in professional book reviews. This preliminary step will lead to a next stage of research, in which we try to use a machine learning approach to book reviews to identify “emotional” and “less emotional” books. We also aim to discover if it is possible to identify, via machine learning, whether reviews of books written by authors of diverse backgrounds (e.g., genders, ethnicities) have stronger representation of the classifications of emotional terms. In addition, in order to understand the context of the identified affective terms more clearly, we plan to create a keyword in context list in our next study.

Given recent trends of publishers making large sets of published data available for non-consumptive research, we also intend to compare the utility and ease of use for various text mining and analysis platforms, such as HathiTrust Research Center, ProQuest TDM Studio, and ITHAKA Constellate.

ACKNOWLEDGEMENT

This research is supported by ProQuest TDM Studio Digital Research Support Program. The research team was given access to TDM Studio software for six months as an award for winning their research proposal competition.

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“I Don’t Want a Book That’s Going to Make Me Sad or Stressed Out, Especially in This Day and Age”: Fiction Reading (and Healing) in a Pandemic

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ABSTRACT

To understand the roles of fiction reading in mitigating readers’ stress during the COVID-19 pandemic, this study explores readers’ motivations, preferences, and reading behaviors. Through an open-ended online survey posted on social media platforms and an online reading community, the researchers collected 76 responses from adult fiction readers. Through qualitative coding, three prominent themes were identified: escapism, re-reading behavior, and access and format. Readers actively escape into fictional worlds, often through re-reading books, to cope with the pandemic. Also, cost and available channels of access shape readers’ selection of fiction book format. These themes highlight elements of fiction reading that are pertinent to emotionally-strained individuals, which can provide insight for reference and recommendation services. By advancing researchers’ understanding of pleasure reading behaviors and the important selection criteria for fiction readers during stressful times, this study contributes to the body of knowledge in Readers Advisory (RA) and information behavior.

KEYWORDS

Fiction Reading Behavior; Motivations for Reading; COVID-19; Readers’ Advisory.

INTRODUCTION

“I literally cannot read. I can’t focus, get easily distracted, the whole bit. Just this month, I missed reading so much (and missed how much it grounded me [in] a routine) that I began setting a timer for 20 minutes every morning before I begin my tele-commute. It feels so good to read again. I’m still not settled in my new routine but it is helping and getting easier to do.” (P34)

In the extraordinary time of the COVID-19 pandemic, people are experiencing unexpected changes and challenges in their everyday lives. Undergoing social lockdowns and encountering new lifestyles have changed how people enjoy leisure materials. E-book reading has been booming due to closed libraries and bookstores (Pressman, 2020; Parikh et al., 2020). According to Merry and Johnson (2020), people are reading more “dystopias, social justice, and steamy romance.”

Previous studies show that bibliotherapy—using books as therapy in the treatment of mental or psychological disorders—may be helpful for people who have experienced psychological trauma (Glavin & Montgomery, 2017) and depression or anxiety (Peterkin & Grewal, 2017). Schutte and Malouff (2006) also state that reading has an emotion-altering power for some readers going through harsh living conditions or physical/emotional distress. In consideration of this potential, what can we, information professionals, do to help readers in this pandemic?

In this study, we explore fiction-reading behaviors, including the motivations for reading fiction books and the types of fiction individuals read, during the COVID-19 pandemic. We aim to understand the roles of fiction reading in mitigating stress, especially the stress induced by a long-term global pandemic. Specifically, we ask the following research questions:

- **RQ 1.** What are the motivations for reading fiction books during the COVID-19 pandemic?
- **RQ 2.** How is the COVID-19 pandemic impacting individuals’ fiction reading behaviors?
- **RQ 3.** What types of fiction books do readers prefer during the COVID-19 pandemic?

With the rich descriptions provided by fiction readers, this empirical study enhances the understanding of pleasure reading behaviors and important selection criteria for fiction readers during a troubling time.

LITERATURE REVIEW

What Readers Want for Pleasure Reading

Readers Advisory (RA) services assist patrons to choose their next book for leisure reading. Ross (2020) proposes five factors in pleasure reading selection: (1) the reader's wanted experience or mood, (2) alerting sources on new books (e.g., recommendations), (3) elements of the book (e.g., characters, plot), (4) visible cues from the book itself (e.g., author, cover art, publisher), and (5) cost in time or money to access a book. When readers can successfully navigate these elements and select a book themselves, their pleasure is enhanced (Ross, 2000).

To facilitate positive reading experiences, RA services must also consider *appeal*. Traditionally, appeal may be described as the characteristics or attributes of a book or genre. Saricks (2005) suggests four key elements of a book's appeal: pacing, characterization, storyline, and frame. Dali (2014) splits appeal into book-related appeal (e.g., genre, central themes, writing style, authors) and reader-driven appeal (e.g., readers' personal situations or current mood).

Currently, however, RA research lacks information on how individuals' personally stressful situations influence book selection or reader-driven appeal. As COVID-19 affects countless people, an exploration of how literature preferences and behaviors are changing during this pandemic may aid RA services now as well as in the future.

Emotion Regulation and Reading

Reading behavior during the COVID-19 pandemic may act as a form of emotion regulation. According to Gross (2014), there are three core features of emotion regulation: (1) an emotion regulation goal, (2) a strategy to meet that goal, and (3) the consequences of trying to achieve that emotion goal. Individuals often regulate their emotions by minimizing self-awareness, and they may accomplish this through leisure activities (Gross, 2014). This emotion regulation behavior aligns with Ross' (1999) position that the bedrock for book selection is the reader's mood. Ross found that busy or stressed readers typically select short or easy reads and search for the comfort of old favorites. Such texts may provide a sense of safety. This aligns with findings from Ministero et al. (2021) on re-reading behavior. The authors identified that re-reading is related to unfulfilled belongingness needs, insecurity about social acceptance, deep engagement with narrative worlds, and readers' personality characteristics.

Psychological Strain, Media Consumption, and Fiction's Power

Psychological strain may be present in people who are not directly exposed to distressing events, and event-related media consumption may predict traumatic symptoms (Monfort & Afzali, 2017; Pfefferbaum et al., 2014). Bendau et al. (2020) report that this indirect strain may also be true of COVID-19-related media consumption. As such, it comes as no surprise that Holmes et al. (2020) emphasize the need to "understand and harness positive uses of traditional media, online gaming, and social media platforms" (p. 550) as a long-term priority for mental health research during the pandemic. Yet, research focuses on individuals' fiction reading behavior in the context of the pandemic is lacking.

The role of an individual's mood, especially when impacted by the stress of a pandemic, may play a powerful role in fiction selection and reading behavior. As Ross (1999) aptly reports, "the affective dimension is involved throughout the reading process, from choosing a book according to mood to valuing a book for its emotional support in providing confirmation, reassurance, courage or self-acceptance" (p. 796). Our study investigates the relationships between affect, mood, and reading behaviors.

METHODS

This paper presents exploratory findings based on a subset of data collected during a larger study; while investigating fiction readers' general reading behaviors, we noted emerging themes relevant to the COVID-19 pandemic.

Once the Institutional Review Board approved the study, the first and second authors conducted a pilot study with an initial set of open-ended online survey questions. After receiving the feedback from the pilot study participants, some of the questions' language was revised for clarity, and examples of responses were added. The open-ended survey included questions about participants' favorite fiction books, why the elements of those books appeal to them, and the motivations for reading fiction books. In August 2020, we distributed the finalized open-ended survey to an online social cataloging website and reading community, *Goodreads* (<https://www.goodreads.com/>), and other social media websites, including *Facebook* and *Twitter*. We used snowball sampling, starting from posting at affiliated communities, and encouraging participants to share the survey link. We did not provide financial compensation for participants.

All participants were 18 years or older. Once the first and second authors observed data saturation in the responses (Corbin & Strauss, 2015; Robinson, 2014), we ceased recruitment and data collection, resulting in 80 responses. Then, we removed four responses to clean the data. Two respondents who answered were younger than 18 years old, and two repetitive responses were identified.

Using a hybrid approach of inductive and deductive coding (Fereday & Muir-Cochrane, 2006), five researchers created a codebook and defined each theme after several iterations and discussions. Then, four researchers coded and analyzed the dataset using a qualitative analytical software, NVivo 12. The average Cohen's Kappa coefficient value between each pair of researchers was 0.74 (agreement ratio of 99.66%), indicating good agreement ("Kappa value 0.40-0.75: Fair to good agreement") (NVivo, n.d.).

FINDINGS/DISCUSSION

Among 76 participants, 69 participants identified themselves as female—we note that this may have influenced the results of this study. The participants' age range in this study was diverse. The largest age group was 25-34 years old (31 participants), followed by 35-44 years old (16 participants) and 55-64 years old (12 participants). The following three sections will answer the three research questions respectively.

Escapism

Escapism is not an uncommon concept to leisure reading research. In their work on imaginative literature, Usherwood and Toyne (2002) state that escapism is "a complex idea with many connotations, often contradictory and not always positive" (p. 34). Regarding escapism, participants had two different goals: mood regulation and change of setting.

Mood regulation

Although participants in this study frequently mentioned that they read fiction to escape from the pandemic situation, it was not merely passive avoidance; rather, it was an active coping strategy. Similar to what Gross (2014) identifies as emotion regulation, the current study's participants also described 1) their goal to alleviate their stress from the COVID-19 and 2) their strategies to actively change their mood by reading fiction books. Through this conscious activity, participants expected to regulate their emotions. Comments from the participants illustrate this phenomenon:

"I feel excited when I read fiction! I feel relief from these current and often fucked up times! I read to escape to something better!" (P67)

"I have both had more time for reading, and I want to read more rather than watch tv. Reading is more soothing and relaxing for me, which helps with the stress of Covid." (P20)

Change of Setting

Participants tended to look for "different worlds" when reading fiction, such as books with fantasy or sci-fi settings or different time periods. Usherwood and Toyne (2002) note that actively being involved in another world provides a contrast to the real world for readers. Alternatively, they suggest that being subsumed into the action of the text itself is a type of escapism. Participants considered reading itself as an escapist act, resonating with the latter description of escapism (e.g., "I've always been a big reader, but I've been reading more fiction since the pandemic started, because I need something to distract me from the stress of the pandemic"). However, more participants focused on enjoying fantastical settings, aligning well with Usherwood and Toyne's (2002) emphasis on other worlds:

"I think I've been more inclined toward escapist books - so, sci fi taking place on other planets, or fantasy versions of the real world but which have magic and such." (P45)

"I'm reading a lot more! I can't really read anything too closely related to the real world - anything about pandemics or apocalypses or anything too political." (P51)

Re-reading Behavior

Re-reading behavior is another notable theme in this study. By re-reading books, individuals immerse themselves in positive memories from their favorite stories. Re-reading may also be more relaxing than exposing oneself to a new narrative; there is less of a cognitive burden in deciphering an already-known plot. Our findings echo Harrison and Nuttall's (2018) study, which found that motivations for re-reading fiction include enjoyment, re-experience emotion, and comfort, familiarity, or nostalgia. Additionally, as an action toward escapism, some of our participants re-read books during the pandemic to distract themselves from worry and anxiety.

"I've mostly been re-reading book series I love—its' a form of escapism lets me immerse myself in interesting worlds and characters that I already know that I like...which makes it a more relaxing experience." (P43)

"I have had more trouble recently with reading new worlds and characters. Have found myself re-reading things I've loved and sequels." (P56)

The COVID-19 pandemic may also be prompting some readers to act in opposition to their usual re-reading behavior. For example, one participant reported avoiding her favorite dystopian novels because of the pandemic:

"I used to love reading dystopian fiction...I used to re-read it every few years. Now I cannot even fathom trying to read stuff like that...the pandemic certainly exacerbated it." (P13)

Access and Format

Ease of access is a major criterion for book selection (Ross, 2001). In the survey responses, we identified two prominent themes about access: cost and the channels of access pre- and post-pandemic.

The pandemic has forced the closure of library buildings. Many people have lost free access to physical books. These closures challenge what used to be free pleasure reading. Participants described purchasing books while being more mindful of book selection. Some participants, however, explained that they needed to prioritize buying necessities like groceries over new books.

"Since I haven't been relying on the library for books, I have been buying more books and being more intentional about the books I choose (rather than relying on the luck of the library hold system, I get to select what book I want to read next in a more direct way)." (P36)

We observed participants shifting to e-books and audiobooks through libraries, reading or re-reading books in their personal libraries, or, for those that can afford it, buying books. This observation aligns with the Public Library Association survey in April (2020), in which 98% of the 2,545 respondents reported that public library buildings were closed but access to digital resources had expanded. The increasing consumption of e-books shapes reading behaviors. One participant described their preference for reading shorter content in e-book format. Some participants discussed their e-book purchases and described how they are more willing to take risks, such as buying a book written by an unfamiliar author, because e-books are often cheaper than print books. Participants also enjoyed the instant access that e-books grant.

"If a plot summary looks good, especially on an ebook, I'll often bite. If it's awful, I can just delete it and I'm only out a couple of bucks." (P46)

"Rather than relying on the luck of the library hold system, I get to select what book I want to read next in a more direct way." (P36)

CONCLUSION AND FUTURE WORK

This short paper explored fiction readers' motivations, reading behavior, and reading needs during the COVID-19 pandemic. Through analysis of the survey data, we have observed that COVID-19 is impacting fiction reading motivations and behaviors in diverse ways. Specifically, the data points to three themes. First, participants' responses embody emotion regulation behavior, particularly in the form of escapist reading. Readers crave a change of setting—a place or time without COVID-19. Second, respondents voiced the comfort of re-reading. This re-reading behavior may foster nostalgia, and it avoids taxing readers' already strained cognitive capacity during this pandemic. Third, dimensions of access are influencing fiction reading behaviors, especially the adoption of digital materials.

We note that there is a high percentage of female respondents (91%). The high percentage of female fiction readers has been a frequently discussed topic in both academia and publishing industries; while this resonates with the demographics of the current study, we acknowledge that this might have influenced the results of this study. In future studies, we plan to address this by reaching out to an even larger size of participants.

Fiction has the power to alleviate stress. Although we do not know how RA services will evolve in the near future, understanding the elements of fiction that matter to readers can improve RA services and assist patrons in getting the reading experiences they need.

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How Big Are Peoples' Computer Files? File Size Distributions Among User-managed Collections

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ABSTRACT

Improving file management interfaces and optimising system performance requires current data about users' digital collections and particularly about the *file size distributions* of such collections. However, prior works have examined only the sizes of *system* files and users' *work* files in varied contexts, and there has been no such study since 2013; it therefore remains unclear how *today's* file sizes are distributed, particularly *personal* files, and further if distributions differ among the major operating systems or common occupations. Here we examine such differences among 49 million files in 348 user collections. We find that the average file size has grown more than ten-fold since the mid-2000s, though most files are still under 8 MB, and that there are demographic and technological influences in the size distributions. We discuss the implications for user interfaces, system optimisation, and PIM research.

KEYWORDS

personal information management; file management; file systems; human-computer interaction.

INTRODUCTION

An ongoing concern in personal information management (PIM) research is people's digital file collections, especially how and why people manage them, what the resulting collections are like, and how therefore to best support people with improved interfaces and services (Jones *et al.*, 2017). For example, studies of people's file collections have looked at their size, how the folders are organised, and the importance people attribute to them (Bergman *et al.*, 2010; Cushing, 2013; Dinneen *et al.*, 2019). Even the *sizes* of people's files are interesting, as they tell us about the nature of the items users manage and retrieve everyday, including how those items occupy storage space and grow over time and what simulated collections (used in testing new management tools) should look like if they are to be ecologically valid (Chernov *et al.*, 2008; Dinneen & Julien, 2020). More particularly, understanding collections' *composition* in terms of different file sizes—also known as the *file size distribution* (FSD)—can be used to improve the features and performance of file managers, desktop search algorithms, file recommender systems, file backup software, etc. We provide more detailed examples and concrete suggestions when discussing our results.

For the use of FSD data to be effective in such cases, the data must reflect the kinds of files the software will be used with, namely, *files in users' collections*. However, the vast majority of studies of FSD, conducted with the goal of optimising system performance (e.g., by choosing a block size according to the most frequent file sizes), have typically examined files that are atypical for most users, like system and server files, simulated network files, or files in high-performance computing environments (Downey, 2001; Evans & Kuenning, 2002; Gribble *et al.*, 1998; Harter *et al.*, 2011; Mitzenmacher, 2004; Ousterhout *et al.*, 1985; Roselli *et al.*, 2000; Satyanarayanan, 1981; Smith & Seltzer, 1981; Vogels, 1999; Welch & Noer, 2013). Very few studies have examined the FSD among *users' files*, and among those, all examine only users' *work* collections (which can contain different contents than collections used for personal matters; Dinneen & Julien, 2019). Further, past works' population samples vary greatly, precluding a comparison of results from different kinds of collections (e.g., Microsoft employees, 40 mechanical engineers, a university's computer science department, and five university admins; Agrawal *et al.*, 2007; Hicks *et al.*, 2008; Tanenbaum *et al.*, 2006; Skondric *et al.*, 2020), and none have compared FSDs across today's popular operating systems (which can influence collections' structural properties; Dinneen & Frissen, 2020).

Although data on users' FSDs could help improve everyday tools for retrieving and organising personal information, to our knowledge no general study of users' FSDs has been conducted since 2007, no prior study has examined FSDs among personal collections, and none have compared distributions across Windows, Mac, and Linux.

METHODOLOGY

To address the above gaps in knowledge we pose the following research questions:

RQ1. What are the differences in FSDs among today's popular desktop operating systems?

RQ2. What are the FSDs like today in collections used for different purposes, and how do they differ?

RQ3. How much growth in file sizes has taken place since the last major study of FSDs?

Data Collection and Sample - 348 remote and anonymous participants downloaded and ran on their desktops and laptops open-source software (Dinneen *et al.* 2016) that collected data about files they indicated they manage. File sizes were measured in bytes using python's `os.stat().st_size`; the collected data are thus comparable to those collected by scanning files or monitoring system traces and disk access (Agrawal *et al.*, 2007; Baker, 1991; Gonçalves & Jorge, 2003; Roselli, 2000; Vogels, 1999). Care was taken to exclude files not managed by the participant: hidden files and common folders containing operating system files were explicitly ignored. A summary of the sample is in Table 1, and further details are provided in prior work (Dinneen, Julien & Frissen, 2019, p. 4).

Size	Age	Gender	Operating system	Collection use
348 participants 49 million files	Range: 14-64 Mean: 30 SD: 9.96	Male: 218 (63%) Female: 123 (35%) Other: 7 (2%)	Mac OS (10.7 – 11): 169 (48%) Windows (XP – 10): 135 (39%) GNU/Linux: 44 (13%)	Work: 166 (48%) Knowl. work: 93 Other: 38 IT: 25 Study: 143 (41%) Personal: 39 (11%)

Table 1. Summary of sample

Data Analysis - Collections were divided according to each analysis conducted: first into the popular operating systems (OSes; Windows, Mac OS, and GNU/Linux), and second into the use of the collection (personal matters only, work, or study) according to participants' responses within the data collection interface. Work collections were further divided (using participants' stated occupations) into three groups common in PIM literature and used in past analyses of the same data (Dinneen & Julien, 2019): knowledge workers (e.g., manager, doctor, journalist), IT staff (e.g., programmer, systems administrator), and all others (e.g., tradespeople, retail, artist, unemployed). To facilitate comparison with prior works we generated arithmetic and log-normal averages (median and mean) for each group and visualised their file FSDs using cumulative distribution frequency plots (CDFs), which illustrate how much of a collection files of different sizes occupy (in terms of count, not disk space used). Because the data are extremely skewed, we assessed the statistical significance of differences between groups with the Mann-Whitney U test, a non-parametric equivalent to t-tests. Finally, while we did not aim to exclude outliers, a collection of 2.2 million files was almost entirely comprised of files sized 64 KB, and a collection of one million files was 50% comprised of 4 KB files. We excluded these collections from all analyses, as they dramatically altered the CDFs otherwise.

RESULTS

Below are highlighted results and implications. Comprehensive CDF plots, full data tables with discrete values for each distribution, and all analysis scripts can be accessed at github.com/jddinneen/fm-results-tables.

FSD of all data and in each OS

Table 2 summarises the FSDs of the complete data set and those the collections in each OS. Relatively small files are very common in each OS: files below ~5 KB account for 50% of Mac and Linux collections, and files below 8.5 KB account for 50% of files in Windows. However, the CDFs of each OS differ significantly ($p < 0.001$) across all measures. Notably, the Mac distribution has more small files than Windows's, while Linux is so skewed (e.g., SD 145 MB, three times that of Windows) that its CDF resembles Mac's below 5 KB (i.e., such files are 50% of both CDFs) despite having more files above 64 KB than Windows.

FSDs of different collection types

As seen in Figure 1, files larger than 32 MB are relatively rare in collections of all use types, but the FSDs are otherwise significantly different (all pairs $p < 0.001$). Personal collections have more large files and are more skewed than work-only collections (log-normal average 15 KB to 1.9 MB), except for 'other' work collections, with which they are largely similar. Among work collections, IT collections are the most different, being the most composed of small files (log-normal average 3.6 KB to 126 KB). Finally, study collections are between IT and knowledge work collections in most regards.

Data set / OS	Log-normal median & mean	Arithmetic mean	50% occupied by (< mean)
whole data set	9.0 KB, 730 KB	1.5 MB	< 5.4 KB
Mac OS	8.0 KB, 533 KB	1.4 MB	< 4.9 KB
Windows	11.5 KB, 1.0 MB	1.7 MB	< 8.3 KB
GNU/Linux	10.8 KB, 1.7 MB	2.2 MB	< 4.8 KB

Table 2. Summary of FSDs of the total data set and within each OS

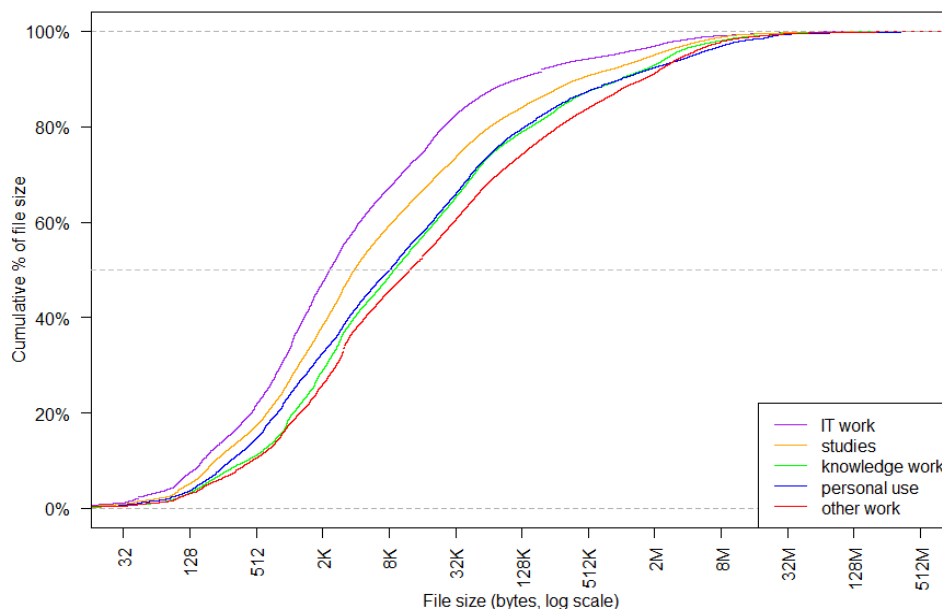


Figure 1. CDFs of file sizes in collections used for different purposes

DISCUSSION

RQ1. *FSDs differ slightly but significantly between today's operating systems.* That larger differences were not seen is perhaps surprising given the influence of the OS on many other properties of the file collection (Dinneen & Frissen, 2020). While the small differences likely do not warrant notable changes in the features of file manager interfaces, they are nonetheless important for the performance of hard drive firmware, media players, and file transfer operations. In particular, performance might be improved for users in all three OSES (and cross-platform scenarios) by increasing the file system block size to reflect the discrete values observed—Windows in particular may benefit from a block size of 8 KB. As the frequency of mobile FM increases (Bergman & Yanai, 2018), it may also be beneficial to examine FSDs across mobile contexts and operating systems (i.e., Android and iOS devices).

RQ2. *FSDs differ between collection uses: personal collections contain more large files than most work collections, and IT collections contain more small files.* These differences are consistent with a recent study of the *types* of files seen in the same data (Dinneen & Julien, 2019): personal collections and 'other' work collections contain fewer documents but more (large) media than other collections, and IT collections contain (small) plain text files for system administration and software development. The similarity of study collections to both IT and knowledge work collections may reflect that studying today resembles knowledge work but also commonly entails IT or programming tasks. Regardless of the cause, we suggest designers of file managers utilise this information, for example by prioritising files in the ranges given above when performing desktop search (i.e., use the file metadata to rank the results) or recommending files to users (e.g., favour files in the typical range for that occupational setting or for that user); whereas the largest files likely stand out in users' memory and are thus easier to find through folder navigation, results that place small files (<1 MB) *higher* would increase the chances that the user sees the file they want since, *ceteris paribus*, the user likely wants a file in that size range. We also suggest future studies further explore the connection between FSDs and file *type* distributions, perhaps *especially* as the merging of personal and work collections presumably increased when people were working from home during the COVID-19 pandemic. It may be useful, for example, to suggest retrieving or deleting files that are exceptionally small or large *for their type*.

RQ3. *File sizes have grown more than ten-fold since the mid-2000s, but most files are still under 8 MB in size.* When comparing our knowledge workers' FSD with those of past results, seen in Figure 2, there appears to be an increase in the presence of larger files from the mid-2000s (Agrawal *et al.*, 2007; Tanenbaum *et al.*, 2006) to today, but without many more *very large* files: whereas such collections were previously mostly (>90%) composed of files smaller than 32 KB, that value today has grown to 1 MB, and files larger than that are still under 8 MB (<95%). These findings are consistent with the only other recent study (Skondric *et al.*, 2020), of five university administrators' collections, except that study found *very few* files are under 8 KB in size (approx. <5%, rather than approx. <50%). It is unclear if this difference is attributable to particular job roles (i.e., uni admins in particular) or simply that particular sample. Regardless, the overall growth we have identified may be attributable to increasing storage capacity generally and new and richer media formats more specifically, which increase in resolution/fidelity (and therefore size) over time. Further growth may also be obscured by older files created under the constraints of prior OSES and software (i.e., smaller block sizes and maximum file sizes), but the strength of such effect is unclear.

Either way, we recommend that developers—of operating systems and file management tools—update their designs to account for today’s FSDs, and that future works investigate the effect of past file size constraints (e.g., using historical OS data with file creation time metadata).

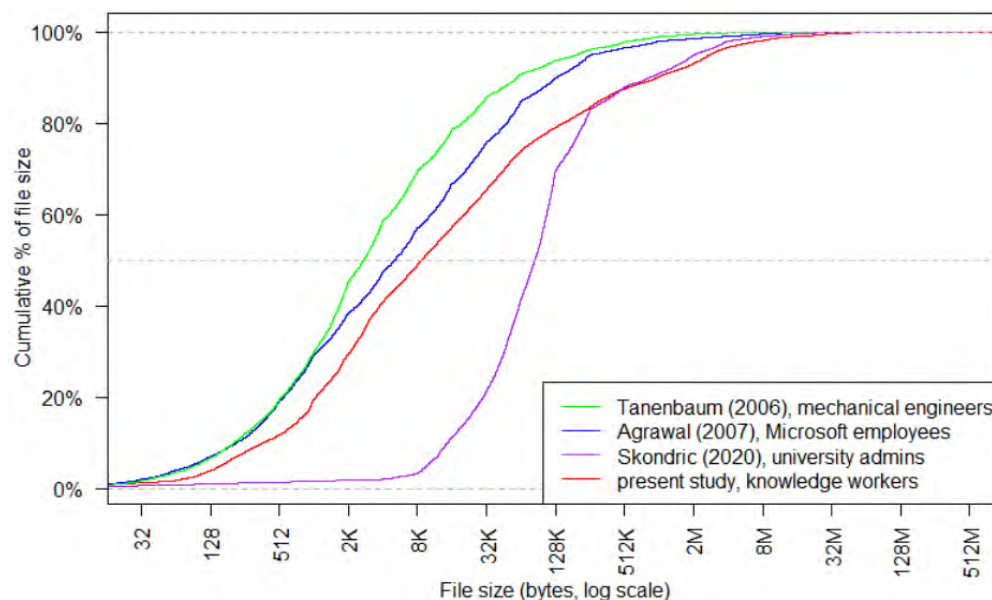


Figure 2. CDFs of file sizes in knowledge workers’ collections from studies past and present

CONCLUSION

In this manuscript we have provided updated data on file size distributions including, for the first time, data about users’ personal collections. We have also identified differences among collections types and between operating systems, and traced the changes in knowledge workers’ files over time. Finally, we have made suggestions for how our findings could be used to optimise system performance and, importantly, to improve everyday tools for retrieving and organising personal information in people’s digital collections. Promising directions for future work, in addition to those discussed above, therefore include designing and testing such improvements, the former of which should be easier with this information about what that test collections should look like if they are to be ecologically valid.

ACKNOWLEDGEMENTS

The authors are grateful to the participants for their time and the three anonymous reviewers for their feedback.

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Towards a Taxonomy of Trustworthy Digital Repository Impacts

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ABSTRACT

Measuring the societal impact of digital repositories is a wicked problem. To capture information about the impacts of digital repositories that become certified as Trustworthy Digital Repositories (TDRs), a taxonomy describing activities cited as evidence of compliance with TDR standards is needed to relate those activities to socially beneficial outcomes. This paper presents a Minimum Viable Prototype (MVP) for a TDR Impacts taxonomy to enable the expression of their activities in a structured way. Our MVP provides a proof-of-concept that by formalizing concepts about TDRs in a taxonomy, we can investigate ways to measure whether the impacts associated with becoming and remaining a certified TDR are also impacts that generate societal value. Implications of the work described include potential strategies to identify, extract, and/or author machine-readable descriptions of measurable facets of TDR activities and the resulting impacts on communities.

KEYWORDS

Trustworthy Digital Repositories; Societal Impact; Minimum Viable Prototype; Taxonomy.

INTRODUCTION

Digital repositories provide the organizational and technical infrastructure for access, use, discovery, governance, and preservation of digital resources both in the short and long term. It is increasingly common for funders of scientific research to require a data management plan with the expectation that the funded data will be deposited in a digital repository. Additionally, data policies of funding agencies and journals are increasingly requiring that these digital repositories be certified as TDRs to ensure competency and capacity in data stewardship.

The goal of this study is to evaluate the efficacy of using a semantic taxonomy to describe and quantify the impacts of digital stewardship activities that are reported by TDRs as evidence of their trustworthiness. A TDR is defined as “one whose mission is to provide reliable, long-term access to managed digital resources to its designated community, now and in the future” (RLG/OCLC Working Group on Digital Archive Attributes, 2002, p. 5). We expand upon the definition of a TDR above by drawing on additional literature on the topic of trustworthiness from two main sources: a general semantics of trust and its application in Internet-based services (Huang & Fox, 2006); and studies on the specific qualities of trusting relationships between repositories and users (Yakel et al., 2013). These sources concur that trusting relationships may yield epistemic and economic effects that benefit both specific stakeholder communities and society as a whole. Our research seeks to develop and test the use of knowledge representation and reasoning techniques as a means of connecting instances of trustor-trustee relations to more abstract formulations that categorize how TDRs produce trust as a social good thereby producing a positive societal impact.

Drawing from TDR certification audit reports, we further investigate what types of societal benefits can be mapped by implication from structured descriptions of their evidence. We represent societal benefits in this context as a relation connecting an impact and a community or set of communities. We use this representation of societal value to identify instances where TDRs achieve impacts that benefit certain sets of stakeholder communities, and characterize the type of trust that is operative in the relationship between the repository and stakeholders. We hypothesize that digital repository certification, by virtue of focus on “the rights and responsibilities of data producers and consumers” (Wilkinson et al., 2016, p. 7), has a more substantial impact on society in general than is shown by currently available outcome metrics. We select building a taxonomy, which we synonymously refer to as a “simple” ontology or knowledge graph, for this research because it addresses the need for a more precisely entailed domain of discourse for description and measurement of societal impacts of digital repositories than what currently exists.

BACKGROUND & SIGNIFICANCE OF THE STUDY

Some of the most readily available information about impacts and outcomes for digital repositories is in the form of website analytics for visits and downloads including metrics for publications and citations (e.g., Arlitsch et al., 2021). However, these “popularity-contest” styles of measuring data preservation impact do not show the entire

picture of the societal value of digital preservation. The task of “selling” stakeholders on data stewardship and digital preservation is difficult because it is a form of infrastructure rather than innovation, and hence, less newsworthy (NITRD Program, 2017). Another difficulty is quantifying socio-economic impacts such as opportunity cost, which affects diverse communities.

While the importance and value of data to society is well-known (Federal Data Strategy Development Team, 2020; United Nations, 2020), less is known about how different communities are able to derive value from data through digital repositories (Virapongse et al., 2020). These communities include a variety of researchers, educators and students, planners and policy-makers, representatives of commercial and non-profit entities, and members of the general public who use data, produce data, or are the subjects of data. Data repositories that enable the use of data by diverse audiences and their designated communities “improve the potential usefulness of data” and “increase opportunities for contributing to both the scientific value and the societal value of data” (Downs, 2021, p. 3). Measuring the societal impact of TDRs is difficult because their certification is not based on the assessment of controllable variables by which to compare outcomes (Kuwuyama, 2017; Maemura et al., 2017). Additionally, attempts to measure the impact of digital repositories are stymied by the lack of “a common language to overcome domain-specific methods and terminology” (Austin et al., 2015, p. 28).

To address the above-mentioned challenges, we explore the use of knowledge discovery techniques, including natural language processing (NLP) and semantic modeling, as a means to derive structured information from raw text and figures found in the CoreTrustSeal (CTS) certification self-audit documents. Transformations of the document text using topic modeling revealed some interesting discoveries about changes in the corpus over time, but did not offer much help in discerning patterns related to the impacts achieved by the repositories. A close reading of the audit documents shows that many of the impacts that have the broadest implications are often obscured by the domain-specific context. Without knowledge of how that community ascribes value to data, it is difficult to understand what type of impact may be implied by the rules and procedures implemented by a repository in response to the particular needs of that community.

We argue that there is value in producing a more readily quantifiable overview of how CTS-required digital stewardship activities map to impacts, communities, and different types of trust. For example, our work could complement re3data.org and the FAIR principles (Wilkinson et al., 2016), both of which provide structured vocabularies for digital stewardship, by facilitating the structuring and collection of information to answer questions about which of a repository’s activities have what type of impact on which communities.

METHODS

Our approach to building a TDR Impacts taxonomy, which is currently a work-in-progress, involves the use of iterative and incremental development. Our target use-case is to represent queries about relations connecting data management activities with impacts that represent the solution to a problem or goal belonging to a community or member of a community (Newell & Simon, 1972). Thus far, we have used the knowledge representation language Web Ontology Language (OWL) to produce a minimal viable prototype (MVP) for a standardized vocabulary capable of expressing the queries and statements specified in the use-case.

Material for the MVP and forthcoming taxonomy of TDR impacts includes the identification of the societal benefits of data repositories as described in the literature on the impact of data on society; the gathering and analysis of information from a representative sample of all TDRs’ activities, practices, and services; and standardization with external knowledge organization schemes.

The first step we took was to create general types for main entities: societal benefits, communities, agents, activities, and information objects. These types form our taxonomy’s foundation of T-Box axioms (i.e., general axioms about “terminology”). We represent the impact of a digital repository’s activities as a predicate relationship connecting a repository and activity with an effect on a community. Our impacts are based on concepts found in the literature about measuring impacts and outcomes for digital repositories (Big Data Interagency Working Group, 2018b; Downs, 2021). Our definition of an “impact” is any individual, named or anonymous, that stands in a “satisfies_goal” relationship to some goal. We applied logical domain constraints to the “impact” class to craft statements that view impacts and outcomes in terms of their constituent elements. We also qualify our “impact” relations with elements derived from an ontology of trust in digital environments, which classifies trust according to two types: trust in belief (i.e., trusting that the data is uncorrupted, statements in the documentation are truthful, etc.) and trust in performance (i.e., trusting that the repository will perform services as claimed) (Huang & Fox, 2006). Also, classes and object properties from the Information Artifact Ontology (IAO), Basic Formal Ontology (BFO), and Relation Ontology (RO) were simplified and adapted for our MVP.

Next, to test the viability of the base categories to address the use-case, we drew from a sample of TDR audit reports because they contain information about their activities, practices, and services. We selected the CTS-certified TDRs

as our corpus to build our taxonomy because they constitute the largest segment of TDRs (i.e., over 100), and they make their audit reports publicly available in English. For the initial phase of this project, where we have developed our MVP, we chose the most recently published CTS certification audit report as of the time of this study, which belonged to the Roper Center for Public Opinion Data, to form A-Box axioms (i.e., “assertional” axioms about the properties of individuals) that capture more specific information about the data management activities and impacts described by this initial sample document. To generate discretely identifiable individuals that may be the subject of A-Box axioms, we used documents that are cited as supporting evidence in the audit report. Individuals are assigned an Internationalized Resource Identifier (IRI); hypertext resolution provides access to the source document. We performed most of the data entry manually, using the graphical ontology editor Protege, as well as some scripts written in Python and Clojure, a Lisp dialect that runs on Java Virtual Machine. Future work on this project will apply this process to each CTS TDR audit report in our data set. With each iteration, we will also work towards revising both T-Box and A-Box axioms, as well as documentation and annotations, based on our own discretion and user feedback.

PRELIMINARY FINDINGS

Our MVP consists of 70 logical axioms, 35 classes, 20 object properties, and 10 named individuals. Figure 1 presents a partial view of the class hierarchy of our MVP, selected to provide a general overview of entities under consideration. Our full MVP dataset and documentation is versioned and stored using git, and can be accessed at: https://gitlab.com/sam_russell/tdr-societal-value-ontology.



Figure 1. Fragment of Trustworthy Digital Repository Impacts Taxonomy MVP

Figure 1 demonstrates how the criteria described in the sets of requirements such as the CoreTrustSeal (CoreTrustSeal Standards and Certification Board, 2019) or the TRUST principles (Lin et al., 2020) can be represented in a formalized manner that could render them more amenable to impact/outcome measurements: machine-readability; disambiguation of terminology; generalization of similar concepts across domains. The orange ellipses (“researcher” and “trustworthy_digital_repository”) contain axioms inferred by the Pellet semantic reasoner. For example, an unintended inference is that a “trustworthy_digital_repository” is also an “impact” because of a T-

Box axiom that asserts a TDR to be equivalent to a “digital_repository” that is the subject of the relation “satisfies_goal” for some “trustworthy_digital_repository_certification,” because of an axiom that asserts the class of “impact” is the domain for the object relation “satisfies_goal.” The semantics of this inference could stand to be cleaned up. It would be more accurate (but more complex) to say that some intermediate object or event (e.g., “certification process”) is what satisfies the goal of becoming a TDR. On the other hand, another axiom assertion, based on the goal-subgoal problem-solving heuristic, is that the range of an impact is a goal, which makes it satisfiable that a TDR, as an impact, can be a solution for at least some goal or problem. Regardless of whether a TDR *is* an impact or *has* an impact, we think that use and development of our taxonomy has the potential to uncover shared or transitive facets that could be used to measure impacts. We expect that when information about the subsequent individual repository instances (including relations about discipline/domain area and affiliations with other organizations) is brought into the knowledge graph, we will be able to use graph analysis techniques to fulfil queries about the participation of digital repositories in certain activities and organizations.

DISCUSSION & IMPLICATIONS

Preliminary findings from the application of our MVP to a TDR audit report suggest that when digital repositories achieve socially beneficial impacts, stakeholders tend to rely on trust in performance more often in relation to the expected impact or outcome. This corresponds with findings from prior studies where their participants based their trust in digital repositories more on organizational and social factors such as transparency and institutional reputation (performance) than they did on their trust in the data itself (belief) (Yakel et al., 2013). Our findings also highlight the importance of trust in the use of data in decision-making and problem-solving activities that have societal value, especially in areas such as reaching marginalized or uncounted groups (Virapongse et al., 2020).

But trust should not be unfounded, so precise and accurate assessment techniques are important means by which digital repositories can build and sustain trusting relationships with stakeholders. Maemura et al. (2017) questions how much empirical evidence is available to justify the “success stories” and “best practices” which often feature in repository assessments and applications, and suggests that a greater degree of structure may increase the rigor and validity of assessments. Having experimented with different knowledge discovery techniques to try to capture information about impacts from assessment documents, we think that increased structure would offer the following possible benefits to repositories and stakeholders:

1. Helping repositories make the case to stakeholders and funders that the services they perform are more than generic Information Technology functions such as storage and backup.
2. Aiding in the development of tools and knowledge bases that may help researchers to connect with digital stewardship services.
3. Allowing repositories to optimize their infrastructure and services by having a greater knowledge of the means by which they can generate societal value with their collections.

To implement the recommendations of the Big Data Interagency Working Group (2018a) to “collect and organize information on the scientific, social, and economic impacts of data repositories” and to establish community consensus, we argue that it will be necessary to develop structured representations of activities, impacts, and communities (p. 3).

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Perceived Usability and Experience with Digital Tools in the Context of Digital Humanities Research

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ABSTRACT

This paper examines differences in the user feedback of scholars with varied experience with digital tools. As part of a usability study of a historical digital collection, our team conducted semi-structured interviews with scholars with varying backgrounds. We categorized the sample into two groups, one with significant experience and one with little experience in using digital technology. Qualitative analysis of the interview data showed that users generally provided similar feedback. However, there were instances in which those with significant experience provided more design suggestions, and those with less experience expressed confusion and provided more feedback on website content. Drawing upon our findings, we provide recommendations for the usability evaluation of historical digital collections.

KEYWORDS

Usability testing; digital humanities; qualitative research; user experience; work practice.

INTRODUCTION

In recent years, the importance of user research has become increasingly recognized in the digital humanities (DH). Warwick (2012) emphasized the importance of user studies in digital humanities contexts, Gibbs and Owens (2012) recommended user-centered design to scholarly software designers, and Given and Willson (2018) studied the diverse research practices of humanities scholars and provided recommendations for digital tool design. Archival projects also aim to understand a diverse user base and develop systems and tools to suit these needs (Gueguen, 2010). However, despite significant attention and investment in DH development, a “research-practice gap” is widely acknowledged, resulting in the low adoption of DH tools and methods in pedagogy and scholarship (Hirsch, 2012; Gibbs & Owens, 2012; Clement & Carter, 2017). Moreover, the development of DH infrastructure and tools still suffers from a lack of a unified approach and generally poor user experience (Thoden et al., 2017).

When it comes to DH, as with any other type of tool or platform featuring a human interface, the question arises whether users with different levels of experience and familiarity with technology might have different usability perceptions. This question is particularly important in the digital humanities due to the engagement of scholars who work with a variety of source material, some physical and others digital.

Much of the usability literature employs quantitative measures of task performance, with experienced or expert users generally accomplishing usability tasks faster than novice users (Dillon & Song, 1997; Ooms et al., 2012; Tüzün et al., 2016). The question of how task performance and interaction experiences differ based on user groups has been addressed by Tang et al. (2018), who reported differences between broadcast and information professionals, archivists/librarians, and other staff, and those with a library and information science (LIS) degree and those without. Reading preferences may also affect users’ search behaviors (Anna & Pertti, 2017). However, to our knowledge, the role that experience with digital tools plays in usability perceptions has yet to be examined in the context of tool use in digital humanities research. In this study, we report the results of a task-based usability study and examine differences in users’ perspectives of a historical digital collection based on their familiarity with digital tools.

METHODOLOGY

This usability study focused on a digitized collection of personal diaries and travel journals written at the turn of the nineteenth century. This project, the Svoboda Diaries Project (<http://www.svobodadiariesproject.org/>), works to preserve historical diaries that capture over 40 years of life, politics, and landscape of Ottoman Iraq. The project employs a user-centered approach including iterative design cycles and usability evaluation, to develop a website enabling users to explore this historical material (Chen et al., 2019).

This study uses data from one cycle of usability testing which included both humanities scholars and DH researchers to diversify stakeholder input. We conducted semi-structured interviews with two parts: 1) participant characteristics, including their background, related work, and experience with physical and digital resources; and 2) a task-based usability session. We employed a common technique in usability evaluation (Jaspers, 2009), the “think aloud,” in which participants were asked to “think aloud” as they performed tasks on the website.

We asked participants to interact with two website features: the diary viewer and the timeline. The diary viewer enables readers to view scanned diary pages side-by-side with text transcriptions (Figure 1, left). At the time of the study, the two sides scrolled separately with no option to synchronize them. The timeline highlights important events in the diaries, divided into six categories (e.g., Family/Personal, Epidemic) (Figure 1, right). Selecting an event displays the date, a “headline” describing the event, a quote from the diary or an event summary, and an image.

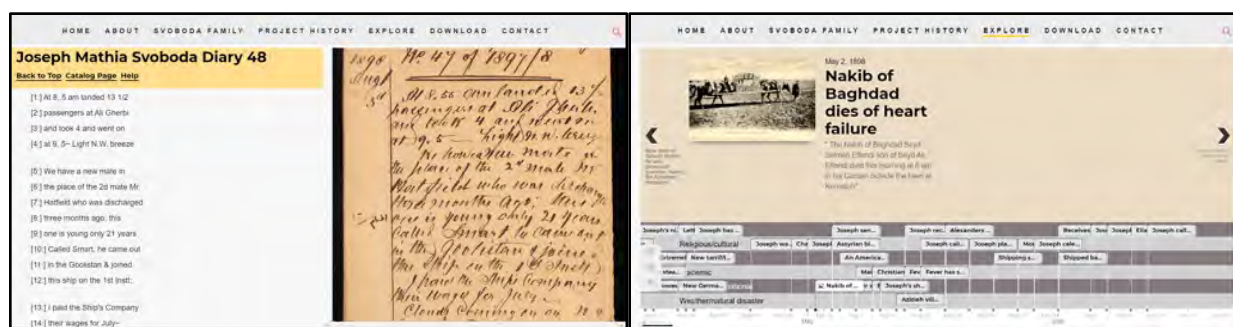


Figure 1. Diary Viewer (left). Timeline (right).

Participants were first asked to explore the website and find their way to the diary viewer and timeline from the landing page. With the diary viewer, participants were asked to engage in a number of open-ended tasks in which they were asked to browse the diaries and locate a few specific entries. Participants were asked to perform both closed-ended and open-ended tasks with the timeline: to find a number of specific events, and to find an event of interest and then navigate to the related passage in the diary viewer.

Interviews were recorded, transcribed verbatim, and then analyzed using a general inductive approach (Saldaña, 2009). Two coders independently identified themes, or codes, in the data, resolved discrepancies by consensus, and refined the coding scheme over successive iterations of coding. The coding schema included the categories of user background, user practices, overall experience, website navigation, usability testing, feedback on other website sections, and potential site uses. Qualitative data analysis was performed using Dedoose (Salmona et al., 2019).

In total we interviewed nine scholars, but one participant did not perform the usability test due to lack of time (N=8). To explore the role of digital experience in usability perceptions, we divided our sample into two groups, participants with significant experience with digital tools and/or digital humanities projects (n=4), and those without such experience who primarily used physical resources and standard software (n=4). While experience with digital tools might broadly be construed as “digital literacy,” we observe that the term has multiple meanings (Buckingham, 2006; Lankshear & Knobel, 2015), and in this study, we choose to use the term “experience.” We compared the responses of those with significant and limited digital experience by nature and frequency. There is substantive variation of sample size in qualitative information systems research (Marshall et al., 2013). In this study, our goal was not to achieve thematic saturation or provide a definitive answer as to whether or not there would be differences in feedback; rather, we sought to provide audibility (Sandelowski, 1986) and transparency in the comparison of the two groups.

RESULTS

Sample and General Site Experience

Our participants came from eight universities in the United States and Greece. The sample was diverse in terms of seniority, research area, and research practice (Table 1). We assigned each participant an experience level with digital tools based on their work and research practices, according to the criteria described in the Methods section.

All users seemed satisfied with the site overall and stated they would use the tool as a teaching resource. They praised the academic value of the digitized material and its pedagogical potential in textual analysis and archival work. One user with significant experience said that the site made the source material easier and more appealing to use, and two users from each category praised the site’s look and feel. Overall, users with significant experience tended to praise more aspects of the site than users with limited experience. Though most users had no difficulties with navigation (n=5), a few had difficulties locating the diary viewer. Some users provided suggestions to improve

navigability (e.g., making certain features more obvious); most of these suggestions came from users with limited experience.

ID	Experience	Title/Position	Research areas	Work and research practices
1	Limited	Associate professor	16th century Ottoman Empire (literature), modern Turkish literature	Does not employ many digital tools
2	Limited	Professor	Modern Middle Eastern and North African studies	Mostly physical sources in archives
3	Limited	Assistant professor	Environmental/disease history of Ottoman Empire	Physical archives; little/no use of digital resources
4	Limited	Doctoral candidate/instructor	Late 19th century Ottoman Empire, modern Middle East	Scanned PDFs and images of archival materials
5	Significant	Managing director of a DH lab	Increasing accessibility of digital image/text collections	Use of digital data and Omeka/Voyant in teaching
6	Significant	Digital humanities librarian	Information science, digital humanities	Literature reviews using electronic journals/literature
7	Significant	Assistant professor	Social and environmental history of Ottoman Empire, 19th-20th century	Searchable digitized archival collections
8	Significant	Teaching fellow	Mapping projects related to Ottoman Empire	GIS tools and location/relationship databases

Table 1. Participant Characteristics

Diary Viewer

Feedback on the diary viewer centered on three themes: source-transcription dual view, navigation, and informational blurbs. Most users appreciated having both the original diary images and transcriptions. Opinions of the independent scrolling were mixed, with most users preferring simultaneous scrolling of the diary images and transcriptions. Two users representing each experience level opposed the use of separate scrolling, but the nature of their remarks differed. The users with significant experience seemed to understand the scrolling but felt it unintuitive, while the users with limited experience found it confusing. Two users, one with limited experience and one with significant, said they liked the separate scrolling, though the user with significant experience felt it warranted additional instructions. Four users, two from each category, noted that finding dates was inconvenient. Of those who commented on navigation, only two with significant experience offered suggestions to fix them. Participants were asked about their design preferences for informational blurbs to accompany the text. Many participants preferred explanatory text to appear based on user interaction, but opinions evenly split between appearing on hover-over and click.

Timeline

Compared to the diary viewer, opinions on the timeline were less positive and more diverse. Five users representing both experience levels reported difficulties understanding or using the timeline. Two users with significant experience felt it was not user friendly, whereas two with limited experience felt its purpose was unclear and suggested adding explanatory text. Users with less experience tended to make more suggestions about timeline content or the need for clarification, while users with more experience tended to make higher-level design suggestions to improve systematicity, such as providing timelines for each category and adding a standardized list of events.

All users considered the timeline cluttered, with many commenting that overlap between event bubbles (Figure 1, right) made it difficult to find specific ones. Two users with significant experience suggested creating separate timelines for each category or including the option to filter by category to alleviate this issue. The categories seemed to generally be useful; five users representing both experience levels mentioned the categories could be used to find certain events. A user with significant experience suggested simplifying the categories to make them easier to use; another user with significant experience, however, suggested further subdividing each category. The lack of a search feature within the timeline was also a concern, mostly from users with significant experience.

DISCUSSION

In this paper, we presented a usability study of a website enabling users to engage in multi-modal exploration of digitized historical material. Participants appreciated the website's visual appeal and features, but they also raised various usability concerns, particularly having to do with clarity. Opinions were divided on some issues, including the utility of enabling separate scrolling of digitized diary images and transcription text and the level of detail of the

timeline. We have addressed issues that were raised by augmenting our usage instructions, adding simultaneous scrolling capabilities to the diary viewer, and pruning events in the timeline.

We explored the influence of experience with digital tools on the feedback that participants provided in usability testing. Overall, similar themes emerged; however, there were differences in the nature of the feedback. Users with significant experience in digital tools or in DH tended to provide more high-level design suggestions; the users with less experience often provided valuable feedback about areas that they found confusing or thought should be clarified. Balancing their needs and perspectives can be important in usability evaluation.

Task performance and user experience can vary due to education, training background, and expertise (Tang et al., 2018). In many cases, experts may perform a task faster than novices, but differences may not be observed in terms of task accuracy, and graphical representations can reduce effort (Dillon & Song, 1997). Thus, the effect of participant characteristics can be task-specific. Our findings contribute to existing usability literature by providing examples of usability considerations with particular tasks, the study of manuscripts and the temporal event exploration, that are important in historical research. Engaging teachers in the development of cultural heritage collections can facilitate collection access and ensure that information needs are met (Pattueli, 2011). However, the more divisive opinions on the timeline suggest that there is not always a straightforward answer to the question of which implementation is best. Engaging diverse stakeholders can expose and facilitate decision making about design tensions.

We would like to propose a few recommendations for user experience interview research in DH contexts. First, an opening discussion of users' work and research practice can inform subsequent usability testing. We began the interview with an exploration of participants' routines, including their use of physical or digital resources, which was particularly pertinent to this study. This discussion, coupled with the think-aloud protocol, afforded greater insight into how users' work practice and perspectives were related. While this exploration took additional interview time, in the digital humanities where interdisciplinary collaboration is so important (Given & Willson, 2018; Poole, 2017), incorporating content about work practices not only establishes rapport with the interviewee and context for interpretation of suggestions in usability testing, but may also foster future collaboration. This might be seen as a variation on the use of contextual interviews to inform early design, which has been recommended in the development of DH projects (Heuwing et al., 2016). Second, given the highly contextualized nature of work practice in humanities research, diversity of participants in usability testing is particularly important. Despite our limited sample size, we recruited a sample that varied on the pertinent dimensions of experience of digital tools and subject matter expertise. Doing so enabled us to engage in collaborative brainstorming with interviewees in complementary ways.

This study has various limitations. Aside from the limited sample size, we focused on persons engaged in scholarly work. Users of DH websites can have varied motivations, including personal use, school assignments, and storytelling (Muiser et al., 2018). In the future, there is a need for larger-scale studies of the effects of user background on the use experience of DH websites. In addition, in this study we dichotomized digital experience into two categories, significant and limited. However, just as there are many ways that we might think of digital literacy (Lankshear & Knobel, 2015), digital experience can be multi-dimensional, e.g., a person can have experience with some digital technologies but not others, have experience with geospatial mapping software but not have experience with design decisions, and so on. Viewing persons as belonging to certain categories, e.g., technologist, subject matter expert, and so on can result in a biased interpretation of what oneself or others have to offer. Thus, in the use of categories for sampling, keeping in mind that digital experience as well as other forms of expertise can be multi-faceted is important.

CONCLUSION

This qualitative study explored the question of how variation in familiarity with digital tools might influence the feedback from a usability study. Our study adds to the existing literature by offering nuanced insights on how experience may affect user perceptions, albeit in a small sample, and provides recommendations for the integration of diverse user backgrounds and work practices in usability research in the context of digital humanities research.

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#StopAsianHate: Archiving and Analyzing Twitter Discourse in the Wake of the 2021 Atlanta Spa Shootings

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ABSTRACT

On March 16, 2021, six Asian women were killed in Atlanta, US, possibly out of racist motivations. This tragic event, now known as the 2021 Atlanta Spa Shootings, precipitated a massive increase in the volume of counter-anti-Asian declarations and discussion on social media platforms such as Twitter. In a pilot study to chronicle and profile public opinions, social movements and patterns in the global Twitter discourse we scraped the Twitter API using the query term “StopAsianHate”, obtaining more than 5.5 million tweets and their metadata. By using social movement analytical frameworks to analyze traffic peaks and the use of hashtags, we identified a set of more than 300 frequently used hashtags that can serve as specific query words in future archival ingest activities, as well as the dimensions of and current problems with this social movement. This suggests the utility of this approach for both archiving applications and social-political analyses of emerging topics and concerns.

KEYWORDS

2021 Atlanta Spa Shootings, Anti-Asian Hate, Social Media Archive, Social Movement Archive, Twitter.

INTRODUCTION

Since the outbreak of the COVID-19 global pandemic, anti-Asian hate speech and hate crimes, both online and in local communities, have surged globally (Fan et al., 2020; Gover et al., 2020; Ziems et al., 2020). On March 16, 2021, six Asian women were killed in the Atlanta Spa Shootings, leading to an unprecedented wave of counter-anti-Asian public protests and online activism. One of the most frequently used hashtags on Twitter has been “#StopAsianHate”, clearly advocating for an end to anti-Asian sentiments (Cost, 2021). Historically, given the minority status of Asians and Asian Americans in the US, efforts to address anti-Asian hate crimes have not been under-documented. In the Web 2.0 era, it has become much easier to express opinions and organize social movements online, as well as to discern opinion trends. Archivists and researchers have been working together to create open access social media archives that can be used to document and analyze these trends and movements, especially after notable incidents (Chen et al., 2020; Jules, 2020). To document and better analyze the dimensions and problems of such online discourse, between March 17 and April 5, 2021, we scraped the Twitter API using the keyword “StopAsianHate”, archiving the resulting tweets and their metadata in the Counter-anti-Asian Hate Twitter Archive (CAAHTA, which is publicly available on <https://github.com/lizhouf/CAAHTA>) (Twitter, 2021). In this paper, we present an initial empirical analysis of the #StopAsianHate discourse captured in this archive, focusing on traffic peaks as well as the dimensions of the rising #StopAsianHate social movement that are perceivable through the use of hashtags. We hope that this study on counter-anti-Asian social movements and Twitter discourse will both encourage more such archiving and analytical approaches and attract more research on this emerging social-political issue.

METHODS

Data Collection and Preprocessing: the Counter-anti-Asian Hate Twitter Archive (CAAHTA)

At the time of submission of this paper the archive contained 5,510,824 tweets, although we are still actively collecting tweets into CAAHTA. To support our analysis, we preprocess both text and location metadata. We first normalize text contained in hashtags by changing all characters to lowercase. We then use the *carmen* Python package’s geocoding tools and extract location information, in this case, for 974,509 tweets from 186 countries (Dredze et al., 2013).

Analytical Method: Categorizing Hashtag Activism apropos of Dimensions of Social Movements

Hashtag Activism is a social media phenomenon where the intensive use of a single or a group of related hashtags is used to build up public support on social media for affirmative social-political changes (Goswami, 2018; Moe 2021). We perform a close reading to categorize Hashtag Activism in the #StopAsianHate social movement. Applying Reuning and Banazak’s analytical framework for social movement phenomena (2019), we use three dimensions, *Advocating Action*, *Influencing Narrative Change*, and *Building Identity*, to summarize the functionality

of hashtags at a high level. We then group hashtags under these dimensions and apply 10 categories within these dimensions to enable further empirical analysis. We divide the *Advocating Action* dimension into two categories: advocating for specific actions (“Specific Advocate”) and overarching advocacy slogans (“General Advocate”), and categorize the *Influencing Narrative Change* dimension into social influencers with Asian origins (“AAPI Influencer”) and social influencers other than those with Asian origins (“General Influencer”). For the *Building Identity* dimension, there are six ontological categories covering frequently mentioned concepts and incidents related to the unfolding social movement. All these lexicon resources help build consciousness and public awareness of the core identity shared by people in the social movement.

These dimensions and categories, together with their chronological information, can clearly indicate the concentration of topics on Twitter over time. We believe the categories are also crucial to identifying the details of who speaks up and what drives the evolving social movement. To better illustrate the criteria for categorization, as Table 1 indicates, we provide specific hashtags as examples under each dimension and category.

Dimensions	Categories	Example Hashtags
<i>Advocating Action</i>	Specific Advocate	#racismisnotcomedy, #gofundme, #apologize_to_bts
	General Advocate	#stopasianhate, #stopaapihate, #stopasianhatecrimes
<i>Influencing Narrative Change</i>	AAPI Influencer	#got7, #bts, #teamwang
	General Influencer	#tachaspeaks, #mlk, #biden
<i>Building Identity</i>	Related Racial	#asianamericans, #asiancorpsetwday, #filipino
	Related Hate Inequality	#racism, #whiteprivilege, #chinesevirus
	Related Movement	#blacklivesmatter, #metoo, #guncontrol
	Related Entity	#wtpblue, #117thcongress, #tiktok
	Related Event	#greencardbacklog, #covid19, #toppsracist
	Related Place	#atlanta, #dcprotests, #atlantaspas

Table 1. Dimensions and Categories for Analyzing Social Movement Hashtags

ANALYTICAL RESULTS

Domestic and Global: Drivers of the Spikes in the #StopAsianHate Volume

Given the speed with which online information is propagated, and the internationality of the topic, the “#StopAsianHate” social movement quickly received global attention. In particular, we observe a change of volume of this topic on Twitter in the US and in other countries. As shown in Figure 1(a), the longitudinal trend of the global volume (Others) closely resembles the trend of the domestic volume (US), while the daily changing rates are different. By analyzing the spikes in tweets, together with key incidents, we seek to further understand the relationship between the domestic and global Twitter discourse.



Figure 1. Domestic and Global Volumes on Twitter through Time with Related Trending Events

Note: Event A - 2021 Atlanta Spa Shootings; Event B - Lee Wang revealed scars in a town hall meeting; Event C - Nationwide “Stop Anti-Asian Protests”; Event D - BTS advocated for #StopAsianHate

We first identify the individual spikes. We observe two significant spikes in the US volume on March 27 and 30, and three spikes for other countries on March 18, 27 and 30. To understand these spikes, we search for key events occurring around those dates and find four relevant incidents: Event A, the Atlanta Spa Shootings, precipitated all

subsequent social movements; Event B (Figure 1(b)), 20-year veteran and Asian American elected official Lee Wong revealing the scars he sustained during his services in the US military, was watched by three million people on Twitter (O'Kane, 2021); Event C, the nationwide “Stop Anti-Asian Protests”, attracted thousands of people to rally and led to further visibility of the #StopAsianHate movement (GARDAWORLD, 2021; Wion Web Team, 2021); Event D (Figure 1(c)), the popular South Korean boy band BTS advocating for “#StopAsianHate” on Twitter on March 26 resulted in tweets containing “BTS” that accounted for over 40% of all tweets on “#StopAsianHate” the next day. From these events, we observe the huge impact of influencers, both in the US and in other countries, who play vital roles in promoting the social movement.

By further analyzing these traffic peaks in relation to the key events through the timeline, we confirm that the online discussions from the US and other countries are reciprocal. On March 27, a day after posts about Lee Wong (Event B) and news about nationwide “Stop Anti-Asian Protests” (Event C) went trending, there is a local spike in the volume of tweets from the US. At the same time, there is also a noticeable spike in tweets from other countries. On March 30, when the official account of the South Korean boy band BTS tweeted using the “#StopAsianHate” hashtag, there is a similar local spike in US tweets. In both examples, we observe the interplay between the domestic and global online discussions of “#StopAsianHate”.

Hashtag Activism: Dimensions of the #StopAsianHate Social Movement

The strategic use of hashtags with different functionalities can effectively advance organizational and advocacy messaging (Saxton et al., 2015). Thus, we conduct close reading of the 315 most frequently occurring hashtags in seven languages to identify their topical functionalities. Since these top hashtags have appeared more than 6.5 million times and comprise more than 96% of the total hashtag occurrences, we are confident that they are representative of the hashtags of the whole archive.

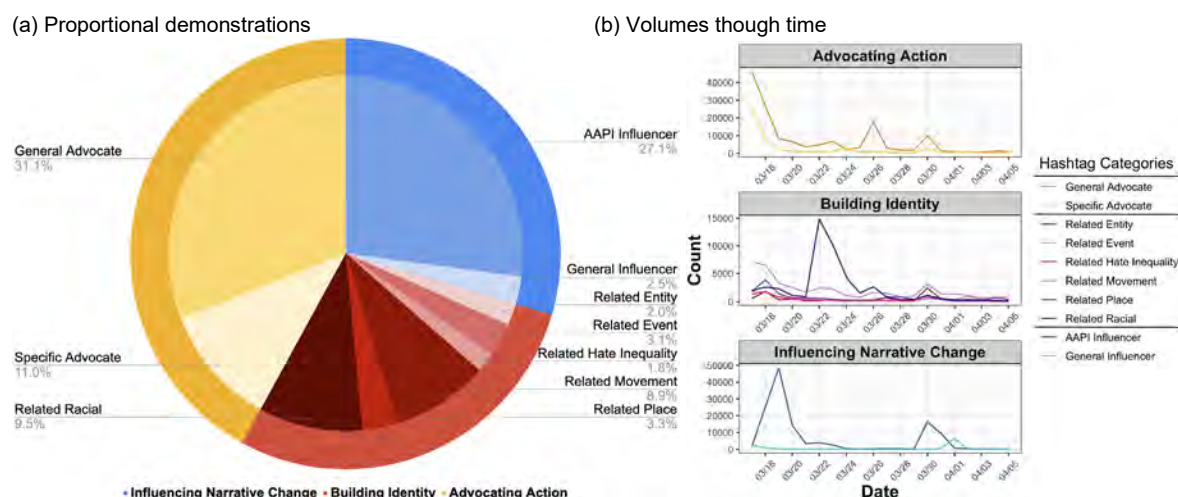


Figure 2. Discourse of Top Hashtags through Time by Dimensions and Categories

Note: Hashtags with more than 200 counts are included and with more than 100,000 counts are excluded

Using the dimensions and categories of the top hashtags, we further analyze the #StopAsianHate social movement from the perspectives of *Advocating Action*, *Influencing Narrative Change* and *Building Identity*. In general, as Figure 2(a) shows, after removing the thematic hashtags “#stopasianhate”, “#stopaapihate” and “#stopasianhatecrimes”, we see diverse discourse relating to all three dimensions. The composition of higher-level topics confirms that the online discussion has rapidly become Hashtag Activism with the coverage of all three dimensions of hashtags, revealing the development of the unprecedented #StopAsianHate social movement.

When it comes to the specific categories, the general slogans (“General Advocate”) and AAPI influencers (“AAPI Influencer”) are dominant in their dimensions. These two findings, together with the counts of the related categories through time, individually identify the current problems of activism from the perspectives of the *Advocating Action* and *Influencing Narrative Change* dimensions. For the *Advocating Action* dimension, as both proportion comparisons in Figure 2(a) and the top graph in Figure 2(b) show, we can clearly see the “General Advocate” category has much more discourse than the “Specific Advocate” category, both for the overall proportion (31% versus 11%) and in almost every daily volume (except for March 24). This trend shows less-specific advocating for functional hashtags such as “#gofundme”, which advocates for fundraising for survivors of anti-Asian hate crimes, or “#racismisnotcomedy”, which responds to a specific type of anti-Asian hate speech. For the *Influencing Narrative*

Change dimension, as shown by the bottom graph of Figure 2(b), the volumes are out of balance across the two categories. While the #StopAsianHate social movement targets hate crimes and calls for equity, like many preceding movements, it attracts less and delayed mainstream attention: in the bottom graph of Figure 2(b), the spike for the “General Influencer” group occurs two weeks after the shootings.

Finally, as the middle graph of Figure 2(b) shows, the discourse through time of the six categories in the *Building Identity* dimension helps summarize this process. At the beginning, from March 17 to March 20, the “Related Place” and the “Related Movement” categories are of higher volumes, which demonstrate the realizing or defining phase of the social movement: the larger volumes of place hashtags (e.g., “#atlanta”) report the fact of the shootings; and hashtags of other social movements (e.g., #BlackLiveMatters”) analogize the significance and attributes of these movements. For the rest of the first 10 days after the shootings, we observe the spike in the “Related Racial” category, which includes vocalization from related racial groups (e.g., “#asianamericans”) and racial subgroups (e.g., “#filipino”), and culturally specific activities (e.g., “#asiancorpssetwtday”). From March 27 to April 5, we see diverse use of all hashtags with an emphasis on the “Related Entities” (e.g., “#117thcongress”) and “Related Event” (e.g., “covid19”) categories. This trend shows a general to specific order of discussion around identity building, which includes not only the manifesto of the minority group of Asians and Asian Americans but also general social-political entities and events in the US and other countries.

CONCLUSION

By analyzing the tweets and related metadata in CAAHTA, we note an intensive amount of online discussion about the #StopAsianHate social movement on Twitter, where people in the US have been able to voice their anger and condemn anti-Asian sentiment online in reaction to the 2021 Atlanta Spa Shootings. When the volume of such voices is high, the domestic incidents quickly begin to have a global impact, and opinions and influencers from other countries in turn influence such online conversations, including those in the US. From an archival perspective, we are now more familiar with the novel domain of counter-anti-Asian social movements, as well as similar events, increasing our confidence in identifying an inclusive set of queries to be used when archiving similar topics moving forward. Through the process of identity-building, especially for crisis events, the use of hashtags, which is the main source of query words, starts with, and is accelerated by, awareness-raising about the incident itself. The mentions of related social movements, related geopolitical locations, and related racial groups are then brought into the broader discussions. Finally, the related entities and events become popular hashtags. From a social-political perspective, we now have a clearer picture of related social media influencers and public education organizations that want to advocate for racial equity and end anti-Asian hate crimes. We can also observe some potential limitations in the current #StopAsianHate social movement. For example, some advocating hashtags are general slogans while specific functional actions are less common; and participants in the movement, especially the influencers, primarily have Asian racial origins, suggesting that the movement may be lacking diversity in its composition.

LIMITATIONS AND FUTURE WORK

Finally, we note a few technological and methodological limitations with our analysis to date. First, our current #StopAsianHate archive is limited by the scraping rate of the Twitter API, which is approximately 1%. Although the extracted sample is representative, the archive is not exhaustive and thus some hashtags and trends might not be fully covered in the analysis. Second, to ensure the timeliness of our analysis, the categorization of hashtags has been undertaken by only one of the researchers and the analytical methods are empirical, which may introduce a certain bias into the analysis. In terms of future work, we will continue building CAAHTA and expand our analyses. Specifically, we plan to apply statistical methods and text mining tools to quantify the spikes in volume and analyze the topics of discourse. Additionally, we aim to cross-reference CAAHTA with news reports to understand the relationship between the discourse on social media platforms and traditional media coverage.

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“Meaning in the present”: Understanding Sustainability for Digital Community Collections

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ABSTRACT

Living independently of mainstream institutions, digital community archives and digital humanities collections confront systemic barriers to medium- and long-term viability. Their sustainability tends to be undermined by shifts in technologies, resources, and communities over time. Because these collections contain irreplaceable and invaluable evidence of communities and histories that are underrepresented in cultural institutions, their fragility compromises the completeness and equity of our collective digital heritage. Partnerships between institutions and community-based collections often founder over a lack of shared understanding: of the expertise each partner brings to the table, of the scope and extent of mutual commitments, and of what sustainability even entails for a given project. This paper reports preliminary outcomes of a case study of the *Lakeland Digital Archive*, exploring how Lakeland’s community understands *sustainability* in the context of their digital archive, as part of a broader study of community-centered sustainability strategies for digital collections.

KEYWORDS

Sustainability; digital preservation; digital community archives; digital humanities; cultural heritage.

INTRODUCTION

A vibrant, scattered profusion of curated cultural collections live outside of libraries, archives, and museums. Independent digital humanities projects and digital community archiving initiatives provide unique or original evidence of groups and histories that are underrepresented in mainstream institutions. Without institutional backing, these collections also confront major barriers to medium- and long-term viability as the underlying technologies and the surrounding communities themselves shift over time. The vulnerability of digital, community-centered collections undermines the completeness and equity of our collective memory. Sustainability efforts and partnerships often founder on a lack of shared understanding: of available expertise (e.g., Flinn, 2011), of necessary commitments, and of what sustainability entails for a given project.

This paper focuses on this last, transcendent problem: within and between communities and institutions, the term *sustainability* bears nebulous, sometimes conflicting meanings, thwarting conversation and progress toward shared solutions. We report preliminary outcomes of a case study of one digital community archive, the *Lakeland Digital Archive*, described below. This case study is part of “Communities Sustaining Digital Collections,” which is investigating how communities in various contexts interpret and implement sustainability strategies that foreground community ownership, needs, and values. A comparative, multi-case study of digital community archives and digital humanities collections, this project aims to identify community-centered sustainability strategies for digital collections living outside of cultural institutions. This paper takes a step toward that objective by exploring how participants understand sustainability for their archive.

Lakeland Digital Archive

Lakeland is a 130-year-old African American community adjacent to the University of Maryland (UMD) in College Park, near Washington, D.C. Under urban renewal in the 1960s, much of the neighborhood’s landscape was demolished, displacing nearly two-thirds of residents. For the past decade, Lakelanders—historical and current residents and their descendants—have worked to collect and preserve their history. The Lakeland Community Heritage Project (LCHP), a small organization of volunteers at the core of this effort, has gathered thousands of historical records from the community, along with oral histories and other documentation. In 2018, building on an

existing community-university research relationship, LCHP embarked on a partnership with the Maryland Institute for Technology in the Humanities, along with faculty and students in UMD's American Studies department and College of Information Sciences, to prototype a digital community archive. With a dedicated team of approximately a dozen people (about half from Lakeland and half from UMD), the digital archive is currently in development.

PRIOR WORK

Community archives develop around nuclei of shared identity, memory, and purpose—around localized histories and places, significant events, ethnicities and races, gender identities and sexual orientation, etc. (Welland and Cossham, 2019; Flinn et al., 2009; and others). Digital humanities collections, on the other hand, arise from the curatorial practices of scholars (Poole, 2017; Cooper and Rieger, 2018; Palmer, 2004) and take myriad forms, from digital archives and databases to interactive maps and multimedia monographs. Despite their differences, these broad categories of collection share important characteristics: communities and teams create them to meet their own immediate needs; they often hold original or unique cultural evidence, often of underrepresented groups and histories; they are usually built by small teams of technologists and researchers with sporadic funding; they are often maintained independently of mainstream institutions; and for all these reasons and more they experience significant challenges to long-term viability (Stevens et al., 2010; Flinn, 2011; Smithies et al., 2019; Fenlon, 2020).

While cultural institutions have partnered with community-based digital projects in different capacities, these partnerships remain rare. Community collections resist the most prevalent institutional models of stewardship, in part because their overriding value is autonomy (Flinn, 2011; Zavala et al., 2017). In addition, institutions with both the relevant purview and the capacity for supporting digital community collections are scarce. A growing literature of empirical research on sustainability for community archives has identified an array of factors in and opportunities for sustainability in various contexts (e.g., Lian and Oliver, 2018; Jules, 2019; Froese-Stoddard, 2014; Newman, 2011; Wagner and Bischoff, 2017), including the need for peer support networks for community archives (Caswell et al., 2017) and alternative funding and partnership models for communities and institutions (Stevens et al., 2010). In parallel, a growing set of practical tools and guidance helps communities of all kinds sustain their own digital projects (e.g., Langmead et al., 2018; Skinner, 2018). A widespread challenge for communities that are seeking to sustain their own collections, and a common stumbling block for community/institutional partnerships, is the lack of shared understanding of the precise definitions, entailments, and implications of *sustainability* in the realm of digital cultural collections (e.g., Eschenfelder et al., 2016): how do the requirements of sociotechnical maintenance and preservation vary across contexts, and what facets of sustainment are absent from our usual discourse? Our work aims to expand on prior work through empirical investigation of how communities variously understand *sustainability* in the context of digital collections.

METHODS

This case is one of a set of comparative case studies of community-based projects. Evidence sources in each case include interviews, participant-observation, and documentation (e.g., Slack spaces, technical documentation, and meeting notes). We are currently continuing data collection on all cases in parallel with iterative cross-case analysis. Interview transcriptions and observational memos are subject to qualitative content analysis, based on a coding scheme developed inductively in correspondence with research questions. All interviews were independently coded by three coders, who then discussed their codes in order to come to consensus. This study has conducted 13 interviews across all cases to date; but this preliminary analysis considers just the 8 interviews that have been conducted in the Lakeland case, with Lakelanders and the archive development team. We have been engaged with this case through interviews and participant-observation in weekly meetings, at digitization workshops, and in other community events since 2019; while the findings are preliminary, they are steeped in substantial experience with the case, resulting in a rich preliminary dataset. In the preliminary outcomes below, participant names and identities are obscured, and participants are referenced by a three-character participant code, e.g., "L01".

PRELIMINARY OUTCOMES

The community is far from monolithic; participants did not express a single, unified vision for the archive's sustainable future, but the visions they articulated have commonalities. The community expects to maintain ownership and control over how the digital archive is represented and contextualized. They hope to grow the archive's collection indefinitely and widen avenues for engagement for broader audiences. They intend to maintain a strong central organization, the LCHP, to speak for the archive and engage its constituents. They seek to leverage the archive as a foundation for active social and political efforts and aim to engage peer communities and institutional partners in different aspects of the archive's sustainability. These preliminary results elaborate how participants understand the sustainability of the archive, in particular how their understanding of sustainability relates to the maintenance and growth of social connections within and beyond the community.

Archive sustainability and community sustainability are inextricable

When asked to articulate their vision for the sustainability of the digital archive, community members tended to foreground the community and its future over the artifact of the archive itself. Most participants described the sustainability of the archive as interwoven with the future of the community in tangible ways. Their understanding of the sustainability of the digital archive does not focus on the mere persistence of the files or web presence, but on community wellbeing and relationships to other communities. Several participants related the archive's sustainability to its capacity for maintaining and nurturing social connections within the community. One participant noted that while the archive served to keep memories alive across generations, the archive alone would not suffice—a socially engaged community surrounding the archive was imperative (L02). The participant clarified that the effort to keep memory alive “wasn’t just about an archive. It was about a whole bunch of people relating around the archive and the organization of LCHP itself” (L02). A few participants described the historical Lakeland community as one vibrant with social interconnections maintained through gatherings and social groups of all kinds. For example, one participant noted: “we had vital lives, we had social lives, and we had our churches, and we had our—then they weren’t called community centers—but we had our social gatherings... we even had juke joints...Everything that the world has, you know, we had as a Black community also” (L03). Another described how one group—the last graduating class of Lakeland’s high school, which was the area school for African American students during segregation—maintained their relationships over 50 years later through trips, reunions, and newsletters, noting “it’s a lot that held us together” (L05). While these social maintenance efforts happened outside of the archive, participants related them to the archive’s purpose. For example, Participant L05 described how LCHP and the archive’s core development group reached out to members of Lakeland’s last class for archival contributions: “the community reached out to us, and we were appreciative of it. ...Having a collection of pictures and artifacts and other items, it made a difference. ...If you know us, you know we have an active group.” (L05).

Connections between the community and the archive’s sustainability extend beyond the maintenance of social ties to other factors in community wellbeing. Several participants related the archive’s sustainability to its potential to serve as a foundation for active political and social efforts, ranging from urban development decisions to racial and restorative justice initiatives. When asked to describe how the archive might become sustainable, one participant (not a Lakelander but a member of the greater College Park community and the archive development team) described how “a sustainable archives...has more meaning in the present, for present action”, specifically observing that the archive’s documentation of the impacts of past transportation, land use patterns, zoning, and development policy standards could helpfully influence decisions about ongoing development in the local area (L04). This participant saw the sustainability of the archive as unfolding through an active role in “resurrecting the original idea of Lakeland,” by informing development efforts to mitigate the effects of physical barriers like high-rise architecture and train tracks, which divided and displaced the original Lakeland community during urban renewal, and which now separate the community from surrounding neighborhoods and local amenities (L04). In the context of a city-wide strategic planning initiative that is currently underway, another participant related the archive to the Lakeland Civic Association’s efforts to bring the community’s voice to bear on the city’s strategic plans. This participant noted that the aim of collecting and preserving the history was in part to provide “a basis for attempting to formulate future plans” (L08). Because of Lakeland’s history, the idea of the archive being sustained as a tool for political and social change focuses on issues of racial equity and justice. The same participant noted that a goal of the archive is, in part, “making sure that past racial inequities are not perpetuated” (L08).

Sustaining the archive helps sustain other communities

From all participants there emerged a notion of the archive as a center or hub for a widening pool of concentric and adjacent communities: not only the historical Lakeland community and its descendants, but current residents and neighboring communities, the University of Maryland, the city of College Park, Route One Corridor communities, etc. Several participants saw the archive’s yet unrealized value for these communities as a sustainability key: “It’s not just Lakeland history, it’s College Park history. And if it’s College Park history, then it’s obviously University of Maryland history as well” (L07). One participant saw the archive as a platform for promoting social causes with benefits beyond Lakeland: the archive’s potential to “keep the idea of racism on the table” would be “a boon to Lakeland as well as to the greater College Park community” (L08). Several participants envisioned the archive as the hub of active outreach. One participant imagined reaching out through the archive to the University community—an “incoming UMD student of color seeing the archive and saying, ‘Okay, let me try to get off-campus housing in this community so I can work closely with them over four years’” (L06). Another indicated that the archive might gain traction toward sustainability through increased connections with other local civic associations through events hosted in Lakeland (L04).

Visibility and impact as sustainability risks

More than one participant expressed the (perhaps counterintuitive) concern that the archive might become too visible or impactful, and thereby undercut its own sustainability. This concern stems from their aspirations for the

archive's contributions to activism, a fear that groups in power will attempt to discredit or silence the archive "because of the light it shines on the harm done to the Lakeland Community" (L06). The quoted participant also acknowledged a contrasting, well established sustainability risk, that "lack of interest and upkeep is always a concern when you have an archive or organization...that's volunteer-run" (L06). Nonetheless, they observed a wax and wane cycle for all things political, including the archive: public interest and support for the archive may wax in times when racial justice initiatives are palatable to powerful institutions or majority groups, but they are prone to wane when politics shift or when majority groups grow fatigued of the issues at stake. Participants expressed concern that the archive might be "swept under the rug" if surrounding communities "might not want to see that every time they go on the College Park website, or drive through Lakeland" (L06).

DISCUSSION AND FUTURE WORK

The community's definitions of *sustainability* are variable and nuanced; and these variations and nuances may bear significant implications for maintenance, preservation, and institutional partnerships. For example, how do maintenance and preservation decisions enable or constrain a community's capacity to leverage their own story as a tool for ongoing decision-making and activist efforts? In addition, each of the partial sustainability measures described above depends on the endurance of an active community around the archive. Such endurance is hardly certain for any community, especially one that has experienced diaspora; this represents another facet of the mutual reinforcement between archive and community sustainability. Future work will tie emergent findings about the meaning and entailments of sustainability to specific technical and organizational implications for community archives, digital humanities projects, and institutional partners.

Participants' conception of archive sustainability—as tightly interwoven with the sustainability of the community itself—is at odds with the prevailing preservation paradigm of institutional collection. While a growing number of voices call for shifts in the ethos and orientation of institutions toward active engagement with external communities (Caswell and Cifor, 2016; Cook 2013; Flinn, 2011), the practice remains uncommon. As communities ranging from historically place-based communities (like Lakeland) to the distributed teams behind academic digital humanities projects engage in conversations about their own sustainability, this work aims to contribute a more nuanced picture of what sustainability means in different contexts. Ongoing data collection and cross-case analysis will examine a broad range of sustainability issues emerging from preliminary outcomes, such as project structures and cultures, workflows, technical implications, and expanding our sense of alternative models of partnership with cultural institutions. By exploring community definitions of *sustainability*, this work aims to help communities set maintenance and preservation priorities for digital collections, articulate their value for partners and funders, and help communities and institutions negotiate equitable partnerships to sustain a more diverse cultural record.

ACKNOWLEDGMENTS

We gratefully acknowledge the generous contributions of our case study partners in this research, including the Lakeland community, the Lakeland Community Heritage Project, and our partners across the University of Maryland. This research is supported by the Andrew W. Mellon Foundation and the Institute of Museum and Library Services (RE-246346-OLS-20).

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Archivists' Information Work Lines: Affective, Information Management, and Hybrid Onsite-Remote Work Performance

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ABSTRACT

This paper is among the first to investigate information work concepts in the archival context. A qualitative case study, it relies on two rounds of semi-structured interviews with information professionals at medical history collections in Philadelphia. These interviews bracketed the six months before and after COVID-19's onset. We analyze three lines of information work that evolved as these archivists shifted the work context to their home environments: affective effort, information management, and hybrid onsite-remote work performance. Findings suggest that tasks such as processing, digitizing, and curating resources (invisible pre-pandemic) and reference services (visible pre-pandemic) overlap in archivists' hybrid onsite-remote work performance during the pandemic. In recognizing the links between archivists' information work and work performance as a holistic approach to studies of the information-intensive archival context, this research has implications for the centrality of work context, purpose, and value in the archival context.

KEYWORDS

Information work; invisible work; archivists; archives; affect.

INTRODUCTION

This paper reports on a qualitative case study in the naturalistic paradigm concerning archivists' information work at medical history collections in Philadelphia. We distinguish work tasks as descriptive and hermeneutic, from work performance, as an individual's use of professional and tacit knowledge both within the work's context and in line with the work's purpose (Byström & Hansen, 2005; Byström & Lloyd, 2012; Huvila, 2008). We focus on how archivists shifted their work contexts from in-person and institutional in 2019 and 2020 to hybrid onsite-remote by the summer of 2020. Inspired by Corbin and Strauss (1988), we draw out three lines of information work. They include affective effort, information management, and hybrid onsite-remote work. Much as IW scholarship portrays liminal spaces of visible and invisible information work, we examine how these three lines of work intersect in processing, digitizing, and curating resources (largely invisible pre-pandemic) and reference services (largely visible pre-pandemic) (Corbin & Strauss, 1988; Dalmer & Huvila, 2019; Hogan & Palmer, 2006; Star & Strauss, 1999). Our data suggests that archivists negotiated visible and invisible work through hybrid onsite-remote work performance that successfully maintained information work and institutional work purposes. This research has implications for recognizing archivists' work performance as holistic and central to work context, purpose, and value in archival settings.

First, we review the literature. Second, we set out our methodological approach. Next, our findings detail the three lines of work, stressing archivists' work performance. Fourth, our discussion interprets findings and scopes limitations. Last, we sum up key points and recommend promising lines of future inquiry.

LITERATURE REVIEW

LIS information behavior (IB) research often centers on understanding users' experiences in relation to information and information systems, foregrounding context as the constitutive differential (Fulton & Henefer, 2018). Whereas IB largely relies on cognitive theory, IW concepts can be used to explore contextual information use more specifically. For example, IW places emphasis on sociality in human information activities as the vehicle of shared knowledge. More pointedly, IW connects sociality and work in terms of life activities, notably with reference to studies of underrecognized, invisible forms of work by persons managing chronic illness along with networks of families, communities, and health professionals (Corbin and Strauss 1988; Dalmer and Huvila 2019; Hogan and Palmer 2006). In the context of chronic illness and the management of information, "work affords a lens that can simultaneously acknowledge the conceptual and mental, and even affective efforts (Dalmer and Huvila, 2019, p. 101). Underpinning many other types of work and often remaining invisible, the work of information management demands time, effort, and resources. It involves the mundane seeking, searching, finding, receiving, sharing,

disseminating, or using information in service of organizing, coordinating, and planning activities (Corbin & Strauss, 1988; Dalmer & Huvila, 2019; Hogan & Palmer, 2006; Huvila et al., 2016). To be effectively managed, information work involves “networking, scouting out, coaching and training, providing and clarifying instructions, distinguishing between needs and wants, [and] searching for people, places, and necessary things” (Corbin & Strauss, 1985, p. 244).

Although IW concepts derive from sociological studies on chronic illness, they are not limited to this context; in particular, IW insights into visible and invisible work merit consideration since information work and information management occur in all aspects of human activity (Huvila, 2008, 2013). The implications of visible and invisible work concepts in IW are to “give voice and recognition to those whose information work may not be known or whose information work may be so commonplace it is unnoticed and undervalued” (Dalmer and Huvila, 2019, p. 104). An inclusive definition of information work encompasses the information worker’s professional training and tacit knowledge in tandem with information activities within and beyond the paid work context, notably self-care, care of others, information management and avoidance, and attendant personal connections (Dalmer & Huvila, 2019; Hogan & Palmer, 2006; Star & Strauss, 1999). Holistic information work, in short, entails information management.

Archivists and other information professionals at medical history collections work with evidential traces that originate in health and medical contexts. These special collections document changing conceptions of wellness, healthcare, and the human body in society (Chaff, 1978; B. L. Craig, 1996; Hannaway, 1999; Lussky, 2005; Matheson, 1995; McPherson, 1996; Novak Gustainis & Evans Letocha, 2015). Traces range widely, from the personal manuscripts of health professionals (doctors, nurses, administrators) to institutional records and medical artifacts; health documentation extends to local practices and alternative medicine (Carson, 1991; B. Craig & Hannah Institute for the History of Medicine, 1990; Hoffman, 2003; McCall & Mix, 1996). Medical history collections preserve records that underpin social memory, interdisciplinary scholarship, and even policy-making; they hold interest for humanities scholars, social scientists, and the public (Hoffman, 2003; McCall & Mix, 1996). The information work of information professionals in this domain directly informs human welfare and planetary sustainability (Martin, 2019, 2020; National Academies of Sciences, Engineering, and Medicine, 2019).

Given that visible and invisible work concepts are integral to an inclusive definition of information work, the IW literature highlights the work context in which work performances embody work purpose(s) (Byström & Hansen, 2005; Byström & Lloyd, 2012; Fulton & Henefer, 2018; Huvila, 2008, 2013). Contextual attributes of a work context are environmental, long-term, and stable; they encompass the material circumstances of work as well as the tacit and explicit knowledge guiding it (Byström & Hansen, 2005). Situational attributes of the work context, by contrast, apply to elements that condition task performance in the work environment: individual attributes related to staff knowledge and available resources in a work setting and may pertain to commonly used techniques (Byström & Hansen, 2005).

While the IW literature has considered work contexts well beyond health and healthcare, few studies have focused on the archives context, and none has investigated medical history collections. Archivists’ performance of information work and information management merits qualitative investigation due to its sociality, complexity, and contemporaneity in providing access to primary sources that originated in health, medical, and related social contexts. The visible and invisible components of this work, in particular, merit study of archivists’ work performance as central to work context and work purpose in archival settings.

METHODS

The paper’s qualitative methods rely on a case study approach situated in the naturalistic paradigm (Lincoln & Guba, 1985; Mellon, 1990; Pickard, 2017; Schwandt & Gates, 2018; Yin, 2009). Geographically bounded by Philadelphia, this case study explores archivists’ information work as a socially complex phenomenon that calls for a human instrument of data collection, inductive reasoning, and emergent research design to foster trustworthiness (Gorman et al., 2005; Lincoln & Guba, 1985; Yin, 2009). We identified the National Library of Medicine Directory of Medical History Collections as an authoritative source for the sample and utilized purposive and snowballing sampling techniques to recruit 11 participants (Atkinson & Flint, 2004; Lincoln & Guba, 1985; Mellon, 1990; Miles et al., 2020). Units of analysis include both individual and groups of information professionals, work settings. Semi-structured interviews are the primary data source, supplemented by documentation (Brinkmann, 2018; Rubin & Rubin, 2005; Weiss, 1994; Wildemuth, 2009). We coded and analyzed fully transcribed interviews in NVivo with Excel and Word software as aids, and applied content analysis techniques to supplementary empirical documentation (Bazeley & Jackson, 2013; Zhang & Wildemuth, 2009). Coding data inductively, per Constructivist Grounded Theory, we integrated a theoretical framework based on IP and IW literature in the secondary coding phase (Miles et al., 2020; Saldaña, 2009; Yin, 2009). Triangulating data types enriches narrative description and along with peer debriefings and member checking, mitigates researcher bias in the findings (Flick, 2018; Gorman et

al., 2005). Findings are transferable according to readers' perception of the study's trustworthiness and applicability to other contexts (Lincoln & Guba, 1985). This paper uses IW literature to focus on a specific area of archivists' information work.

Coincidentally, our two rounds of interviews bracketed the six months before and after COVID-19's onset in Philadelphia. We conducted the first round from November 2019 to March 2020 with 11 participants at six institutional work settings, and the second with nine participants via Zoom in August and September 2020. The on-site visits established rapport with the archivists and acquainted the interviewer (Author 1) with the institutional work setting. The mediated platform yielded context-rich data about participants' home work environments (Deakin & Wakefield, 2014; Lo Iacono et al., 2016; Weller, 2017, p. 613). A juxtaposition of the two interview modes limned visible and invisible work dynamics that tend to elude documentation (Dalmer & Huvila, 2019; Star & Strauss, 1999).

FINDINGS

This paper's theoretical framework encompasses work context, work purpose, and work performance. It inductively grounds these components in data based on semi-structured interviews with archivists and documentary evidence. We highlight work performance by considering three lines of work—*affective*, *information management*, and *hybrid onsite-remote work performance*—participants initiated during quarantine, then developed even as the pandemic wore on and institutional re-openings remained indeterminate. Participants' work purpose is twofold: visible work is largely reference services and forms of outreach such as tours of collections, while invisible work entails processing and collections management. Key to maintaining work purpose during the pandemic, participants' work performance highlighted both affect and information management related dimensions of visible-invisible work.

Affective work line

Affective effort "requires one to induce or suppress feeling in order to sustain the outward countenance that produces the proper state of mind in others" (Hochschild, 2012, p. 7). Defined as "*real work*," affective effort "implies directionality, intention, and effort (Hochschild, 2013, p. 31). Participants coped with personal stress as part of developing remote work performance under quarantine. P05 and P06 at setting 5, for example, waited three months. P05 engaged the interviewer's empathy, relating, "I'm sure your first few weeks in March, when everything shut down, you were kind of like in... in... kind of like...untethered, really, and we kind of felt untethered. Things started syncing into a rhythm probably by the middle of April." Conversely, P10 describes her psychological adjustment, "the transition to working from home took about a month to really get into it. Personally, pre COVID, I worked a lot of hours, but I did no work at home. That's just how I like to compartmentalize things." By August 2020, P06 remarks on the stress of staff reduction and her increased workload, "It's not sustainable to have two full-time staff members in the [special collection], especially when we've been away from the collections for so long and we have so much work to catch up on." In these examples of affective effort, participants' invisible work is integral to information management.

Information management work line

Holistic information work entails information management, as noted above. Once in place, archivists' remote connections eventually enabled them to manage information work much as they did in their institution. P11 comments on working closely with P09, "I report to P09 for the majority of the grant project. We were meeting either once a day or once every other day to talk about work stuff and non-work stuff. So that was really awesome for her to be able to offer that to me [remotely] because that's what we did mostly everyday anyways." P09, for her part, regards management work as labor-intensive: "There was an adjustment to managing everybody from home, making sure everybody was OK, and implementing all the measures that we needed to support their remote environment and keep everybody on track." The information management work line illustrates the time and effort, professional training, and affective work that characterize information work and management concepts. Participants' invisible work involved affective work and information management work lines meld hybrid onsite-remote work line(s).

Hybrid onsite-remote work line(s)

Three examples illustrate participants' work performance as hybrid onsite-remote work line(s). First, reference services preoccupied P01, P05, P06, P08, P09, and P10. P08 anticipated remote reference services even before receiving quarantine notice, "We knew exactly how we were going to tell researchers; we knew how we were going to close everything down, and had some semblance of an idea of what we could work on." As P08 undertakes invisible work to support remote reference services for researchers, affective effort and information management lines of work converge. Invisible work aligns with information management that often remains unrecognized by institutions and employees alike (Dalmer & Huvila, 2019; Hogan & Palmer, 2006; Huvila, 2013; Star & Strauss, 1999).

As a second example, participants concentrated on projects that languished in the hectic office environment. P02 broached work performance in terms of new initiatives supported by institutional leaders, “because of this year with the push for racial justice, I’ve had some high-level talks with leaders on campus to talk about historical things that are painful for people and shameful for institutions. So, we are definitely thinking twice about these things that we didn’t unfortunately focus on before.” Affective effort and hybrid work lines converge in P02’s account of work performance at home and its impact on the institution given the momentum for social justice at information-intensive work contexts.

Online exhibitions comprised a third hybrid onsite-remote work line. Participants responded to increased use of online media by drawing on their previous invisible work of digitizing and curating collections. P05 and P06 created online exhibitions, while P08 uploaded educational materials she had curated for the 1918 influenza centennial. P03 and P10 created interactive online Student Orientation Day presentations during the summer of 2020 from resources digitized previously and never used for this purpose; the archivists had always set up displays in physical booths. Although only 2% of holdings are digitized, P10 noted, “it’s a core 2%.” The invisible work of processing and digitizing resources became visible and valued as archivists developed hybrid onsite-remote lines of information work.

DISCUSSION

In effect, the pandemic compelled participants to convert their homes into workplaces. While under quarantine, they developed resilient information work performances that maintained work purpose outside of the institutional work context. Participants not only continued reference services, but also delved into projects that often had languished in the hectic pre-COVID office environment. They met increased demand for online resources by utilizing resources digitized as part of invisible work. In terms of our theoretical framework, the affective work line enabled recognition of participants’ psychological disorientation at pandemic onset and after staff reductions by late summer, while the information management work line added recognition of invisible layers participants interleaved to support information management routines familiar to staff but now in remote form. The hybrid onsite-remote work line(s) participants developed for reference services, projects challenging to accomplish in the office, and creative forms of online outreach enabled recognition of preparatory invisible work crucial to participants’ work performance.

If a work task is defined by description or hermeneutics, work performance encompasses an individual’s professional training, tacit knowledge and expertise, and all aspects of personal information work and its networks. The static work task definition provides a benchmark for our holistic concept of participants’ information work as work performance, which adds to the work-focused orientation of IW research inclusive of visible and invisible work (Byström & Hansen, 2005; Byström & Lloyd, 2012; Huvila, 2008; Star & Strauss, 1999). We find that work performance is key to elucidating the gap between descriptive hermeneutic work tasks and work performance, where the visible and invisible dynamics of information work occur, a finding in line with IW research but never applied to the archival context (Dalmer & Huvila, 2019; Huvila, 2008, 2013). In sum, archivists formed hybrid onsite-remote work contexts that maintained work purpose outside of the institutional work context. Our research recognizes and underlines the centrality of archivists’ work performance through their handling of visible and invisible work.

CONCLUSION

This paper explores IW concepts’ emphasis on work context in the archival context. It examines participants’ information work performance along three lines: affective effort, information management work, and hybrid onsite-remote work. A holistic concept of participants’ information work includes affective effort and preparatory invisible work, notably for reference services and curating digitized resources for interactive and visible online use. Participants maintained work purpose and greater online presence for repositories in the wake of the pandemic. Three directions for future qualitative research include exploring connections between work performance and affective effort research, the influence of work performance on work context, and the implications of recognizing work performance holistically, rather than partially, as the expression of work purpose—notably in the archival context.

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Towards Finding a Research Lineage Leveraging on Identification of Significant Citations

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ABSTRACT

Finding the lineage of a research topic is crucial for understanding the prior state of the art and advancing scientific displacement. The deluge of scholarly articles makes it difficult to locate the most relevant prior work and causes researchers to spend a considerable amount of time building up their literature list. Citations play a significant role in discovering relevant literature. However, not all citations are created equal. A majority of the citations that a paper receives are for providing contextual, and background information to the citing papers and are not central to the theme of those papers. However, some papers are pivotal to the citing paper and inspire or stem up the research in the citing paper. Hence the nature of citation the former receives from the latter is significant. In this work in progress paper, we discuss our preliminary idea towards establishing a lineage for a given research via identifying significant citations. We hypothesize that such an automated system can facilitate relevant literature discovery and help identify knowledge flow for at least a certain category of papers. The distal goal of this work is to identify the real impact of research work or a facility beyond direct citation counts.

KEYWORDS

Research Lineage, Citation Significance Detection, Idea Propagation, Machine Learning, Feature Engineering.

INTRODUCTION

Literature searches to discover publications and the knowledge discovery that follows are crucial parts of developing an understanding of a research problem, finding the previously explored frontiers, identifying research gaps, and leading to the development of new ideas. However, with the exponential growth of scientific literature (including published papers and pre-prints), it is almost impossible for a researcher to go through the entire body of the scholarly works even in a very narrow domain. Citations do play an important role in discovering the relevant papers that further topical knowledge. However, not all citations are equally (Zhu, X., Turney, P., Lemire, D., & Vellino, A. (2015)) effective in finding pertinent research. A majority of the citing papers cite a work contextually (Pride, D., & Knoth, P. (2017)) for providing additional background context. Such background contextual citations obviously help in the broader understanding; however, they are not central to the theme of the citing paper in concern. A few papers use the ideas in a given paper, build upon those ideas, and are the ones that make displacement to the body of relevant research. Such papers are expected to acknowledge the prior work (via citing them) duly. However, the nature of citation, in this case, is different from that of contextual citations. These citations, which heavily rely on a given work or build upon the top of that work, are *significant citations*. However, the current citation count metrics put equal weights to all the citations and are therefore not adequate to identify the papers that have significantly cited the given work and may have taken the relevant research forward. Identifying such *significant* citations are crucial to the literature study.

It is not uncommon that authors sometimes fail to acknowledge the role of relevant papers in stemming up their ideas (Rousseau, R. (2007), Van Noorden, R. (2017)).

As a result, researchers spend a lot of their time searching for the most relevant papers to their research topic and locating the literature that carried forward a given scientific idea. Also, it is usually desirable for a researcher to understand the story behind a prior work, trace the emergence of the concept, and its gradual evolution through publications and identify the knowledge flow. Identifying references that are significant to a given paper and then hierarchically locating meaningful prior work is what researchers do to curate their literature base.

The idea of recognizing *significant citations* is also important to understand the true impact of a given research or facility. In order to understand how pervasive a research was in the community, it is essential to understand the influence of the given research beyond the direct citations it received. To this end, tracking *transitive* influence of a research via identifying significant citations could be one possible solution.

In this work, we propose to develop automatic approaches to trace the lineage of given research via transitively identifying the significant citations to a given article.

The overall objective of our work is two-fold:

- Accelerate relevant literature discovery via establishing a research lineage
- Find the true influence of a given work and its pervasiveness in the community beyond citation counts

There are two aspects to the problem: identifying *the relevant prior work* and identifying *the follow-up works that stemmed or are influenced by the current work*. The first aspect would facilitate relevant prior literature discovery for a paper while the second aspect would facilitate discovering knowledge flow in subsequent relevant papers. Obviously, our approach would not be a *one-shoe fits for all*. Still, we believe it would be effective to find works that build upon others, facilitate relevant literature discovery, and steer towards identifying the pervasiveness of a given piece of research in the community.

RESEARCH QUESTIONS

The mechanism of citations in academia is not always transparent (West, R., Stenius, K., & Kettunen, T. (2017), Viiu, G. A. (2016), Van Noorden, R., & Chawla, D. S. (2019)). Problems like coercive citations (Wilhite, A. W., & Fong, E. A. (2012)) anomalous citations (Bai, X. (2016)), citation manipulation (Bartneck, C., & Kokkermans, S. (2011), *rich gets richer effects* (Ronda-Pupo, G. A., & Pham, T. (2018)), discriminatory citation practices (Camacho-Miñano, M. D. M., & Núñez-Nickel, M. (2009)) etc. are continual problems in the academic community. However, in spite of all these known issues, citation counts and *h*-indices still remain the measures of research impact and tools for academic incentives, though long-debated by many (Cerdá, J. H. C., (2009), Laloë, F., & Mosseri, R. (2009)) Here in our research we seek to go beyond mere citation counts and develop measures to reflect true research influence. Usually, we measure the impact of a given paper or a facility by the direct citations it receives. However, a given research may have induced a transitive effect on other papers, which are not apparent with the current citation count measures. Figure 1 shows a sample citation network where A could be a paper or a research facility. We want to know how pervasive was research or facility A in the community.

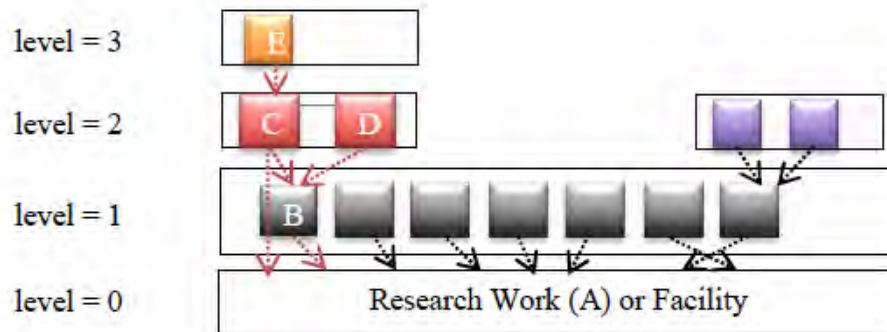


Figure 1. Research Lineage with Four Levels

At *level=1* are the direct citations to A. We see article B cites A significantly, or B is inspired by A. Other citations to A are background. At citation depth *level=2*, we see that article C and article D significantly cites B (direct citation). We see that C also cites A significantly. Finally, at citation depth *level=3*, E significantly cites C. We intend to understand if there is a lineage of research from A to E ($A \rightarrow B \rightarrow C \rightarrow E$). Although E does not cite A directly, can we identify the influence of A on E? If E is a seminal work, receiving hundreds of citations, can we infer that A was the prior work that indirectly inspired E?

We are interested in discovering such hidden inspirations to truly assess the contributions of a research or a research facility. Another use case of this investigation is to accelerate the literature survey. A research lineage would enable a novice researcher to quickly discover relevant articles rather than drowning in the sea of citations. Kindly note that we are currently discovering significant citations and, hence, report our preliminary results on citation classification. However, we list our action points to shape further investigations towards finding research lineage.

RELATED WORK

Measuring academic influence has been a research topic since publications got associated with academic prestige and incentives. Several metrics (Impact Factor, Eigen Factor, *h*-index, citation counts, altmetrics, etc.) are devised to comprehend research impact efficiently, but each one is motivated on a different aspect and has found varied importance across disciplines. The closest literature for our task are the ones on citation classification. Citation

classification with NLP has been explored in the works of Dong, C., & Schäfer, U. (2011), Teufel, S., Siddharthan, A., & Tidhar, D. (2006), Alvarez, M.H., Soriano, J.M.G., Martanez-Barco, P.(2017), Cohan et al. (2019).

Identifying significant citations have been explored in the works of Pride, D., & Knoth, P. (2020), Valenzuela, M., Ha, V., & Etzioni, O. (2015), Qayyum, F., & Afzal, M. T. (2019), Zhu et al. (2015). However, our problem is motivated beyond only citation significance detection, and to the best of our knowledge, we did not find any work leveraging citation classification for finding a research lineage. However, in the current paper work, we report our work-in-progress until detecting significant citations which would clearly form the basis of establishing a research lineage in a citation network, which we plan to pursue next.

DATASET DESCRIPTION

We take the Valenzuela dataset (Valenzuela, M., Ha, V., & Etzioni, O. (2015)) for our task. The dataset consists of incidental/influential human judgments on 465 citing-cited paper pairs for articles drawn from the 2013 ACL anthology, the full texts of which are publicly available. Two expert human annotators determined the judgment for each citation, and each citation was assigned a label. Using the author's binary classification, 396 citation pairs are ranked as incidental citations, and 69 (14.3%) were ranked as influential (important) citations. We used oversampling to balance the instances.

METHODOLOGY

To identify significant citations, we pursue a feature-engineering approach where we curate several features from cited-citing paper pairs. The objective is to classify the citations received by a given paper into SIGNIFICANT and CONTEXTUAL. The original cited papers in the Valenzuela dataset are in PDF. We convert the PDFs to corresponding XMLs using GROBID (Lopez, P. (2009)). Our features are:

- *In Text Citation Frequency (TCF)*: We measure the number of times the cited paper is referenced from within the citing paper's body. The intuition is that if a paper is cited multiple times, the cited paper may be of significance to the citing paper.
- *Author Overlap Ratio (AOR)*: Number of authors in common between citing and cited papers.
- *Is the citation occurring in Table or Figure Captions? (CiTC)*
- *Is the citation occurring in groups? (CG)*
- *Number of citations to the cited paper normalized by the total number of bibliography items in the citing paper (NOCN-TB)*
- *Number of citations to the cited paper normalized by the total number of citations made by the citing paper (NOCN-TC)*
- *Similarity between abstracts of the cited and citing paper (SA)*: We take lexical similarity between *tf-idf* representations of the abstracts via cosine similarity.
- *Title Similarity (TS)*: We take cosine similarity between the *tf-idf* representations of the titles of cited and citing papers.
- *Citance to Abstract Similarity (C-AS)*: Citances are the sentences in the citing paper containing the citation to the cited paper. We take the average and maximum similarity of the citances (there could be multiple citation instances of the same paper in a given paper) with the abstract of the cited paper.
- *Paper Type (PT)*: Whether the cited paper is a journal, or conference, or other (books, etc.)
- *Length of the Citance (LoC)*: Total length of the citances in words.
- *In how many different sections does the citation appear in the citing paper? (SoC)*: A citation that spans across multiple sections of a paper (such as in Introduction, Related Work, Method, Results, etc.) can be considered significant for the current paper.
- *Temporal Distance between the citing and the cited paper (TD)*
- *Reference Overlap (RO)*: Overlap between cited and citing bibliography normalized by the total number of references in citing paper.

INITIAL EXPERIMENTAL RESULTS

We experimented with several classifiers for the binary classification task ranging from Naive Bayes, Support Vector Machines, to Decision Trees. We found Random Forest to be the best performing one. Table 1 shows our current results against the earlier reported results on the Valenzuela dataset. We differ from the comparing systems in terms of the features we use to classify citations. We attain promising results compared to earlier approaches with a relative improvement of 6 points in terms of precision. However, our end goal is not just citation classification but to make use of a highly accurate citation classification approach to trace significant citations and thereafter, try and establish a lineage of the given research. Figure 2 shows the importance of some features ranked as per their *information gain*. We can see that features like in-text citation frequency, length of the citances, the appearance of citations in multiple sections, if the citation is occurring in groups, the relative importance of the concerned citation

with respect to other citations in the citing paper, similarity of the citance to the cited-abstract, play an important role in the classification. Next we intend to explore the other available larger datasets and use deep learning methods to automatically discover useful features for citation influence detection.

Methods	Precision
Valenzuela, M., Ha, V., & Etzioni, O. (2015)	0.65
Qayyum, F., & Afzal, M. T. (2019)	0.72
Our Proposed Approach	0.78

Table 1. Preliminary results on Citation Significance Classification on Valenzuela dataset

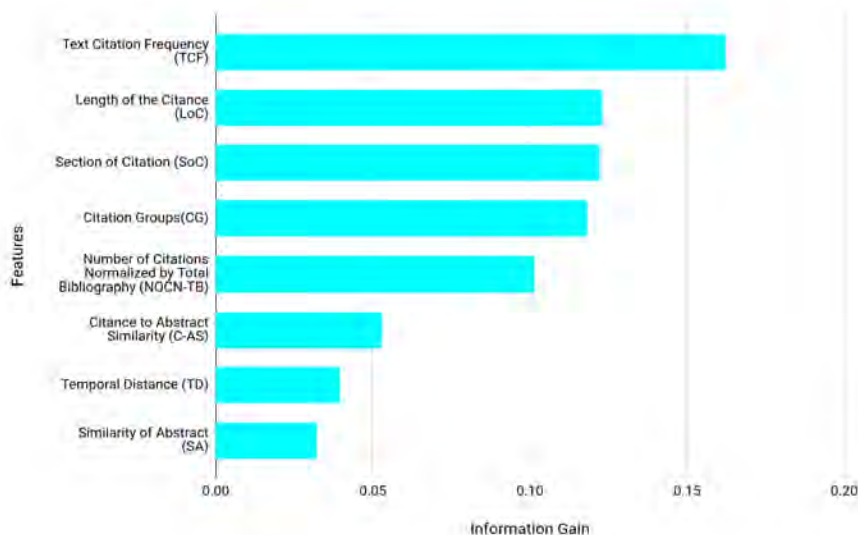


Figure 2. Feature importance ranked via Information Gain (Top-8).
Feature definitions are in the preceding section.

CONCLUSION AND FUTURE WORK

Here, we present our novel idea towards finding a research lineage to accelerate scientific discovery via identifying significant citations. We extract features from the cited-citing paper full-text to classify the nature of how a paper cites the other. We hypothesize that identifying significant citations-trail in a citation network would help establish a research lineage for a certain category of papers, if not all. However, with our current work-in-progress we are still to explore the formation of a research lineage in a citation network. In the future, we intend to exploit the role of semantic features, keywords, sentiment intensities across cited-citing pairs to improve our classification results. The next step would be to test our method on an actual citation network of papers and check if we can visualize research propagation and identify transitive hidden influence links between connected papers.

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Publisher References in Bibliographic Entity Descriptions

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ABSTRACT

This paper describes a method for improved access to publisher references in linked data RDF editors using data mining techniques and a large corpus of library metadata encoded in the MARC21 standard. The corpus is comprised of clustered sets of publishers and publisher locations from the library MARC21 records found in the Platform for Open Data (POD). POD is a data aggregation project involving member institutions of the IvyPlus Library Confederation and contains seventy million MARC21 records, forty million of which are unique. The discovery of publisher entity sets described forms the basis for the streamlined description of BIBFRAME Instance entities. The result of this work includes a database of association rules and RDF editor improvements. The association rules are the basis of a prototype autosuggestion feature of BIBFRAME Instance entity description properties designed specifically to support the auto-population of publisher entities in linked data RDF editors.

KEYWORDS

Bibliographic Entities; BIBFRAME; Linked Data; Data Mining; FP-growth.

INTRODUCTION

Library practitioners are progressing from cataloging practices of library metadata encoded in MARC21 to linked data encoded in BIBFRAME RDF (Library of Congress, 2016). The LD4 community's recent advances and the Library of Congress's work have allowed library descriptions in linked data to be created with native RDF. A major contribution among the LD4 grants and community include the open source linked data RDF editor, Sinopia (Nelson, 2019). The Library of Congress is engaged in a year-long process to integrate BIBFRAME entity descriptions into their systems fully (Library of Congress, 2021). While both traditional metadata and new RDF-based metadata will exist side by side for some time, early adopters of BIBFRAME have a growing need to streamline the creation of linked data entity descriptions.

Bibliographic Entities as Sets

In a position paper on "Bibliographic Entities and their Uses," Svenonius (2018) posited the set theoretical view that "Bibliographic entities are sets of items..." and argued that "... one item is taken to be emblematic of each item in the set. The attributes of the item are, by way of shorthand, regarded as attributes of the bibliographic entity to which the item belongs" (p. 715). Using a set theoretical frame for bibliographic entities is the departure point for this research. Properties of bibliographic entity descriptions may be identified using frequent pattern data mining algorithms over targeted sets of existing metadata descriptions. Not all sets or MARC21 tag associations will be of interest for data mining. Associations in the legacy cataloging description vary in their application and use—in one sample it was found that a small percentage (5%) of MARC21 tags accounted for almost 80% of use (Moen & Benardino, 2003). Semi-automated bibliographic entity identification using data mining outputs may streamline BIBFRAME cataloging to allow rapid identification of the authority properties required in BIBFRAME descriptions. In this paper, the focus is on the BIBFRAME Instance description. Selecting and referencing linked open references is time consuming for the linked data cataloger, with many potential open linked data references to incorporate.

The BIBFRAME data model's core hierarchy is comprised of BIBFRAME Work, Instance, and Item entity descriptions. A BIBFRAME Work entity description is "...the highest level of abstraction," and, further, "...reflects the conceptual essence of the cataloged resource: authors, languages, and what it is about (subjects)" (Library of Congress, 2016, p. 1). The BIBFRAME Instance entity description is concerned with "... one or more individual, material embodiments, for example, a particular published form" (Library of Congress, 2016, p. 1). In practice, Work and Instance BIBFRAME entity descriptions reference linked open data on the web.

DATA MINING METHODS

Data mining methods in this project can be understood as an extract, transform, and load (ETL) process. The extraction of associative publisher name (MARC21 field 260\$b) and place (MARC21 field 260\$a) from legacy

IvyPlus metadata creates comma separated values (CSV) from MARC field data. To address the varieties of metadata quality, the CSV are then loaded into OpenRefine, a data cleaning tool, to cluster publisher name and place. OCLC research's previous work, which experimented with the development of a publisher name authority file from existing metadata, inspired clustering over a publisher's name (Connaway, Silipigni, & Dickey, 2011). The clustered associative publisher name and place data are then loaded into a data frame using a PySpark Jupyter Notebook, which is configured thereafter to make use of SparkML functionality, specifically the FP-growth algorithm (Han, Pei, & Yin, 2000).

Extract: Obtaining Data

The POD Data Lake completed the proof-of-concept work for the Minimum Viable Product (MVP) in 2020 and makes IvyPlus Library metadata available to its membership (IvyPlus Library Confederation, 2020). Library metadata encoded in the MARC21 standard vary by library. Table 1 delineates the corpus accessed from the data pool for this project. Note that not all IvyPlus Libraries are represented in the corpus. To complement the corpus of records available, enriched PCC Data Pool records (Samples & Bigelow, 2020) and Library of Congress open metadata were added.

Library/Dataset Source	MARC21 Records	Sets of {MARC 260\$b, MARC 260\$a}
Columbia University – 2020	476970	460464
Dartmouth University – 2020	1152503	1012040
Library of Congress Open Metadata Set – 2016	2670462	2601806
PCC Data Pool Export 1 – 2020	4263628	2593909
University of Pennsylvania – 2020	5109538	4373619
Brown University – 2020	5490307	4454205
Duke University – 2020	6704722	5209400
University of Chicago – 2020	7648280	6512061
Stanford University – 2020	8258948	6288443

Table 1. Data Corpus in this Research is Comprised of a Selection of Early Access POD Data Supplemented with LC and PCC Data Pool Metadata. Dates Indicate When Data Were Published Originally

Transform: Clustering Data

Several filtering and clustering steps were conducted to make the data mining process effective. Specifically, transformation is aimed to eliminate any potential “noise” in the dataset. Datasets were first filtered for sets that contained the publisher's name and location. Then, after filtering, various stop characters were also discarded or excluded if they contained characters that do not represent words accurately. For example, these libraries' historical cataloging practice used brackets to indicate uncertainty or assumed location or publishers. Bracket data were discarded in favor of more certain strings of text. Strings of the remaining text in the legacy MARC21 are known to be entered as uncontrolled names.

The next step in the process therefore, used OpenRefine text clustering (<https://openrefine.org/>). Previous work has found that text clustering of publisher names is effective (Connaway, Silipigni, & Dickey, 2011). The OpenRefine implementation used a common algorithm method of “fingerprint key collision,” that is known to be both quick and results in few false positives. According to the OpenRefine release notes, many of its text clustering algorithms available for fingerprinting were developed initially in the SIMILIE project at MIT (Butler et al., 2004). In turn, these were influenced by several seminal overview works on pattern matching and string processing in (Hull, 1996; Navarro, 2001).

As an output of the clustering techniques in OpenRefine, 2.4 million (2,460,674) unique publisher names were found in the corpus of the over 40 million records. Uniqueness is defined as one and only one occurrence of an identified string of either publisher name or city after the filtering and clustering aforementioned. After clustering the city names and de-duplicating the initial set of 40 million records, the same filtering and clustering technique found a set of 314,244 unique cities was represented in the dataset.

Transform Inputs

MARC21 Records Retrieved for Data Mining: 41,775,358

MARC21 Records with Unambiguous Publisher Name/Publisher Place Sets: 33,505,947

Transform Outputs

Filtered and Clustered Training Corpus: 24.5 million non-unique pairs

- Unique Publisher Names: 2.4 million (2,460,674 clustered names)
- Unique Publisher Cities: 314,244

Load: Spark Machine Learning

The FP-growth algorithm can be called from within Spark machine learning software. Spark is a software tool used commonly to compute clusters in big data processing and scales very well to large datasets. Data mining researchers introduced FP-growth over twenty years ago and its techniques still help identify interesting patterns in datasets (Han et al., 2000). A refinement to parallelize the algorithm for automated query suggestion was presented in a publication in the ACM Recommender Systems conference proceedings (Li, et al., 2008). Settings for FP-growth support and confidence can be configured within the Jupyter notebook. As an experimental first step in data mining of all association rules, minimum support is set at 0.00001 and the minimum confidence set at 0.6, shown in Figure 1.

```
#set model support and confidence
fpGrowth = FPGrowth(itemsCol="items", minSupport=0.00001, minConfidence=0.6)

model = fpGrowth.fit(df)
```

Figure 1. Configuration of the FP-growth Algorithm in the Jupyter PySpark Notebook

RESULTS

The results from data mining are comprised of association rule and prediction databases. The full association rules database table can be viewed here: <http://ow.ly/pLC550Erq0S>. The association rules database contains 7,937 rows of data grouped into 5 columns comprised of: antecedent, a text column with 7,937 unique values; and consequent, a text column with 1563 unique values. The most frequent values in the consequent column are London (899), New York (836), Paris (441), Washington D.C. (239), and Moskva (204). There are three numeric columns in the association rule table: confidence, lift, and support. Confidence and support metrics act to guide evaluation of FP-growth data mining and were introduced in association rule algorithms (Agrawal & Srikant 1994). Lift is a metric that builds upon confidence and support computations (Bayardo & Agrawal, 1999).

An accompanying prediction database is made up of two text columns: an item set row, and the prediction set row. There are a total of 1,599,051 associative rows from which an RDF linked data editor may derive property autosuggestions. The RDF linked data editor can retrieve the publisher cities from a file packaged into the RDF editor for quick autocompletion uses. The prediction database table may be queried by a webservice API using cataloger input as a query for the field of publisher to bring in city entities and may also autosuggest publisher names when a publisher city is input into the linked data editor. Future integration, therefore, is designed make use of one or more properties from disparate data fields in the Sinopia RDF Editor as signals to populate those properties in another field relevant to the returned value from the prediction table. When a field such as publisher place is entered, this queries and filters candidates for publishers only from that city and vice versa for publisher. The publisher place autocompletion target is shown in Figure 2.

Figure 2. Target Integration of Publisher City Autocompletion into the Sinopia RDF Editor

CONCLUSION AND FUTURE WORK

In this paper, the set theoretical approach made use of Svenonius's (2000, p.32-35; 2018, p.715) work as a departure point to discover the way a corpus of existing legacy metadata attribute sets may ontologically—by set existence—describe publisher entities. The set theoretical frame was employed herein to move beyond a singular commitment to conceptual modeling; from an Entity Relational (ER) model to the Extended Entity Relational (EER) model (Renear & Choi, 2007, p.10-11). Set theoretical models can obviate the need for abstract entities, specifically, “both

set-theoretic and abstract entity models use sets to model domains, but the set-theoretic strategy is distinctive in using sets of similar concrete objects as a strategy for eliminating the need for abstract entities,” (Renear & Choi, 2007, p.10) A commitment to concreteness in set theoretic modeling was obtained through the observation that bibliographic descriptions are concrete.

To streamline BIBFRAME metadata creation further for linked data catalogers, future research will undertake development of association rules based upon associations from Agent Entity to a Publisher Entity autosuggestion, and the Author Entity to Subject Entities for autosuggestion in a linked data RDF editor. Furthermore, as the corpus of heterogeneous linked data Work entity description sets grow, there is also the future possibility to perform semi-automated predictions for existing Work descriptions both within BIBFRAME and beyond the ontology (including LRM, RDA, and others) by attribute set membership (Hahn & Dousa, 2020).

An anticipated outcome of this research, poised for integration into practice, will make possible semi-automated RDF editors whereby metadata creation is optimized for quick entry by building upon legacy metadata and employing data mining techniques whereby the constituent associative properties heretofore described by MARC21 already hold ample evidence for their membership in BIBFRAME, LRM or RDA metadata description sets.

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Avoiding Information during Serious Illness: Insights into the Information Behavior of Cancer Patients

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ABSTRACT

Cancer patients seek information about their health and illness using many different approaches. Some prefer to seek intensively whereas others avoid seeking information. Over the course of the cancer continuum an individual may meet their needs using several different approaches. In this paper, we explore how avoidance can be an approach used as part of information seeking activities and not just as an alternative approach. Interviews with six current and former cancer patients were conducted and audio recorded for transcription. The transcriptions were coded to identify themes and concepts. We identify the different patterns of information seeking among the interviewees ranging from seeking intensively to avoiding information. Furthermore, we find that exposing yourself selectively to information as well as avoiding some information can be strategies to protect the information seeker from information the individual is not able to cope with. This study indicates that information seeking approaches are overlapping.

KEYWORDS

Information seeking; information avoidance; cancer patients; interviews; selective exposure and avoidance.

INTRODUCTION

Cancer is a globally occurring, life-threatening disease, and bearing the prevalence of cancer in mind it is important to consider how and why cancer patients seek information about their illness. Focusing on the information behavior of cancer patients, studies have shown that the information needs of cancer patients are diverse (Abi Nader et al., 2016, Abu Sharour et al., 2020, Ancel, 2012, Arroyo and Tillinghast, 2009, Germei and Schulz, 2014). Cancer patients seek information about their health and illness and increasingly, the Internet is an essential informational source (Ebel et al., 2017). However, it can be difficult for the patients to navigate the vast amount of information (Perrault et al., 2020, Chua et al., 2020).

Through significant life changes information seeking has lifelong impacts (Huttunen and Kortelainen, 2021). During critical illness both lifestyle and health behaviors can be affected by the patient's information seeking (Zhang, 2012). Information seeking affects health outcomes (Katavic et al., 2016, Kostagiolas et al., 2020) and can influence illness fatalism (Paige et al., 2020). In addition, seeking information can help the patient gain an increased sense of control (Faller et al., 2016, Persakis and Kostagiolas, 2020). Miller (2014), however, argues that information plays a salient role in the management of uncertainty and can both facilitate as well as complicate the individuals' management of cancer-related uncertainty. The information needs of cancer patients include coping and information seeking is considered a key coping strategy in health-promotive activities and psychosocial adjustment to illness (Lambert & Loiselle, 2007).

There are variations in the approaches used by patients to seek information. Costello and Veinot (2020) identify five spectrums of approaches to health information: avoiders, who close themselves off from health information; receivers, who encounter information in the dialysis clinic but do not seek it out; askers, who only pose questions about health to their healthcare providers but otherwise do not seek; seekers, who actively look for health information both in and out of the clinic; and verifiers, who seek information and triangulate it among multiple sources. Lambert et al. (2009a,b) identify five patterns for cancer patients:

- intense information seeking looking for as much information as possible
- complementary information seeking adding to what they already know
- fortuitous information seeking consulting other patients for health information
- minimal information seeking where the individual does not look for information on their own
- guarded information seeking where the individual avoids some cancer information.

The five patterns represent different approaches to addressing the needs of the individual (Sheridan et al., 2020, Germení and Schulz, 2014). As we can see from the five patterns, some patients avoid information even though avoiding e.g. cancer-related information may have severe health impacts (Chae, 2016). Sweeny et al. (2010, p. 341) define information avoidance:

We define information avoidance as any behavior intended to prevent or delay the acquisition of available but potentially unwanted information. Information avoidance can entail asking someone not to reveal information, physically leaving a situation to avoid learning information, or simply failing to take the necessary steps to reveal the content of information. That is, information avoidance can be active (e.g., by asking someone not to reveal information) or passive (e.g., by failing to ask someone a question that would reveal the information).

Loiselle (2019) finds that almost 40% of a large cohort of cancer patients are uninterested or even deliberately avoids information related to their illness. In an earlier study Carlsson (2000) finds that about 30% does not actively seek information regarding their illness. It should be noted that Nelissen et al. (2017) stress that information avoidance is conceptually different from information disinterest. In general, a considerable number of people actively avoid challenging information in their daily lives (Karim et al., 2019).

The cancer information seeking preferences have been used to characterize behavior but also in many cases individuals (Germení and Schulz, 2014). A recent example is the study by Loiselle (2019) who assesses cancer information seeking preferences by asking participants to characterize their own cancer information seeking preferences. Characterizing individuals has been questioned by e.g. Germení and Schulz (2014) who argue that information seeking and avoidance are not two distinct behaviors pertaining to different groups of patients. Shim et al. (2016) argue that there is a lack of longitudinal studies examining information seeking behavior of cancer patients throughout their cancer journey or over the course of the cancer continuum. The information seeking behavior can evolve across different stages of the patient journey and thus longitudinal studies are needed (Germení et al., 2015, Shim et al., 2016).

Summing up, information seeking and avoidance are approaches to meeting a need. We can identify the behavior in an individual, and over the course of the cancer continuum an individual may meet their needs using several different approaches. According to Germení and Schulz (2014, p 1371) information seeking and avoidance are two sides of the same coin. In this paper, we take a step further and explore how avoidance can be an approach used as part of seeking activities and not as an alternative approach to seeking. Information can be avoided while seeking if particular sources are disregarded (Festinger, 1957). Kwanya (2016) characterizes this shortcut to satisfying an information need as an echo chamber. Based on an analysis of social media (Malinen et al., 2018) labels the behavior in which a person actively seeks information that supports their views and avoids information as selective exposure and selective avoidance. Case et al. (2005) argues that selective exposure, which relates to behaviors aimed at preventing confrontation with specific information, is an early characterization of avoidance.

In this study, we explore how cancer patients actively seek information while cautiously and consciously avoiding information that may be relevant, but does not meet their needs.

METHODS

In order to further our understanding of the information-seeking behavior of cancer patients with special attention to selective avoidance interviews with six current and former cancer patients were conducted. Meeting current and former patients naturally requires a number of considerations, because the interviewees can be both vulnerable and fragile. Prior to the interview, all interviewees signed a written consent that allows the interview to be recorded and used for research purposes. It was stressed that the transcript would be anonymized. The names of the interviewees were changed to IP1-IP6 in the data and other personal information was excluded.

The interviewees were located through the Danish Cancer Society in which one of the authors is actively involved. The interviewees did not receive any financial or material payment for their participation. To reduce potential bias an author unrelated to the interviewees performed the interview without the presence of the other authors. The interviewees were 25 to 58 years old. Although one of the interviewees' native language was not Danish, all interviewees speak Danish fluently and are residing in Denmark. Therefore, the interviews are conducted in Danish and translated to English for the purpose of this publication.

Four interviewees are former cancer patients whereas two are current cancer patients. Two men and four women participated in the interviews. Each interview interaction starts with an introduction to the process which is not recorded or transcribed. The interviewee is introduced to the study and is being informed that the interview can be paused or interrupted if the person so wishes. Before the recorder is started the interviewee is given the chance to ask questions. The interview then begins and concludes with any comments or remarks the interviewee would like to add.

The in-depth interviews used a semi-structured interview protocol and each lasted approximately an hour. Most of the participants preferred a telephone interview because of the lockdown caused by the COVID-19 pandemic during the time period of conducting the interviews and because it was easier to organize. The interviews were audio recorded and later transcribed. The transcriptions were coded to identify themes and concepts. The transcripts were coded individually by two of the authors. The individual coding was then compared and discussed until agreement was reached. The focus of the coding was on information avoidance and information seeking during serious illness. No categories or theoretical framework formed the coding and the study utilized an inductive content analysis.

FINDINGS

In the analysis we identify the different patterns of information seeking among the interviewees. We identify intense information seeking as one pattern of information seeking behavior among the cancer patients interviewed in this study. Some of the interviewees are interested in knowing as much as possible and they seek information intensively. Some of the interviewees clearly state that they seek intensively and prefer having as many answers as possible to satisfy their information needs.

I am realistic, if one is to die, then one might as well find some information about it. I was hoping I would not find anything of that kind but I have not avoided anything because I wanted answers (IP4).

The thing about closing your eyes to something.... and prognoses, it does not matter at all, because it does not mean that it is something that will affect me. So no, the more information, the better (IP6).

However, even though a cancer patient is interested in knowing as much as possible, it can be difficult to navigate the overwhelming amounts of information, and some of the information may even distress the cancer patient. One of the interviewees reflect on the need to know as much as possible and maybe not having the mental resources for handling the answers.

But in the beginning, I just swallowed everything raw. But it didn't really do me anything particularly good. It was the information I got primarily from my friend who is a doctor and the information I got in general from my network who has had cancer. Now, I don't know that many people who has had cancer. But I don't think searching the Internet was good for me in the beginning. Since I also had to know what to look for and how to sort it. I did not have those mental resources. I only had those [mental resources] later. So in hindsight I should probably have saved the Internet for a later use (IP1).

However, not all cancer patients are interested in knowing as much as possible about their disease. We also find examples of minimal or guarded information seeking where the individual does not look for information on their own or avoids some cancer information. One of the interviewees did not feel a need for seeking information regarding the illness and primarily relied on the health professionals because the interviewee did not feel a need for further information:

No, not so much. Now, of course, it is a few years ago, but it was all very overwhelming, and I was only 21-22 [years old] at the time ... so in the beginning it went mega fast and you already get a lot of information. So in the first 2-3 weeks I could not keep up. Not mentally either, because it went so fast. But when I have had questions, I have just asked [the health professionals]. But otherwise, I think they were reasonably good to inform [the patient] (IP2).

Some cancer patients may feel need for information although they do not seek it actively. Some consciously choose not to seek information regarding their illness. They are aware that information seeking can result in finding information that is difficult to cope with. One of the interviewees actively chose early in the process to avoid searching on his/her own:

I chose from the beginning not to [...] read online. That was probably to avoid.... I'm generally critical in regard to online information, of course I googled some things. But it is very minimal. Otherwise, I have actually relied heavily on the healthcare staff. Both regarding surgery and radiation therapy, yes... (IP3).

Exposing yourself selectively to information as well as avoiding some information during the process of information seeking can be strategies to protect the information seeker from information the individual is not able to cope with. An example is IP5 who asks a close relative to seek information regarding the illness and only provide the patient with a minimum of information:

I avoided all that was uncomfortable to hear, but luckily, I felt I was well-informed from the start that my diagnosis was not so bad or what to say. So if I heard anything about someone who had been severely ill I could not cope with that [...]. It's a lot about getting something that made sense to me. So I could cope with being in [a situation] which was so difficult (IP5).

Then [my mother] passed on the information to me in a gentle way because I could not bear to have in-depth information about the illness at all (IP5).

The interviewee thus gets information filtered by a relative to protect him/her from information that would cause distress. Another example of selective exposure and avoidance is to select the sources carefully and thus avoid specific sources of information that can upset the patient. One of the interviewees reflects on the choice of resources when seeking information:

There were many guesses... Many asked "now I have these symptoms, what could it be?" and then there were hundreds of suggestions, and I think that could worsen my condition. [...] I would get more upset. [...] then I would rather ask a doctor who knows my specific situation (IP3).

To avoid getting upset the interviewee carefully selected the resources to rely on. However, the resources relied on depends on the information need and is therefore not necessarily constant. IP3 also states that seeking information on personal experience is of value:

Well, Wikipedia and something like that I avoid ... but otherwise I searched for [information from] previous cancer patients and their experiences with, e.g. bras - it was not the disease I searched for, because it is different from one person to another. I'm probably also critical, as no one has the same case as me (IP3).

A cancer patient can also select a resource because they expect it to give them a specific answer to their question and thus fulfil their information need and it may not necessarily be authoritative or quality approved information. One of the interviewees needed to be assured that treatment would cause serious side effects in his/her case and as the health professionals could not give him/her any guarantees she went to a different source of information.

It was worse when I googled the prognoses for facial paralysis, so I actually completely stopped googling it. Then I went to a healer instead, and I do not believe in such a thing at all. But just to give [the interviewer] a picture of how far out you can get. Well, it did [give positivity]. That's the worst part. I wish I could say no (IP1).

Even though the interviewee does not trust healers in general, a healer is asked about a crucial aspect of the patient's prognosis. First and foremost, the interviewee needs a positive answer to the question regarding prognosis and if internet searching cannot provide that then an alternative source is identified. Therefore, selective exposure and avoidance is used in order for the patient to be able to fulfill their information needs.

CONCLUSION

During serious and even life-threatening illness patients have many different information needs and fulfilling unmet information needs can improve their health-related quality of life as well as optimizing their health care. Cancer patients use a variety of approaches to satisfy their information needs. The role of information seeking during serious illness includes information seeking as a coping-strategy. Different information seeking approaches can be identified in an individual and over time a patient may use several different approaches.

However, seeking and avoidance can be considered two sides of the same coin, and in this study, we have explored if they can be used simultaneously. We have found that the approaches can overlap, and this seems to be tied to coping. In order to cope with the information found several approaches are used simultaneously. The patients seek information while avoiding otherwise relevant information regarding their illness. Therefore, cancer patients can actively seek information while cautiously and consciously avoiding information that is relevant but does not meet their need and support them in coping with a serious and potentially fatal illness.

More research is needed to confirm our findings and elaborate on how avoiding information can be part of an active information seeking process during periods of significant life changes such as serious illness.

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Five Motivating Concerns for AI Ethics Instruction

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ABSTRACT

Artificial Intelligence (AI) systems are embedded in institutions that are not diverse, that are inequitable, unjust, and exclusionary. How do we address the interface between AI systems and an unjust world, in service to human flourishing? One mechanism for addressing AI Ethics is AI Ethics Education: training those who will build, use, and/or be subject to AI systems to have clear moral reasoning, make responsible decisions, and take right actions. This paper presents, as part of a larger project, work on what AI Ethics instructors currently do and how they describe their motivating concerns. I find that although AI Ethics content and pedagogy is varied, there are some common motivating concerns particular to this kind of teaching, which may be useful in structuring future guidance for new AI Ethics teachers, evaluating existing pedagogy, guiding research on new pedagogies, and promoting discussion with the AI Ethics community.

KEYWORDS

Artificial Intelligence Education; Artificial Intelligence Ethics; Ethics Education; Pedagogy; Thematic Analysis.

INTRODUCTION

Ethical issues involving Artificial Intelligence (AI) continue to arise in the context of powerful institutions that have histories of inequity and injustice, such as policing, health, and education (Gilbert et al, 2019; Goodman, 2010; Hendl, 2020; Hung and Yen, forthcoming; Jones and Mendieta, forthcoming; Marckmann and Goodman, 2006; Obermeyer et al, 2019; Rubel et al, 2021; Sheehy, 2019; Susser, forthcoming). For example, in Pasco County, Florida here in the US, a police department created an algorithm ostensibly to predict crime and used its output to justify the harassment of innocent members of the public (McGrory et al, 2020). At Stanford Medicine, hospital leadership used an algorithm to allocate early doses of a COVID-19 vaccination on the grounds that it would provide equitable results, though the algorithm faultily allocated few doses for patient-facing staff (Chen, 2020). And in the UK, the British government used an algorithm to award college-entrance test scores in order to avoid in-person testing during the pandemic, but the algorithm systematically awarded lower scores to otherwise outstanding students from low-income areas (Satariano, 2020).

We ought to address such interfaces between AI and inequity/injustice on multiple fronts. One such front is AI Ethics Education (Bates et al, 2020; Gardelli et al, 2014; Mitcham and Englehardt, 2019). Universities in the United States have shown an interest in this kind of teaching as part of a historical move towards embedding Applied Ethics in Science, Technology, Engineering, and Math (STEM) curricula, which has been required by the Accreditation Board for Engineering and Technology (ABET) since 2008 (Homkes and Strikwerda, 2009; Mitcham and Englehardt, 2019). But (i) ABET requirements provide little guidance in *how* to fulfill them, (ii) there are ongoing calls in Computer Science for better research on Applied Ethics, (iii) there are calls for better articulation of AI-specific Applied Ethics competencies as a way to give new AI Ethics teachers some pedagogical guidance, and (iv) what constitutes “ethics learning” in the first place has been variously formulated over the decades (Bates et al, 2020; Fiesler et al, 2020; Furner, 2012; Grosz et al, 2019; Mitcham and Englehardt, 2019; Trim, 2020). This is not all to say that AI Ethics Education is doomed. It is to say that Applied Ethics, in the context of AI education, has lacked a strong history and lacks sufficient present guidance. Some researchers, for example, have called for STEM teachers to seek collaboration with their Philosophy departments as a stop-gap solution (Grosz et al, 2019). And others, like ourselves, have sought to provide this guidance by either drawing on what current Tech Ethics instructors do in practice (Fiesler et al, 2020) or evaluating the various arguments for why we ought to teach ethics in school in the first place (Gardelli et al, 2014).

Continuing that line of inquiry, I interviewed ten AI Ethics instructors across Computer Science and Information Science departments in the United States. This exploratory study asked:

RQ1: How do instructors of AI Ethics Courses describe their course objectives related to artificial-intelligence?

RQ2: What are the practices and concerns of instructors of AI Ethics Courses when they structure assignments in those courses to synthesize those objectives?

RQ3: What themes co-occur between RQ1 and RQ2?

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RQ4: How do the findings in RQ3 differ between two of the common departmental homes for AI Ethics, Computer Science and Information Science?

This paper describes some of the findings for RQ2. Like previous work, I find that the content and framing of AI Ethics Education is varied, and that instructors tend to draw heavily on their own past education—even when that education lacked a strong history of AI Ethics in particular (Fiesler et al, 2020). And I found participants advocating for both *moral fostering* and *philosophical ethics* approaches to curricula, and I saw justifications that aligned with *socialization*, *quality of life*, and *tool* arguments: educators ought to foster good qualities in their students, educators ought to give them the tools to “do” normative ethics, and educators ought to do these things because the school has an obligation to produce good citizens, who will live in morally correct ways, and whose products will be beneficial to society (Gardelli et al, 2014).

However, my in-depth approach allowed me to discover that underneath the pedagogical and conceptual variance are some common motivating concerns that are particular to AI Ethics Education. This provides an encouraging light that AI Ethics Education *can* be given guidance in this “bottom up” way, and it highlights some of the motivating concerns specific to AI Ethics around which guidance could be structured in order to be applicable to a wider audience. These areas of concern may also help guide evaluation of existing pedagogy, structure future research on AI Ethics pedagogy, and promote discussion within the AI Ethics community.

METHODS

Participants

Thirty-five faculty members across thirty-five US schools were contacted for recruitment via two emails sent two weeks apart. Ten faculty agreed to take part, five each from Computer Science and Information Science. No participants were persons of color, which may reflect a lack of diversity in teaching in this area, or may reflect a mode effect of recruitment methods.

Faculty were selected for recruitment through a multi-stage, judgement-based, purposive sampling method (Allen, 2017c; Allen, 2017d; Frey, 2018; Lavrakas, 2008). First, I created an initial list of 191 schools exported from Indiana University's Carnegie Classification database, restricted to only R1 and R2 Public Four-Year schools that were not Exclusively Graduate. Second, schools were excluded if they had neither a Computer Science nor an Information Science department, or if they had a combination “Computer and Information Sciences” department, as a goal of RQ4 was to increase variance along this dimension for this initial exploration. Third, I excluded those that gave no indication that an “AI Ethics” course, broadly conceived, was taught at their institution. Finally, faculty from those schools were selected for recruitment by reading bios, courses taught, publications, and research interests for evidence of interest in AI Ethics. If multiple faculty were identified for one school this way, only one was randomly selected for recruitment.

Data Collection

Semi-structured, constant-comparative, remote interviews were conducted between July 21st, 2020 and September 11th, 2020, and all interviews were between twenty-five and forty-five minutes (Allen, 2017a; Allen, 2017b; Given, 2008a). At this time, faculty were preparing for their second semester of the COVID-19 pandemic and the first semester going into it with COVID in mind. Although the pandemic was not a topic of this study, it weighed heavily on all participants' minds. Interviews were conducted remotely over Google Meet, Microsoft Teams, or Zoom. Meetings were recorded with two external audio-only recording devices. I then uploaded the better quality of the two to a secure folder and deleted all other copies. Interviews were transcribed automatically using Microsoft Word's “dictate” feature and then hand-corrected.

Analysis

Between October 2020 and March 2021, audio recordings and transcripts were analyzed using a thematic, constant comparative, and grounded theory inspired approach that sought to produce several memos to capture the researcher's analytical thinking early and often (Allen, 2017e; Emerson et al, 2011; Given, 2008a; Given, 2008b; Mathison, 2005). First, audio recordings were inductively coded by taking hand notes about concepts, with analytic memos written after each. These memos and concepts guided further data collection. For example, two questions were added to the protocol that asked, “[reiterate] Why are those objectives important?” Second, after all interviews were conducted and analyzed, an integrative memo was written drawing together initial themes, produced by reading and re-reading all previous notes. Third, transcripts were produced and focus-coded to better flesh out those themes. A few new themes were identified and the boundaries between existing themes were allowed to shift. Finally, a second, longer integrative memo was written, again drawing on all notes that had been written so far. The findings below follow from this second integrative memo.

FINDINGS

AI Ethics Courses are Important in Light of Today's Learning Environment

A common goal for these AI Ethics teachers was that they help students think about the downstream effects of AI and related technologies. However, this goal is in tension with pedagogical challenges not faced in other technology classes and educators' preconceptions about their students. For example, many AI Ethics classes are relegated to 1-credit courses that students take less seriously than their technical courses. And some appeared to view their "techie" students as less equipped to approach Ethics. However, AI Ethics educators are not alone in facing these tensions, and so they may make use of communities of practice to help them achieve their objectives, such as learning from others doing similar work or working with faculty in nearby departments.

One participant made a salient remark that Computer Science lacks the history of Ethics that nearby departments might have, and this has limited their ability to approach AI Ethics more richly in their teaching: "My preconception is that Computer Science does not have a rich history of ethics embedded into it. You go to Engineering or Bio-Engineering and those disciplines, they have a much more ingrained sense of these kinds of professional ethics and codes and norms, you know, versus someone like me who has multiple Computer Science degrees and I had never even heard of STS [Science and Technology Studies] until I was well into my faculty life."

Students in AI Ethics Classes are Future Professionals

AI Ethics educators care about the futures of their students—they want them to be successful, and they want their students to advance human flourishing. Some worry about their students will be placed in powerful positions and have opportunity to cause great harm, in virtue of their AI training. But others recognize that it is not individuals, but institutions, that enable those harms to become wide-spread.

One participant explained this tension between the institutions and the imagined sole programmer well: "We really have an ideal about the individual entrepreneur creating a technology by himself...My students, I think, are trained by the culture they consume, by their other classes, by the context of their own homework that has them competing against each other to build designs, to approach any technological design...as something that emerges *de novo* like Athena from Zeus's head...But in the real world, no technology escapes the context of its design, which is always collaborative. And especially for something that is as big and expensive as AI...it is always something that is going to be designed by a large organization and implemented by a large organization. So it is just unfair to the reality of the world as it works to describe technology in general, but AI especially in particular, as anything but a product of specific institutions."

AI is not Hypothetical

There is a wealth of AI examples for teachers to discuss in class and for students to find for use in class assignments. These may be representations from popular media, or these may be concerning real life cases. And examples of concerning AI continue to emerge. Students find popular media representations of AI engaging, and teachers find real life case studies fertile for productive Ethics assignments. For example, the most popular case mentioned by participants was ProPublica's report on a recidivism prediction algorithm (Angwin et al, 2016).

However, while popular media can be engaging, it can also be distracting. As one participant put this: "We spend time doing science fiction based stuff on AI, though I try to steer the conversation too far from like—'cause people get really interested in talking about like sexual consent for robots, which is an interesting intellectual conversation, I suppose, but not actually—'this isn't the stuff that we should be worrying about right now' is basically the issue there."

AI Muddies Students' Moral Reasoning

There are several reasons students' ethical thinking may be unclear. They are, after all, novices. But as participants remarked, there are factors about AI in particular that can muddy students' ethical thinking further: the ubiquitous yet technical nature of AI can confuse students as to what AI exactly is; AI technologies have been speciously hyped, so students may need to first disentangle realistic AI uses from exaggerated AI promises; and AI is ascribed moral qualities that students can articulate, but cannot articulate clearly within a moral framework.

One participant describes combating students' tendencies to launder their responsibility into an AI system: "I think there's a social aspect here where people want to say, 'well, there's this AI system, and I used this system, so this system has the responsibility for these decisions...I'm going to claim that it's unbiased in some way because I didn't make that decision, the system made that decision.' So I think there's definitely that sort of mentality or lean when you're using AI. So the thing that I try and get at is, you can't make that claim, because somebody built that system, and that responsibility lies somewhere. It lies with you because you're using a system and need to have some kind of understanding about what the implications of that system are, and that responsibility also lies with the creator of that system, about how they built that system, what data they used, all these things, that you should be aware of the implications of this system's use."

Peer-to-Peer Discussions have Inherent Value

While participants' pedagogies varied too much for inclusion in this paper, nearly every participant remarked as a rock bottom premise that AI Ethics education must include peer-to-peer discussion. In this way, discussions differed from other types of learning activities. I noticed three common values attached to discussions: discussions support social-emotional learning; discussions help the class run; and the work of Ethics itself must be discursive.

For example, as one participant puts it, discussions are one way for students to become aware of their own values: "You need...the peer-to-peer so people can understand what their value statements are, and then they can be forced to defend those value statements, and understand how their values or their perspective of the world becomes embedded."

DISCUSSION AND CONCLUSION

This paper has presented work on what AI Ethics instructors currently do and how they describe their motivating concerns. AI is increasingly embedded in institutions that have long histories of inequity and injustice. And one front for addressing this interface between AI and inequity/injustice is AI Ethics Education. There is a growing body of literature aimed at AI Ethics Education that provides actionable suggestions, such as example assignments, case studies, reading lists, frameworks, lessons learned from many years teaching the same course, and so on (eg. Bates et al, 2020; Fiesler et al, 2021). Continuing that line of inquiry, I have focused on the salient and common concerns particular to AI Ethics that might motivate one's teaching, going deep into a small sample of AI Ethics teachers' experiences.

Guidance on just how to achieve AI Ethics Education's goals is still coming out of the AI Ethics research community. In light of this study's findings though, I believe that such guidance may see wider adoption if it: (i) addresses the history of limitations in teachers' actual institutions; (ii) connects to the actual futures that students are expected to have; (iii) presents a clear rationale behind the guidance's choice of AI Ethics case(s); (iv) has clear pedagogical aims that drive any group work; and (v) provides advice for how to help students articulate moral qualities commonly ascribed to AI and how to help students morally reason about AI cases without losing the "moral thread" in that reasoning. There are three things we can do with these areas of concerns. First, we can compare them to existing pedagogical tools, which may help refine and deploy them for a wider audience. For example, Fiesler et al (2021) offers recommendations that *do* address each of these areas of concern, except for the last, where Fiesler instead remarks on a *barrier* to type of moral reasoning: "when students struggle with technical material, they seem less engaged with the ethical components [and] they are focused on trying to understand the part they are being graded on." Second, we can incorporate these areas of concern into frameworks when researching new pedagogies. This will be one goal of my own future research. And third, we can offer these areas of concern to the AI Ethics community in order to promote a discussion on which of these ought to be "best practices" and what teaching materials we might share to advance them.

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Tattoos and Information: Mapping the Landscape of Tattoo Research

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ABSTRACT

This paper is the initial discussion of a larger project *Tattoo and Information*, exploring tattoos as an information and communication phenomenon from multicultural perspectives and various use purposes. The overall purpose of the project is to provide insight into information seeking and experience in the context of tattoos to identify information literacy, visual literacy and cultural literacy skills as well as communications skills necessary for a successful tattoo experience in Aotearoa New Zealand. In this paper, we present findings from the literature review accompanied by preliminary insights from four interviews. The findings reflect thematic areas of research focusing on tattoos and gaps that exist. We used interviews to capture what topics emerge from tattoo narratives and whether they align with topics and gaps identified in the literature review. Based on the findings, we identify areas for future research.

KEYWORDS

Tattoos; information; information behavior, personal information management.

INTRODUCTION

Studies focused on information-seeking behavior in relation to tattooing have stemmed primarily from the disciplines of health information, consumer behavior, and anthropology. Studies on tattooing as a risk-taking behavior suggest that people employ varying levels and types of decision-making strategies to mitigate the risks of acquiring a tattoo and make a range of suggestions regarding the provision of health information to different groups (Armstrong & McConnell, 1994; Armstrong & Pace Murphy, 1997; Armstrong et al., 2002; Brown et al., 2000; Schulz et al., 2006). As tattoos became more widely accepted in many parts of the world, researchers began to study tattooing as a consumer commodity, noting that tattoo consumers usually engage in the high-involving decision-making process (Lipscomb et al., 2008) and extensive information searching, including internet and website analysis, an inspection of premises, levels of hygiene, and tattooists at work, studies of tattoo portfolios, and discussions with past and existing clients (Goulding et al., 2004). In some cases, such as in extreme body-modification, people experienced information poverty because of the stigmatization of the practice (Lingel & Boyd, 2013). Those receiving traditional tattoos undertook a lengthy research process that took many factors into account, including genealogy, astrology, career goals, and future aspirations (Krutak, 2017) and searched for tattoo designs and artists in a variety of ways, including choosing a design from a tattooist's arm, through the internet and digital technology, by word of mouth, and via images of tattooed people from the past (Salvador-Amores, 2011). Changes to the work of tattooists using Instagram have been investigated, but not specifically through the lens of information management (Force, 2020). While there are only a small number of studies that investigate tattoos from an information sciences perspective, there are many relevant and interdisciplinary perspectives that can inform information-oriented studies. Therefore, the purpose of this paper is to present work in progress on mapping the landscape of tattoo research through thematic analysis of literature review and interview narratives in the context of information behavior.

LITERATURE REVIEW

A preliminary review of literature has yielded results presented in Table 1 and organized under three main themes derived from analyzing the content and focus of the literature. The search strategy included searching databases LISA, LISTA, Scopus, JSTOR, PubMed, and Google Scholar by combining the following terms: tattoo, identification, information, document, information behavior, information seeking, archive, indigenous tattoo, traditional tattoo, Māori and Pasifika tattoo.

Theme 1: Tattoo as a Record and Information	
<i>In library and information science (LIS) field</i>	<ul style="list-style-type: none"> tattoos as documents (Fortier & Menard, 2018) or non-authoritative documents (Gorichanaz, 2015), and in relation to information theory concepts of the document and the archive (Sundberg & Kjellman, 2018). tattoo as a means of communication and a sign carrier on the body (Cwojdzinski, 2019) intellectual property and copyright in relation to tattoos (Chronis, 2019; Minahan, 2015; Tan, 2013) technical methods used to detect and search tattoos (Han, Shan, & Chen, 2019)
<i>In indigenous contexts</i>	<ul style="list-style-type: none"> the ability of tattoo to function as a person's signature (Ellis, 2008), tattoo in identifying an individual's lineage (Hanlon, 2003), the tattooed bodies read and written on by a variety of narrators (Olguin, 1997)
<i>In historical contexts</i>	<ul style="list-style-type: none"> colonization (Bailkin, 2005; Balvay, 2008), identification in concentration camps (Friling & Waltzman, 2014), branding for slaves, and convicts (Samel, 2004; Schildkrout, 2004; Lobell & Powell, 2013)
<i>In police science and criminology</i>	<ul style="list-style-type: none"> ethical and social issues of tattoo recognition technology (Bacchini & Lorusso, 2017), the symbolism and typologies of criminal tattoos (Jacques, 2016), use of tattoos for identification purposes (Bălan, 2020; Caplan, 1997; Fang et al., 2018; Miranda, 2019; Sun et al., 2016)
<i>In medical field, biological and veterinary sciences</i>	<ul style="list-style-type: none"> to record blood-type and medical alert information (Bote 2018; Chadwick & Shah, 2013; Lai et al., 2018) tattooing as a method of animal identification (Awad, 2016; Roughan & Sevenoaks, 2019)
Theme 2: Tattoos, Identity, Narrative, and Memory	
<i>Personal identity</i>	<ul style="list-style-type: none"> the symbolic nature of tattoos and their role in the 'project of the self' (Krutak, 2017; Woodstock, 2014) development and communication of self-identity and narrative (Lippert, 1980; Oksanen & Turtiainen, 2005; Rowsell et al., 2013; Sweetman, 1999), tattoos as a storyline and a narrative device (Paterson, 2017)
<i>Group identity</i>	<ul style="list-style-type: none"> information about a person's lineage and the location of family resources (Wilson-Fall, 2014) religious and ethnic identification (Meinardus, 1972), pilgrimage tattoos (Diktaş, 2020; Kurrat & Heiser, 2020); trade or artisan tattoos (Caplan, 2010; Newman, 1998), immigrants tattoos (Hiramoto, 2015) identity formation and communication among prisoners (DeMello, 1993; McCarron, 2008; Phelan & Hunt, 1998; Shoham, 2009; Vegrichtová, 2018)
<i>Narratives and memory</i>	<ul style="list-style-type: none"> tattoos as literacy artifacts (Kirkland, 2009), as culturally acquired 'sign vehicles' (Kosut, 2000), and as 'bodily writing' which may need to be both interpreted and translated (Lei, 2009; Sullivan, 2001) tattoos as means to negotiate memory, trauma, mourning and memorializing the dead (Brouwer & Horowitz, 2015; Davidson, 2017; Dyvik & Welland, 2018; Hill, 2020; Steadman et al., 2019)
Theme 3: Tattoos Information Seeking and Presentation Through Archives and Libraries	
<i>Tattoos as archives</i>	<ul style="list-style-type: none"> tattooed bodies as repositories in the absence of the Western concept of archives (Calano, 2012), representations of indigenous cultural tattoos in contemporary archives (Jelinski, 2017; Wright, 2009) 'intimate archives' of memorial tattoos amongst genocide survivors (Halilovich, 2016), and tattoos as personal records (Bastian, 2013; Harris, 2003)
<i>Tattoos as information sources</i>	<ul style="list-style-type: none"> tattoos as a starting point to discuss oral histories in a library outreach program (Pionke & Osborne, 2018) readers' advisory services recommendations based on patrons' tattoos (Dali et al., 2021; Morehart, 2018) tattoos as decolonized forms of literacy and reading (Clariza, 2019; Gilhooly et al., 2019; Irving, 2019) tattoo images as information sources that assist decision-making (Goulding et al., 2004; Salvador-Amores, 2011) and presentation of tattoo artists' work (Force, 2020) stigmatization of tattoos and information poverty (Brouwer, 1998; Lingel & Boyd, 2013)
<i>Tattoo related decision-making process</i>	<ul style="list-style-type: none"> factors influencing (re)search process in traditional tattoos (Krutak, 2017) health and risk factors in the decision-making process and search strategies (Armstrong & McConnell, 1994; Armstrong & Pace Murphy, 1997; Armstrong et al., 2002; Brown et al., 2000; Schulz et al., 2006) consumer commodity factors in the decision-making process (Lipscomb et al., 2008)

Table 1. Themes in the Academic Literature on Tattoos Relevant to Information Science

Having in mind preliminary mapping of tattoo research and gaps perceived from the literature review, we have identified several questions needing further exploration from the information science perspective: Are tattoos part of cultural heritage and as such should they be collected, presented and preserved for the future? If so, by whom and using what methodology? How can tattoos in their physical, intellectual and digital representation be preserved? How can the LIS sector help address tattoo copyright and cultural appropriation issues? Are personal information management and personal digital archiving practices of relevance to tattoo artists and individuals with tattoos? What literacy skills assist successful tattoo experience? What identity information do tattoos reveal in personal and work environments?

METHODOLOGY

Three research questions guided the first stage of our study: 1) What stories do people tell about their tattoos? 2) What information-related aspects (behaviors, need, experiences, environments, contexts, etc.) emerge from these stories? 3) Do the individual stories map to themes in the literature review? By answering these questions, we aim to identify components for a wider research framework that can be used to explore holistic individuals' tattooing information experience.

As a pilot study for a larger study, four participants in Aotearoa New Zealand were interviewed (two females, two males, age group 25 to 50, all of them with multiple tattoos). In this stage, our study doesn't aim for a representative sample; therefore, demographic criteria were not crucial. However, we included different cultural backgrounds as an important parameter. Our research approach was framed by a narrative inquiry of tattoo experience. We asked participants only one question, and that was to tell us about their tattoo(s). By allowing participants to tell a story of their tattoos, we were able to observe individual narratives of the tattoo experience and identify what topics emerge and recur. We will present collaboratively developed themes that came out of the thematic analysis of the interviews.

RESULTS AND ANALYSIS

I got this because...(Meaning)

All four participants opened their stories with a specific tattoo that is especially important for them and elaborated a meaning or a reason why they have a tattoo. The meaning was connected to a life phase, event or accomplishment they wanted to mark, so the tattoo served as a personal reward and also served as a memory. The meaning did not evoke emotions or memories on a daily basis ("You forget it's there" P3) but did unlock memories when participants were sharing stories about their tattoos with other people. The meaning-making process sometimes involved careful constructions of an image that would capture the reason. In some cases, a tattoo was decided on a whim, and the meaning was added later (such as an image from a label on a product found while shopping in a supermarket). "That's common for all my work. I just stumble upon it, and then it's just stuck in my mind, I think that would be so cool, I should get that done" (P1). In the cultural context of Māori and Pasifika participants, the meaning of their cultural tattoos links them to their ancestors, family history and culture (P2, P4). P2 talked about the meaning of his traditional tattoo linked through the *whakapapa* [genealogy] of his father and how with the meaning, he carries a certain level of responsibility to his *whanau* [family], "[*tā moko* (traditional Māori tattoo)] encapsulates my future kids and whakapapa they will share, stories I could pass on to my kids as a vehicle for continuing that bloodline and connections to ancestors." (P2)

I googled...(Search process)

The search process revolved around finding an image and finding an artist. For some tattoos, participants had an idea of a central symbol, and they browsed through artists portfolios (usually online, most often mentioned on Instagram) to find a representation they like. In other cases, they started with Google and browsed for ideas. "I jumped on Google and found that they do tattoos, followed them on Instagram, and looked their work and their tattoos and I absolutely loved their style" (P1). Participants often found Google searching to be a time-consuming process that leads to feeling overwhelmed with information, so they had to leave it aside and come back to it at a later point. In contrast, P1 often went with the gut feeling and deciding on the spot (for example, to get a tattoo as a souvenir while travelling). The search process in cultural tattoos included googling as well but more for cultural information on elements in a tattoo image and consultation with other members of their community whether it would be appropriate or allowed to use them (P2). As all four participants had previous tattooing experience, they didn't need information about health and safety, so they didn't search for it. P1 discussed conflicting advice on aftercare for tattoos and skin often received from artists, friends and googling, "I figured out my own opinions [...] People swear by different things. I've done a bit of googling as well, and you can't get a straight answer either."

I found this artist who is amazing...(Artist evaluation and communication)

After identifying one or more artists whose work they liked, participants booked an appointment to visit their studio and discuss their tattoo or directly go to have one. The trust was established on an intuitive feeling evoked by the artists' tone, communication style, the atmosphere in the studio, and on observing hygiene practices and contract

documentation. "They struck me as people who are respectful of human bodies, which was important to me as I was quite in an intimate place" (P1). Physical vulnerability and "lying their exposed" to some participants meant a lot (P1) and to some not at all (P3, P4). Participants were open to the influence of the artists on their decision and aware of the uniqueness of tattoos as art. "There is a lot of trust involved there. You tell them what you want, you show up on the day but you can never tell 100 % what it's gonna look like in the end. It could go terribly wrong" (P1). Participants mentioned allowing artists to share images of their tattoos through their portfolios, but the further conversation about the topic did not reveal any copyright or privacy awareness or issues on the participants' side.

With family, without family, for family, despite family (Sharing)

All participants emphasized the importance of sharing the experience and the result with loved ones and the way in strengthens family and friendship bonds. "When my friends are getting tattooed, I'll pop by the shop and say hi to staff that I know and hang out with my friend for a little bit, and they'll do the same with me" (P1). Participants who had traditional Māori and Pasifika tattoos described the relevance and meaning of family presence during the tattoo process as a support network and to celebrate achievement. P4 described how his tattoo of a name influenced other family members to get the same tattoo, and they now share a special connection within the family. P3 explained getting a tattoo despite parent opposition, but because of that being more supportive when her children wanted to get a tattoo. For all participants, tattoos encourage family conversations and understanding of family history, although those stories are usually told orally and not written down, even though photos are shared through closed groups on Instagram or Facebook. However, not much attention is given to preserving photos for future use (as a record of the original tattoo).

Do I hide it? (Identity presentation)

Choosing a body part on which to get a tattoo is closely connected to participants desire to be able to hide or display their tattoos. All participants expressed the fear of being judged negatively in a job interview or at work, although recognizing that there is growing awareness and acceptance of tattoos in New Zealand society as an expression of individual and collective culture. Participants were aware that tattoos speak about them whenever they are meeting new people. Some are open to talking about their tattoos in such situations (P2, P4, both with cultural tattoos), while P1 considers it as a private part of her identity, and P3 "forgets they are there".

Tattoo with time

Interviews revealed some indication of how the passing of time affects tattoo experience. There is a stronger association with feelings and memories as time passes, but not much changing body awareness or the need to retouch or correct tattoos. "Once you get one, you keep thinking about another one you want..." was an attitude expressed by all four participants. They elaborated how having a tattoo influence the way you look for a new tattoo, especially looking for a piece that would fit in and agree, visually and in meaning, with the tattoos they already have. "The more I get, the more lackadaisical I become about it, whereas my first one was quite small, and I thought for ages, and ages, and ages about it. I went back and forth with the artist asking them to share drawings they've done" (P1). P2 expressed a desire to get a *tā moko kanohi* (a traditional facial moko) in the future as a mark of a significant achievement in life.

CONCLUSION

Stories people tell about their tattoos reflect meaning-making process, information needs and seeking behaviors, information sources and information landscapes. Individual stories map to some of the themes in the literature review, such as tattoo in relation to identity, memory, narrative, and tattoo as a record and a document. While these mappings need to be further uncovered in a detailed analysis, the preliminary analysis showed connections between needs, practices and formation of individual and collective identities through tattoos.

This research presented the first steps toward exploring the information behavior of people who have tattoos on their bodies or are about to get one. Information behavior in this context includes searching for information about the tattoo process, deciding on the tattoo image, communication between a person getting a tattoo and a tattoo artist, attributing meaning to tattoos in personal and cultural contexts, caring for and preserving tattoos as physical and conceptual information, and sharing stories about tattoos. By providing insight into information seeking and experience in the context of tattoos, we aim to contribute to identifying information literacy, visual literacy and cultural literacy skills necessary for a successful tattoo experience. These findings can be relevant to the researchers of tattoo-related topics, to policymakers aiming for a more inclusive and diverse society, to everyone getting or having a tattoo and to tattoo artists and service providers in the field.

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What is a Good Visualization for Digital Humanities Researchers? An Exploratory Study

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ABSTRACT

Visualization in digital humanities (DH) has developed into a charged topic as increasing numbers of humanities researchers begin to work with machine-readable data. The current research literature on DH visualization has primarily approached the subject from a theoretical perspective, arguing the humanistic visualization should fundamentally differ from scientific visualization to represent the distinct nature of humanities data and inquiries. However, few studies have tried to empirically understand what it means to be a *good* visualization for humanities researchers and practitioners. This study aims to bridge this research gap by offering an exploratory investigation into researchers' perceptions on visualization, particularly how they evaluate a visualization in humanities research. Through 10 semi-structured interviews with humanities scholars engaging in digital work, our study demonstrates that perceptions of a quality visualization among the humanities researchers are closely related to researchers' purposes of using visualization and their self-confidence in visualization knowledge and skills. This study serves as a baseline for future empirical research on DH visualization and potentially informs the best practices for humanistic visualizations.

KEYWORDS

Digital humanities; visualization; semi-structured interviews; research data curation.

INTRODUCTION

Digital humanities (DH) have developed into an interdisciplinary field that comprises a broad range of research conventions, interests, and methods (Schreibman et al., 2004, 2016). The term "Big Tent DH" proposed as the theme of the DH Conference in 2011 rightfully captured the nature of the field (Svensson, 2012). Among the numerous research agendas in DH, visualization is a relatively new topic of examination. In recent works, scholars acknowledged the central roles of visualization in facilitating humanities interpretations and prosed the term "visual digital humanities" to capture a specific sub-field under DH that deserves more in-depth research (Drucker, 2020; Münster & Terras, 2020). As the graphical form of data representation, visualization is an enduring topic of *empirical examination* in science and technology studies (STS), especially its roles in measuring scientific evolution and facilitating scientific communication and education (Cleveland, 1984; Dimopoulos et al., 2003; Evagorou et al., 2015; Smith et al., 2002). Visualization research in the context of humanities scholarship, however, has predominantly focused on theoretical discussions of an ideal *humanistic visualization* without providing empirical accounts on what is actually perceived as a *good* humanistic visualization among DH researchers and practitioners. As a result, we know very little about how DH researchers and practitioners evaluate visualization. This study aims to bridge this research gap by posting a qualitative, empirical exploration of what counts as a good visualization among DH researchers. The "DH researchers" in this paper means any individual engaging in broadly defined digital humanities research projects, in which all levels of digital technologies and methods are leveraged to address humanities inquiries (Alvarado, 2012).

The central research question in this paper is: What is a *good* visualization to DH researchers? More specifically, we intend to explore how DH researchers' criteria for good visualizations relate to the following two aspects: (1) How do researchers' perceptions of good visualizations relate to their purposes of using visualization in research? (2) How do researchers' perceptions of good visualizations relate to the self-assessment of their visualization knowledge and skills? The first aspect was motivated by the wide variety of research areas in DH, while the second aspect was rooted in a hypothesis that digital humanists' appreciation for visualizations is impacted by their self-confidence in visual literacy, which might be examined more thoroughly in future studies. By addressing these questions, this study aims to empirically understand how DH researchers evaluate visualization in their daily research practices. Besides, by investigating the relationships between researchers' evaluation of visualization and their purposes of using visualizations as well as the self-confidence in visualization skills, this study sets out the first step to reconsider how information professionals can push forward visualization practices in digital humanities in the future.

LITERATURE REVIEW

In sciences and general information research, standards and criteria for good visualizations have been raised and explored in various ways. One prominent example was Tufte's (2001) principles of *graphical excellence*. Graphical excellence refers to "the well-designed presentation of interesting data" (Tufte, 2001), which is comprised of "complex ideas communicated with clarity (no ambiguity or confusion in graphs), precision (truthful results and distortion-free presentations), and efficiency (a minimal amount of chart "junk")" (Chen, 2017). By contrast, what it means to be a *good* visualization in humanities research remains a central question in DH scholarship. Researchers have discussed the idea of a *humanistic visualization*, which emphasizes the potential distinct character of visualization in the humanities scholarship. Compared with scientific visualization that values data abstraction principles, an ideal humanistic visualization is thought to be reflecting the nature of humanities scholarship and addressing issues such as bias, subjectivity, ambiguity, and complexity that are inherent and highly valued in humanities analysis (Bradley 2019; Champion, 2016).

Jessop (2008) proposed that good humanistic visualization should be treated as a scholarly activity that is highly interwoven into humanities interpretations. Corresponding to this notion, Drucker (2011) argued that visual displays in the humanities act as an "intellectual Trojan horse," a vehicle that always bears hidden, underlying data assumptions. And humanities data, which according to Drucker (2011) should be better described as *capta*, captured the "situated, partial, and constitutive character" of humanities knowledge. Manovich (2011) proposed the concept of "direct visualization" to argue that humanistic visualizations should retain the complexity and original forms of humanities data to serve the purposes of humanistic inquiries. Hinrichs et al. (2019) went further to model visualization in the humanities as a "sandcasting" process. Different from a "sandbox" that is widely used in computer science and software design to refer to a "safe yet constrained" experimental environment, "sandcasting" is "a metaphor for mindset, a methodology, and a praxis" integrated into visualization and research practices.

Empirical studies on DH visualization focused on the approach of bibliometrics analysis (Benito-Santos, 2020; Jänicke et al., 2017), benefiting from the increasing volume of publication data on DH visualizations (Bradley et al., 2018). In addition to the tremendous insights they have offered, a broader range of disciplinary and methodological practices, especially the ethnographic, qualitative methods, can also be applied to examine researchers' perceptions and practices of visualization (Antonijević, 2020).

METHODOLOGY

Interview design. In this study, we used semi-structured interviews as the major method to gather DH researchers' perceptions on a quality data visualization (Creswell & Creswell, 2018). We adopted an inclusive definition of DH researchers as our pre-screening criterion for interviewee selection, in which any individual with research experience using visualizations in DH-related projects qualifies as an interviewee for this study. To *recruit interview participants*, we used a snowball sampling technique (Biernacki & Waldorf, 1981). We started identifying potential interviewees from our social networks, combined with a major academic conference, i.e., the Association for Asian Studies (AAS) annual conference, which took place in March 2021 and had a digital technology sector. The AAS conference has a strong tradition in humanities research and a particular digital technology sector that features DH works, making it a suitable venue to identify and recruit DH researchers. After conducting interviews with a few participants recruited from the conference, we invited the interviewees to recommend participants based on our pre-screening criteria. We used the Critical Incident Technique (CIT) approach to design the interviews (Butterfield et al., 2005; Byrne, 2001). CIT involves the study of "critical incidents—or significant instances of a specific activity—as experienced or observed by the research participants" (Lipu et al., 2007). For each project, we instructed the participants to focus on one DH project where they used visualizations, illustrating the overall research topic, the central messages of each visualization, and how they made design decisions for the visualizations. We also asked about participants' purposes of using such visualizations and investigated how confident they are in incorporating visualization in their research by asking them to rate their visualization knowledge and skills on a scale of 1 (lowest) to 5 (highest). Each interview lasted for about one hour and was audio-recorded for transcription purposes.

Participants. We recruited 10 participants for the interview. Table 1 presents an overview of the participants. All the participants have strong academic backgrounds in the humanities and social sciences fields, with a few having multiple training in disciplines such as information science, mathematics, and biophysics. Most participants are junior scholars (e.g., PhD Candidate, Assistant Professor), except for one being a senior curator at a prestigious museum. Eight participants practice research in the United States, while two in France and China. The participants' research also covered a wide variety of visual representation forms, classified based on Arsenault et al.'s (2006) framework.

Participant	Academic Background	Academic Position	Region	Visualization Type Covered
P1	History	PhD Candidate	US	graphs
P2	Religion, information science	PhD Candidate	US	graphs
P3	Sociology, art history, museum studies	Senior Curator	France	photographic images
P4	Biophysics, chemistry, Japanese	Assistant Professor	US	graphs
P5	East Asian studies, mathematics	MA Student	US	graphs, geospatial maps
P6	Linguistics	PhD Candidate	US	graphs (e.g., bar charts, box plots)
P7	Religion	Postdoc	US	geospatial maps, photographic images
P8	History	PhD Candidate	US	geospatial maps
P9	Digital humanities, cultural computing	PhD Candidate	China	photographic images, 3-D simulations and models, drawings
P10	Anthropology, museum studies	Assistant Professor	US	photographic images, 3-D simulations and models, maps

Table 1. Overview of participants.

Coding and analyzing. We utilized the grounded theory approach for data coding and analysis (Charmaz, 2014). Two authors of the paper each conducted an open coding of the interview transcriptions. Open coding is the first step of coding and analysis in the grounded theory approach, which aims to formulate theoretical insights from the empirical data (Charmaz, 2014). The authors coded and analyzed information on (1) participants' criteria for good visualizations, (2) research tasks and perceived purposes associated with visualizations, and (3) researchers' self-confidence in their visualization knowledge and skills. Two coders then compared and discussed the open coding results to ensure they were accurate and comprehensive.

RESULTS

Criteria for a good visualization. Our results demonstrate that DH researchers have developed diverse standards and criteria to evaluate the quality of visualization. Among the answers we obtained, information clarity and the capacity of a visualization to effectively communicate the embodied ideas are the most important criteria among participants (n=6). However, most of these participants who valued information clarity the most in a visualization tend not to appreciate visual aesthetics. For example, as indicated by P1, "as long as the visualization shows clear information, visual elements such as the color do not matter that much to me." In addition, some participants (n=3) emphasized that simple visual forms are critical to them. A quality visualization, according to them, should bear simple visual forms to facilitate both the clear communication of the claims as an author and a straightforward interpretation of the visualization as a reader (P1, P2, P6).

When asked about their criteria for a good visualization in their research, a few participants (n=3) did not provide a clear answer but rather demonstrated that "it is something that depends." P3, a curator currently working in a museum, emphasized that visualization "should fit the purposes of research questions and be created with the most suitable tools to satisfy research goals." P8, a Ph.D. candidate in history, indicated that the most valuable visualization attribute to her is its ability to "clearly present arguments." Besides the effectiveness of addressing research questions, P7 also demonstrated that a good visualization needs to have "a high level of manipulation and flexibility" so that users can customize how complex they want the visualization to be based on their research needs.

Interestingly, only three participants in our data sample acknowledged the importance of visual aesthetics and design in a visualization. An information designer with academic training in both East Asian humanities and biophysics, P4 emphasized the importance of using effective "visual metaphors," in which data are manipulated and represented in a way that best expresses the ideas they aim to embody. One vivid example that P4 gave was to visualize non-linear, complicated narrative structures of movies. Visualizations, in this context, should be designed as an effective and powerful rhetorical device to visually inspire and express the narratives of the research objects. From another aspect, P7 also claimed that he would make the visualization *pretty* towards the end of the research, naming the aesthetic values as "the point of having a visualization, rather than a table or a list."

Purposes of using visualization. Participants reported various purposes of using visualization in their research. Two most commonly identified visualization purposes include: (1) describe data (P6, P9) and (2) present research findings to make them easier for understanding (P1, P2, P7). P2 also treated visualization as an analytic tool, stating that “in the stage of analysis, visualization can show me some information that I did not realize at the beginning and can help me dive deeper into the data analysis.” Participants also highlighted that visualization is particularly assistive to certain types of research questions in their fields. P1 indicated that visualization works the best for addressing questions related to change, while P5 demonstrated visualization is instrumental for him to answer pattern-oriented questions. Based on his research experiences in visualizing textual data, P4 claimed that visualization is particularly beneficial for “investigative research questions,” offering “another way of seeing data and documenting the investigation process of a question.”

Self-assessment of visualization knowledge and skills. We asked participants to rate their visualization knowledge and skills on a scale of 1 (lowest) to 5 (highest) and elaborate on the reasons. The majority (n=7) rated their knowledge and skills as between 2 and 3, while two participants (P3, P10) rated 1 and one (P4) rated 5. Almost all the participants explained for their self-rating based on their technical skills. Participants who rated towards the lower end of the scale demonstrated that they either could not program or were not familiar with the massive visualization software and tools out there. Only two participants (P4, P10) evaluated their visualization knowledge and skills from the perspective of visual critique, e.g., the ability to critically choose visual forms for data display and argumentation.

DISCUSSION

From the preliminary results, we have observed interesting relationships between DH researchers’ criteria for good visualizations and their purposes of using visualization as well as their levels of confidence in visual literacy. Researchers who only intend to use visualizations for data descriptions and results presentation seem to solely emphasize on information clarity and simple visualization forms. By contrast, researchers who use visualization as an argument-based analytic and interpretation tool tend to value more about the *design* aspects of visualization. The findings imply that functions of visualization in DH are perceived differently across DH researchers, and the evaluation criteria for DH visualization might vary based on distinct expectations and perceptions. Some uses of DH visualization demonstrate to be the same with scientific visualizations and follow the same principles of data abstraction and simplification (Lynch, 1990; Tufte, 2001); while some attempts seem unique in trying to capture and embrace the intrinsic uncertainty, complexity, and fluidity of humanities arguments with more reflexive and critical visual design. From another perspective, visual literacy plays a role in evaluating DH visualizations. Our results indicated that researchers with higher levels of self-confidence in visualization knowledge and skills might be able to think more thoroughly about visualization criteria, especially in terms of going beyond the functional considerations of visual displays (e.g., information clarity) and extending towards rhetorical and philosophical considerations (e.g., visual metaphor). Researchers who are confident about their technical skills seem to have the tendency to treat visualization as an integrated component of their research, expecting a good visualization to embody the humanities argumentation and analytical procedures (e.g., P4). Less confident researchers, in comparison, are more likely to focus on channeling the simplification power of visualization to assist with data description and results sharing. Findings from this exploratory study offer preliminary insights and hypotheses for understanding how DH visualizations are evaluated, which can be further tested with larger datasets and mixed methods in future studies.

CONCLUSION AND LIMITATIONS

This exploratory study demonstrates DH researchers’ various evaluation criteria for a good visualization and how the criteria relate to researchers’ purposes of using visualization and their self-perceptions of visualization knowledge and skills. We do acknowledge, however, that this study bears certain limitations. First, the limited data size of this study (i.e., ten interviews) made it difficult to draw more specific conclusions on—for example—the relationships between visualization criteria and the data types visualized. Larger data points in future studies are needed to further generalize insights in this aspect. Second, since most of the recruited participants come from humanities and social science research backgrounds, findings in this paper may only represent the realities in this community. Studies involving more diverse research communities, e.g., the STEM (science, technology, engineering, and mathematics) researchers, are in need to extend the current claims to other knowledge domains. Finally, our study at this stage cannot draw solid conclusions on the differences (if any) between criteria for DH visualizations and those for scientific visualizations, and future work is necessary to examine this issue in more depth. Despite these limitations, this study demonstrates preliminary steps to understand how DH research communities perceive a good visualization, including implications for information professionals to push forward visualization practices in DH.

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Image Position and Layout Effects on User Engagement of Multi-image Tweets

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ABSTRACT

Current researchers pay less attention to the image position and layout of tweets containing multiple images. This study explored the impact of image position and layout on user engagement on the Weibo platform. The XGBoost model trained on single-image tweet data was used to predict the “user engagement potential” of images in multi-image tweets. Then, the image position and layout effects on user engagement were analyzed through correlation analysis and OLS regression. It was found that the right position was more important in tweets with less than or equal to 4 images, and the position effects became symmetric with image adding. Layouts with 2, 3, 4, 5, 6, 8 images had positive effects on user engagement, while layouts with 7 and 9 or more images had negative effects. This study provides insights for user engagement with social media images and may help improve interaction.

KEYWORDS

Social media image, user engagement, machine learning, regression analysis.

INTRODUCTION

The Internet is undergoing a visual transformation, with pictures becoming the main social currency for online communication (Oeldorf-Hirsch et al., 2016). Previous studies have confirmed that the content of images can affect the user attention, and then affect user engagement (Keib et al., 2018). However, previous studies mostly focused on the single image and its content, ignoring the position and layout factors of images in the tweets containing multiple images. At present, most social media platforms support uploading multiple images in a single tweet. For example, each tweet on Twitter supports up to 4 images, and each tweet on Chinese Weibo can contain up to 18 images, but only the first 9 images are presented. The layout and the position of multiple images may affect the user's attention allocation and engagement. Therefore, this paper will investigate the effects of image position and layout on user engagement from the perspective of multi-picture tweets. Two questions are addressed:

RQ1: In multi-image tweets, which image position is more related to user engagement?

RQ2: In multi-image tweets, what are the differences among the effect of various layouts on user engagement?

The contribution of this study comes from three folds: (1) To the best of our knowledge, this is the first attempt to consider the position and layout effects of social media images on user engagement. (2) With the concept of “user engagement potential” of images, this study integrates the advantages of deep learning in prediction with the interpretability of correlation analysis and linear regression, which is instructive in methodology. (3) Findings towards position and layout effects can be used to guide image releasing and promotes user engagement.

LITERATURE REVIEW

Online users' social engagement includes click-based interaction and simple content browsing and reading behavior (Khan, 2017). Social media image can affect user engagement. It was found that aesthetic taste and specific visual features affect the popularity of food images (Peng et al., 2018). Photos taken by celebrities, sexy photos are more likely to be liked (Park & Lee, 2017). Showing face and emotions in a non-political environment usually increases the user engagement of images published by politicians on Instagram (Peng, 2020). The existing study also focused on the user engagement prediction with image features, such as color, texture, and entity objects (Khosla et al., 2014; Lv et al., 2017). For example, Gelli et al. (2015) combined visual emotion features with context features to predict image popularity based on the support vector regression (SVR) method. Ding et al. (2019) used the deep neural network and found that the user information features are more effective than images and text features for prediction.

User perception and behavior are influenced by spatial layout and position of information. According to the theory of conceptual metaphor, the core of the conceptual system is based on perception, body movement, and experience of physical and social nature. Abstract concepts such as time, quantity, and quality can be represented by more specific experience domains such as space (Lakoff et al., 2008). For example, people automatically believe that objects with high visual space are good, while objects with low visual space are bad (Meier et al., 2004). In the field

of marketing, consumers believe that popular products are placed on the middle shelf, expensive products are placed on the top, and promotional products are placed on the edge (Valenzuela et al., 2013). Some studies have also found that placing labels on packaging in a higher vertical position can enhance the perception of product power, which then influences the purchase intention (Machiels et al., 2017).

While research about social media images only focused on the position factors within one image, little attention was paid to the layout and position of multi-image tweets. Layout and position metaphors exist widely. Therefore, this study attempts to explore the layout and position effects of multiple images on user engagement.

METHODOLOGY

Data collection

This study used the image tweets from the Weibo platform, a Chinese social media site similar to Twitter. To make the tweets representative, a list of 2,972,119 accounts was extracted from the fan lists of the 20 most influential people in each of the 44 interest areas. Then, users who posted less than 2 tweets in December 2020 and had fewer than 100 followers were filtered. 23,665 eligible users were randomly selected. Finally, we retrieved tweets containing at least 1 image from the selected users between December 1st, 2020, to December 31st, 2020. Each tweet includes the text description, image, image position number, number of thumb ups, number of comments, and number of retweets. The whole dataset contains 123,380 image tweets with 296,470 images.

User engagement potential prediction

The user engagement of image tweets was manipulated to the natural log of the sum of the number of thumb ups, retweets, and comments, which were the main interacting ways on Weibo. Then, it was assumed that each image has some “user engagement potential”, that is, the amount of user engagement the image might get if it is published separately with the context (text, user, time, etc.). Here, we proposed a novel calculation method, which used the prediction model trained on single-image tweets to estimate the user engagement potential of images in multi-image tweets. In this way, the user engagement potential of each image in multi-image tweets could be separated.

The XGBoost algorithm, a machine learning method based on the ensemble learning principle, was used to predict user engagement. 80% of the 72,342 single image tweets were used for training and the rest as test data. The input features of the model included 2,826-dimensional features from three aspects: image, text, and social context. Specifically, a 2048-dimensional image representation was extracted from the deep learning model ResNet-101 (He et al., 2016) pre-trained on ImageNet. A 768-dimensional text representation was extracted from the pre-trained deep learning model ERNIE (Sun et al., 2019), which is effective in Chinese natural language processing tasks. The hashtag and the character number were also included. Then, the average user engagement, the tweet number, fans, followed, the location tag, the gender, the releasing date were taken as the social context features.

Image position and layout effects evaluation

Multi-image tweets will be presented in different layouts through adaptive adjustment in the Weibo platform according to the image number. Figure 1 shows the image layout corresponding to different numbers of images, where tweets with 2 images to 8 images are presented in layout 2 to 8, and tweets with 9 or more images are presented in layout 9.

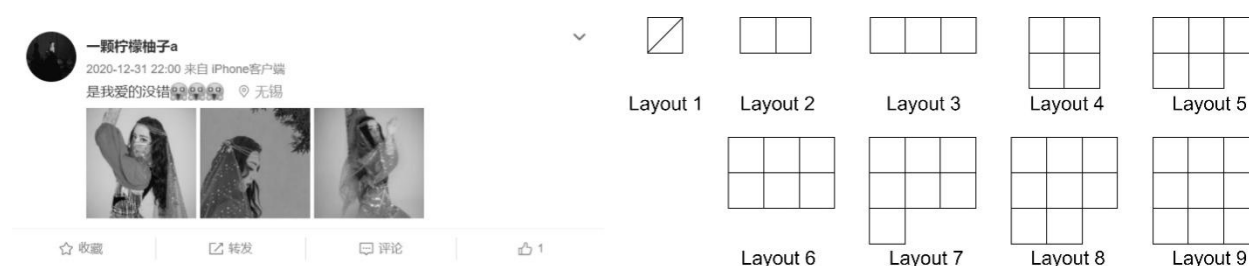


Figure 1. A multi-image tweet sample (left) and the layout patterns of tweets (right)

Due to the multicollinearity between the positions, the correlation analysis instead of regression analysis was used. The Pearson correlation coefficients between the user engagement potential that the image on each position held and the actual user engagement of tweets reflected which image position was more important.

The OLS regression analysis was used to explore the layout effects on user engagement. Firstly, the dummy variables of the image tweet layout were constructed. Then, the user engagement potential of tweet images, which aggregates image, text, and social context information, was weighted by location correlation to get the overall user engagement potential of multi-image tweets, which was used as a control variable.

RESULTS

Data description

The image tweet dataset included 72,342 single-image tweets, while the rest 51,038 tweets contained multiple images. For the number of various multi-image tweets, the number of tweets with 2 images was the largest, accounting for 12%, followed by tweets with more than 9 images (11%), 3 images (7%), 4 images (5%), and 6 images (4%), and the number of tweets with 5 (1%), 7 (1%) and 8 (0.5%) images was relatively small.

User engagement potential prediction

The mean square error (MSE), mean absolute error (MAE), and Spearman correlation coefficient (SRCC) were used to evaluate the prediction performance. The MSE, MAE, and SRCC of the final model on the test set were 1.56, 0.94, and 0.77. This model was used to predict the user engagement potential of each image in multi-image tweets. Besides, Table 1 shows the performance of models trained on different feature aspects. The social context features were the most effective predictors, indicating that user and spatiotemporal features largely determine user engagement.

Feature	MSE	MAE	SRCC
Image Features	3.63	1.57	0.38
Text Features	3.30	1.50	0.45
Social Context Features	1.73	0.97	0.75
All Features	1.56	0.94	0.77

Table 1. Performance of Different Features

Correlation between image position and user engagement

Figure 2 shows the Pearson correlation coefficient between the user engagement potential at each image position in tweets with different layouts.

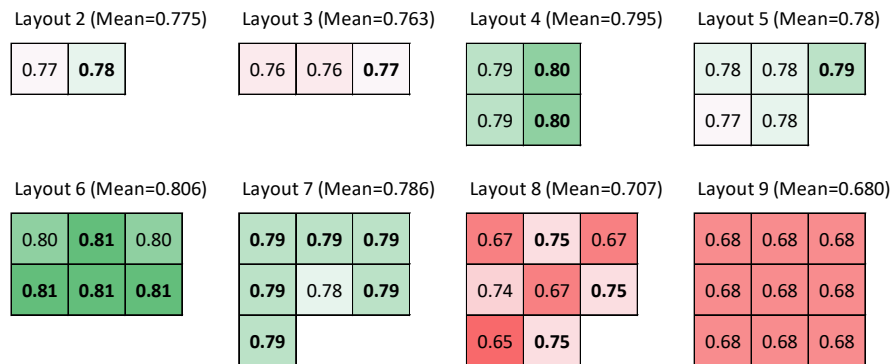


Figure 2. The Pearson Correlation Coefficient between Image Position and User Engagement

All the correlation coefficients were significant at 0.001 level, which indicates that the user engagement potential of images at each position was correlated with the user engagement of tweets. It can be seen that in layouts 2-5, the position with the largest correlation coefficient was located at the right side of the image. The highest correlations in layout 6 were in the middle and at the bottom. In layout 7, the position with the highest correlation coefficient was located mainly at the edge. The positions with the highest correlation coefficients in layout 8 were the four positions around the center. The correlation coefficients of layout 9 at all positions were equal.

The impact of layout on user engagement

The regression analysis results are shown in Table 2. The multi-image layout variables were compared with the reference group of the single-image layout. Every layout pattern had a significant impact on user engagement at the 0.001 significance level. Layout 2 ($B=0.046$), layout 3 ($B=0.081$), layout 4 ($B=0.154$), layout 5 ($B=0.181$), layout 6 ($B=0.235$), and layout 8 ($B=0.270$) had a positive impact on user engagement compared with layout 1. Layout 7 ($B=-0.146$) and layout 9 ($B=-0.079$) had a negative impact on user engagement. Besides, the position-weighted user engagement potential also had a significant positive impact ($B=1.065$) on user engagement.

Variable	B	Std. Err	t	Sig.	[95% Conf. Interval]	
Layout 2	0.046	0.010	4.470	0.000	0.026	0.067
Layout 3	0.081	0.013	6.303	0.000	0.056	0.107
Layout 4	0.154	0.015	10.330	0.000	0.125	0.184
Layout 5	0.181	0.033	5.496	0.000	0.116	0.245
Layout 6	0.235	0.017	13.790	0.000	0.202	0.268
Layout 7	-0.146	0.041	-3.539	0.000	-0.227	-0.065
Layout 8	0.270	0.047	5.781	0.000	0.178	0.361
Layout 9	-0.079	0.011	-7.026	0.000	-0.101	-0.057
Position-weighted user engagement potential	1.065	0.002	563.433	0.000	1.061	1.069
Adjusted R-squared	0.757					

Table 2. OLS Regression Analysis of Image Layout on User Engagement

DISCUSSION

The effects of image position on user engagement

For RQ1, this study found the role of image position in user engagement. Similar to the metaphor of shelf position to consumers, the importance of image position has a certain regularity in the horizontal direction, the right position was more related to user engagement than the left position, which was most obvious in layout 2~5. The characteristics of the longitudinal position effect were not obvious relatively. As the number of images increased, the position effect pattern became more complex, but it is still noticeable that the left-right position effect shrinks: the position effects of layouts 6~9 were relatively symmetric. It has been suggested that the origin of the ordinal position effect is the reading/writing direction and spatial metaphor like “more is right” (Zhou et al., 2019). So one possible explanation for the image position effects might be related to the image browsing order habits.

The effects of image layout on user engagement

For RQ2, the results of regression analysis demonstrated that user engagement was affected by the layout. Adding images and changing the layout may have a certain scale effect and increase user engagement, but sometimes the effect was no better than a single image. Layouts like 4 and 6 had positive effects, while layouts 7 and layout 9 produced negative influence. It may be due to the image attracted the attention of users. But some layouts make it difficult for users to grasp the key content. Excessive images increase the cognitive load of users and distract their attention, which also limits the relationship between each image and the user engagement. This explanation can be supported by the analysis of the position effect. After layout 6, as the number of images increased, the level of the correlation coefficient representing the importance of the location decreased. Besides, there was a mismatch between users' layout using habits and the actual user engagement effects. The frequently used layout 9 was not effective in promoting user engagement.

CONCLUSION

This research explored the position and layout of images in multi-image tweets on the Weibo platform through a novel method. The right position was more important in tweets with less than or equal to 4 images, and the position effect became symmetric with the adding of images. Some layouts like layouts 6 had a positive effect on user engagement, but others like layouts 7 and 9 had a negative effect. As a study driven by social media data, this study has some limitations in psychological motivation analysis. Further study could verify the user's selective reception process of image position information and psychological motivation through questionnaire survey, and eye movement experiment. In the aspect of user engagement prediction, in addition to image features with translation invariance, the internal and external position features can also be considered.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the grant from the Ministry of Education in China of Humanities and Social Sciences project (19YJA870009), Natural Science Foundation of Shaanxi Province of China (2020JM-056), and Fundamental Research Funds for the Central Universities (SK2021037).

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Policies, Procedures, and Decision-Making: Data Managers and the Research Lifecycle

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ABSTRACT

Research data is an asset. Researchers may be required to provide access to their data by scientific funders or academic journals and deposit their data in archives. Managers of archives are guided by principles, policies, and the law when curating and providing access to data. Practices around data storage and access, however, are not always cut and dry; research data managers sometimes need to interpret policies. This paper presents findings from qualitative interviews with 15 data managers from 8 repositories in the U.S. These repositories were all affiliated with universities but served varied constituents and provided a range of services. Differences revealed opportunities and challenges in managing data repositories regarding, for instance, who can access data and the level of protection data requires. We also found that data-related policy challenges may stem from any stage of the research lifecycle.

KEYWORDS

Research data management; archives; policy; decision-making; research support.

INTRODUCTION

Empirical research is performed through surveys, measurements, observation, and other methods that produce data. Data can take significant time to collect, and thus, it has value. Primary data is often used to answer original research questions, but if it is made accessible after its original use, other researchers can reuse it to answer questions through secondary data analysis (Devine, 2003; Heaton, 2008; Moulaison Sandy et al., 2017). Researchers might share their primary data for altruistic reasons, to support readers' interpretations of their work, or because they are required to do so by a funding agency or academic journal (Stebbins, 2013; Tenopir et al., 2018). Datasets can be stored in a university repository, a data repository associated with a publisher, or a standalone repository. Repositories are often managed by a librarian or data manager who helps researchers deposit their data, curate the data, and provide access to data.

Increasingly, research data is available through archives because of data sharing requirements (e.g., the White House Office of Science and Technology Policy (OSTP) 2013 memorandum entitled *Expanding Public Access to the Results of Federally Funded Research* "directed Federal agencies with more than \$100M in R&D expenditures to develop plans to make the results of federally-funded research freely available to the public" (para. 1)). Digital tools make it easy for researchers to collect and share data, and the open science movement encourages the sharing of data to allow for study replication.

Policies, created by repositories, funding agencies, etc., guide decisions about what kinds of data archives can accept, how data will be protected, who will be granted access to data, and how users will access it (e.g., in person, via VPN). Interpreting or implementing policy, though, can be difficult, especially with sensitive or problematic data. Research managers also must comply with legal and policy requirements (e.g., *The Family Rights and Privacy Act*, or FERPA; Institutional Review Board (IRB) requirements; *The Common Rule*) created by other entities governing the research lifecycle.

This study focuses on problems that research data managers encounter and how they interpret and implement policy to meet organizational goals and advance science.

RESEARCH QUESTIONS

This paper presents findings from interviews with researchers in their work as data archivists. What is the nature of problems that arise in research data archives? How did our study participants navigate decisions in their work that challenged or complicated policy adherence and implementation?

METHOD

We completed our study in January 2021 by conducting semi-structured interviews, using Zoom, with 15 participants (7 administrators and 8 staff) in 8 U.S. data archives, including large, internationally known archives, smaller institutional archives affiliated with university libraries, and archives affiliated with research institutes. Our

interview protocol and IRB form were distributed to participants prior to our interviews. Each participant was invited to describe their job and then describe a problem they had encountered in the course of their regular work. Our interviews were recorded and transcribed using the online service Rev. The researchers read the transcriptions, identified main policy and decision-making problems that the participants discussed, then created overarching themes that framed the problems discussed by study participants. The researchers identified (1) the “types” of dilemmas during the research lifecycle in the context of data management, and (2) situations where policy was insufficient to avoid dilemmas or guide decision-making.

FINDINGS

The main ideas we identified in our interviews related to *access and sharing data*, *data collection*, and *infrastructure and resources*.

Participant and Role	Case	Main Idea
P-1: Project Manager	Challenges in responding to restricted data access violations and providing computing resources	Access and sharing data; Infrastructure and resources
P-2: Research Professor, Past Director	Obtaining permission from school districts for a large-scale research project that was consistent with FERPA to create a data access plan that could be approved by IRB	Access and sharing data; Data collection
P-3: Project Manager	Conflict between the U.S. executive and judicial branches regarding who provides access to a statistical data series	Access and sharing data
P-4: Research Investigator	Dilemma in determining how to allow sharing of crosswalk file for a legacy longitudinal study	Access and sharing data
P-5: Project Manager	Worries by curator about releasing a high-profile, well-funded research dataset because of questions about accuracy and falsification	Data collection
P-6: Privacy Officer	Questions about how to make uniform decisions about the repercussions of restricted data access violations	Access and sharing data
P-7: Assistant Director	When working with a journal, there is a requirement for computational reproducibility using data; however, journal editors can overrule this, so the archive creates notes if this happens	Access and sharing data; Data collection
P-8: Associate Director	Cases of questions whether qualitative data can be shared	Access and sharing data
P-9: Project Manager	Lack of detail in grant document and policy to determine who to contact when there was a restricted data access violation	Access and sharing data
P-10: Research Data Librarian	Issues with determining ownership of code	Access and sharing data
P-11: Director of Curation	Difficulty in curating data from multiple funding agencies to meet federal data archiving requirements	Infrastructure and resources
P-12: Librarian	Challenges associated with creating a university-wide research data policy	Infrastructure and resources
P-13: Senior Curation Specialist	Difficulty in accommodating data depositors request for their data to be provided as open access	Access and sharing data
P-14: Director of Research Data Services	Balancing the desire to provide open, free access to data by the library with IRB desire to protect study participants, and doing so in a comprehensive manner under a larger policy framework	Access and sharing data; Data collection; Infrastructure and resources
P-15: Director of Research Data Services	Finding how much storage space to provide for users who self-deposit for them to meet data archiving requirements	Infrastructure and resources

Table 1. Participants, dilemmas, and main ideas found in dilemmas

Access and sharing data

The most common problem presented by our study participants, as expected, related to providing access to data after it had been deposited in an archive. This step falls at the end of the traditional research cycle but at the beginning of the secondary research cycle (that is, re-use). Participants discussed reasons that they encountered for depositing data in a repository (e.g., a requirement of a federal grant or journal) as well as secondary users’ research intentions (e.g., combining datasets to produce new knowledge or for investigator reporting).

P-1 reported that although their archive has policies regarding terms-of-use, sometimes researchers do not adhere with these terms. Their dilemma centered on a researcher’s publication that included sample sizes that were small enough to identify individuals; they explained that their repository has a responsibility and contractual obligations to

prevent such data from being published. They also had policies to balance providing data access with the potential for harm, which may come from reuse: “there’s this grid where it’s easy to identify little harm, or hard to identify, but a great deal of harm could happen.” P-2 reiterated the point and demonstrated a challenge for the open science movement: “In this space we’re talking about confidential data, the dilemma is, how much protection do you put, do you use, versus how easy you make it for researchers? The researchers want everything to be costless from their point-of-view, and they want to get as much data as possible.”

Meeting policy or legal requirements

All data repositories have policies to guide decisions, but they are not iron-clad; there are exceptions which arise based on changes in situations, personnel, technology, etc., and differing interpretations of policy at all stages of the research process. For instance, data managers ensured that researchers followed research protocols approved by IRBs prior to data collection, and that archives followed their own policies for data storage and access after deposit. P-7 described a policy conflict about publishing data with a journal editor. The archive is contracted to verify all statistics following peer-review:

the authors are required to submit their data sets and their code and certain documentation... We curate [data] to make sure all the documentation is complete, and then that dataset goes to our statisticians. These are Ph.D. students who will run the code on the data to make sure the outputs match what’s in the manuscripts before the manuscript is published. And then we publish the data.

Disagreement arose when statisticians were unable to verify study results, but the editor wanted to publish the paper anyway. Ultimately, the editor’s wishes were granted, but P-7 felt mollifying the author and editor ultimately undermined the journal and archive’s reputations.

P-13 discussed a need for consent documents that clearly allowed data-sharing, marking a legal issue at the beginning of the research cycle. P-2 discussed storage and access to student test scores and teacher observation data, which fell at the end of the research cycle. The school system’s lawyers focused on FERPA, but the archive staff were concerned about teacher data because it was identifiable. P-6 discussed external regulations regarding the security of information systems. P-10’s dilemma concerned the intellectual property of code; policy or legal requirements were not sufficient and muddled by university regulations about intellectual property, as it was the property of a university. P-11 discussed policies surrounding levels of curation and resources that data managers are allowed to devote. Less experienced staff members, complicated data, and unfamiliar technologies can cause processing delays, and archivists must have some flexibility in meeting federal archiving policy requirements when delays arise.

Infrastructure and resources

The third theme in our findings related to policies in place within data archives regarding infrastructure and resources, such as how much data an archive can accept, and resources (human, time, finances) that the archive is able to devote to a project. Data security is an important systems-related consideration; smaller university repositories might not be equipped to provide secure data storage and access, so their policy may be to direct researchers to a more appropriate archive. Time was frequently mentioned as a restraint, especially regarding data curation. P-15 discussed constraints on storage space with researchers allowed two terabytes of storage per year, but they explained, “it’s not like there’s a hard stop in the system. [At] 10 [GB], we start to get a little bit more anxious. 80 [GB], we can’t do. It’s not the right system for that, honestly.” If researchers required more resources than the archive could provide the archivist directed them to another, more appropriate institution. Resource availability and infrastructure were especially problematic for smaller, general university data archives as well, which tend to have fewer resources than large or topical repositories. Larger, specialized repositories appeared to have more resources to perform tasks associated with data curation and providing secure data storage, as well as other services.

DISCUSSION

One of the purposes of this study was to find if rules and policies effectively guide data managers’ decision-making, and whether they have sufficient capacity to navigate conflicts or anomalies that fall outside of policy. The people we interviewed were all professionals and had substantial expertise in their domain. Most worked on a team that can help clarify procedures or directions when no existing policy applied. P-6 explained that they “create policies that we can generally all agree on or at least policies that are 80-20, right? Like, it covers 80% of the use cases, and then 20% we deal with as one-offs.” This means policy was generally sufficient to address problems, which we found most often related to our three themes.

Research data managers often work within a multi-layered system, though, and the values inherent in such layers are not always in alignment. This was noted by P-14:

I think our organizations all have particular ways that we think about this. Like the library is coming at [data policy] from one angle of wanting to make information as open and accessible as possible to satisfy people’s

[...] needs. The IRB has the mantra or the rule of protecting human subjects. And sometimes that leads them to think more overly cautious than perhaps might be warranted in my generalist opinion. The university itself, I think they recognize that there is a compliance aspect to this, and they do not want to jeopardize research funding or being able to publish in prestigious journals. But they're also very worried about getting sued or having legal action taking against them.

P-12, however, found that they could rely on campus partners (e.g., IRB or the legal team) to help address dilemmas in research data management.

During the course of our interviews, most participants stated that their repositories exist to support scholarship, and when possible, to make data open and reusable. However, “open” does not always mean freely available to everyone. Determining who is eligible to access data (e.g., credentials needed), and how (in person, via secure VPN, etc.) created intractable problems for study participants. Several discussed occasions when they refused to accept or provide access to data. P-6 said that it was easy to comply with associated federal regulations, but that “individual users who want to access data and there's something weird about it, or a dataset has come to us where we're not sure how best to protect it because it's something we don't often deal with” are problematic. Some datasets are very complex. These data might have been created with specialized software or domain-based knowledge. In such situations, policy was insufficient, and archives turned to partners for help.

Publishers, too, might present an emerging concern in the research data space. P-12 explained that data services located in university libraries focus on open and reproducible data, but that now publishers:

are really expanding the scope of their services to grab more than just research articles. They're trying to get data, they're trying to move into this open area and enclose them a little bit, and there's a concern. We're very protective of our intellectual property on campus, but we don't really have anything that we say around data.

This quote emphasizes both the value of data and the necessity investment in the infrastructure of data curation and preservation to support scholarship.

CONCLUSION

The research data management space is not new, but it is still evolving. Different models of data archives continue to emerge in response to researchers' needs, technological evolution, and grantors' requirements. Laws and policies exist which pertain to each phase of the research lifecycle, but they cannot anticipate all problems. New technologies, legal or funders' requirements, and competition tax data archives' resources. Data managers still have to make decisions on a case-by-case basis in these instances, shaping policy as they muddle through decisions.

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Interpreting Police Video: A Pilot Study

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ABSTRACT

The visual records police body-worn cameras (BWCs) produce are frequently characterized as presenting more complete, comprehensive, and objective evidence of police-public encounters than other forms of evidence. Despite a growing body of research on the social impacts of BWCs, we still lack a rich understanding of what *information* these technologies provide viewers. This ongoing exploratory project examines how people interpret what they see in BWC footage and what judgments they make about the appropriateness of depicted police conduct. Drawing from interviews with twelve students and twelve sworn police officers, I present initial exploratory findings. Participants viewed BWC video of a police-public contact in which an officer stops a man on a sidewalk to question him, resulting in a foot chase and, ultimately, an arrest. When asked whether the officer's behavior was justified, police officer participants were more likely to focus on things like police training, procedure, and legality to justify the officer's action, while student participants were more likely to focus on the officer's demeanor, reporting that he should have been calmer and may have escalated the situation by not explaining clearly why he had initiated the stop.

KEYWORDS

Body-worn cameras; surveillance; policing; information politics; visual evidence.

INTRODUCTION

Police body-worn cameras (BWCs) have become an increasingly popular tool for the techno-regulation of law enforcement officers in multiple countries around the world. They often represent a “deliberate or intentional use of technology to regulate human behavior” (Leenes, 2011, p. 149; Koops, 2011). The adoption of BWCs by public police agencies certainly makes daily police work more visible and, at least when deployed within certain regulatory contexts, promotes police transparency. However, despite a quickly growing body of research on the social impacts of BWCs, we still lack a rich understanding of what *information* these technologies provide viewers (in the sense of what they communicate to various audiences and what these audiences infer from the records that various BWC technologies create). We can draw insights from prior research in visual communication and other disciplines that examines how people view and interpret video and other visual evidence, but the point-of-view and movement of police body-worn camera video (BWV) provides a unique opportunity to examine these questions.

This research represents an exploratory investigation, still in progress, designed to examine **two primary research questions**: 1) how do viewers interpret what they see in BWC footage and 2) what judgments do they make about the appropriateness of the depicted police officer conduct? In short, I am interested in what information BWV provides participants and how they then make judgments about what they see. BWV is frequently viewed and interpreted by a wide variety of actors, from lay persons to journalists, the police officers themselves, jury members empaneled in criminal cases, or internal affairs employees working within a police agency. Understanding how viewers interpret what they see in BWC footage and what judgments they make about the appropriateness of depicted police conduct may give us greater insights into the role that BWCs are playing—or may play—in building or degrading community trust in local law enforcement and how they may impact outcomes in criminal or civil litigation.

I use the word *information* here in the “ordinary, everyday sense” described by Buckland (2017, p. 6), with its two primary meanings: “(1) what we infer from gestures, language, texts, and other objects; and (2) material forms of communication—bits, books, and other kinds of physical messages and records.” That is, I am interested in understanding what participants infer from BWV—digital, visual records made up of bits (Blanchette & Becker 2018; see also Blanchette 2011)—and what meaning they attach to those inferences as that relates to judgments about the appropriateness of, or justification for, officers' decisions to use force or effectuate an arrest. This inquiry is situated within *realistic*, or “higher” information science (Buckland 2017, pp. 1-5), approached from the perspective of social informatics, or “the interdisciplinary study of the design, uses and consequences of information technologies that takes into account their interaction with institutional and cultural contexts” (Kling 2007, p. 205). More broadly, I intend this exploratory research to inform future projects on the social implications of BWC adoption by law enforcement, the subsequent visibility that these cameras afford to police-public interactions, and the inferences that people draw from viewing the resulting BWV produced by the cameras—that is, the knowledge imparted (Buckland 2017, p. 2).

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POLICE VISIBILITY AND THE POWER OF POLICE IMAGES

Video evidence is often touted as providing a more objective view of real-life events than other forms of evidence, including eye-witness testimony. A variety of actors have constructed an image of video surveillance (like that generated by BWCs) as something desirable that can empower democratic oversight of the police. At the same time, the role of video evidence in documenting police officer conduct has expanded dramatically in recent years. In 2020, the police-involved killings of George Floyd, Breonna Taylor, and others ignited massive protests around the US and internationally. These tragic events of police-involved violence have (once again) cemented police transparency, visibility, and accountability as central topics of public discourse in American society.

The notion that “video ‘tells us exactly what happened’ [is] an ideology which extends throughout the justice system” (Adams et al., 2020, p. 2). Indeed, the “new transparency encourages beliefs in images speaking for themselves, in cameras as mechanically objective witnesses, and in information as self-evident” (Brucato 2015, p. 44), a view adopted by the Supreme Court of the United States in a case involving dashboard camera video of a high-speed chase (Scott v. Harris, 550 U.S. 372 [2007]; see Kahan et al., 2009) and in other federal courts (see, e.g., Fields v. Philadelphia, 862 F.3d 353, p. 359 [3rd Cir. 2017], wherein the court proclaimed that a video recording of a public-police encounter “corroborates or lays aside subjective impressions for objective facts”). The willingness to accept the “mechanical objectivity” (Brucato, 2015) of visual records (such as BWV) is sometimes referred to as *naïve realism* (Feigenson & Speisel, 2009, pp. 8-9). In the current moment, “the only evidence more powerful than ‘I saw it with my own eyes’ is ‘I have it recorded on camera’” (Adams et al., 2020, p. 1). As the famous Rodney King trial (in which defense attorneys successfully re-framed the narrative surrounding the beating of a black man by several Los Angeles police officers by playing the video in slow motion and offering officer-friendly explanations of the depicted events [Brayne et al., 2018; Goodwin, 1994; Stuart, 2011]) demonstrated, the interpretation of video evidence is not always a straightforward, objective task. Indeed, visual images operate “as de-contextualised records of corporeal experience” and differ from text and language in how they are, and should be, interpreted (Bock, 2020, pp. 1-2). Likewise, as Gates (2020, p. 404) has argued, “turning media records into evidence is an analytical, interpretive activity.”

Research from a variety of disciplines has started to examine the use and interpretation of BWC footage as visual evidence (see, e.g., Bailey et al., 2021; Adams et al., 2020; Gates, 2020; Ristovska, 2020; Kalle & Hammock, 2019; Birck, 2018; Fan, 2017; Culhane et al., 2016; Boivin et al., 2016; Blanchette & Becker, 2018). Some of this research suggests the presence of bias in the interpretation of video evidence in a variety of contexts (Granot et al. 2017), including with BWCs (Culhane et al., 2016) and videotaped police interrogations (see e.g., Lassiter & Irvine, 1986). The meaning of these records—what information they communicate—is often highly dependent on contextual factors such as perspective, placement, or field of view (Kahan et al., 2009; Taylor & Lee 2019; Smith et al., 2019; Kalle & Hammock, 2019; Birck, 2018; Boivin et al., 2017; Adams et al., 2020). Importantly, misconceptions about the objectivity and self-evident nature of video evidence has the potential to impact judges, juries, and other groups of individuals tasked with interpreting video evidence of crime or police (mis)conduct, and likely also impacts public perceptions of policing within communities after instances of on-camera police-involved violence (see, for example, work on cultural cognition and cognitive bias by Kahan et al., 2012; Kahan, 2009, 2013). “Justice may need to be seen in order to be done” (Ristovska, 2020, p. 420)—but what does it mean to *see* evidence captured on video? Reaction to these videos is driven by the information gained by the viewer—that is, how the viewer interprets the events and makes judgments about the appropriateness of the depicted officer conduct. In many cases, interpretations of the depicted events can vary, as subjectivity, context, and individual biases all contribute to how people make sense of what they see.

METHODS AND LIMITATIONS

I surveyed and interviewed twelve (12) police officers and twelve (12) university students. Participants completed an online questionnaire, which included the 34-item Attitudes Towards Police Legitimacy Scale (APLS) (Reynolds et al., 2018), prior to sitting down for face-to-face interviews. The interviews included a series of prepared questions alongside the review of selected police videos. In this short paper, I report initial findings based on interview responses related to one of these videos. This video depicts a bicycle officer stopping and questioning a Black man on an urban sidewalk. The man argued with the officer, claiming the stop was racially motivated, and the officer did not appear to explain exactly why he had stopped the man for questioning. Eventually, after being told he was not free to leave, the suspect turned and fled from the officer, leading him on a foot chase. Shortly thereafter, the suspect stopped running and the officer, along with another officer who had arrived in a patrol vehicle as backup, effectuated an arrest. Due to a technical error in the early stages of the pilot, only 11 officers viewed this particular video.

Officers were recruited from a municipal police agency in mid-sized city in the midwestern United States that employed more than 500 sworn officers at the time of the study and had deployed BWCs two years prior to when the study took place. All of the officers identified as white men, ranging in age from 32 to 51 years old. Five of the

12 respondents were regular police officers (four in patrol and one in the department's training section), one was a corporal (patrol), five were lieutenants (two in patrol, two in internal affairs, and one in the administrative section), and one was a commander within the department's internal affairs section. Half reported having more than 10 years of professional law enforcement experience. All but one officer reported having at least a four-year degree, with half reporting at least some graduate-level education. Nearly two-thirds ($n = 8$) reported being on the "conservative" side of the political spectrum.

Student participants were recruited through an established mechanism in which undergraduates could obtain academic credit for participating in research studies at a large public university located in the midwestern region of the US. Students could choose from a variety of options, of which this study was one. They represented nine majors across campus. Student participants ranged in age from 18 to 24 years old, with eight identifying as "female" and four as "male." Nine students identified as "White" (with one additional student identifying as both "White and Native American"). Two students identified as "Black or African American." Half reported being on the liberal side of the political spectrum, while the other half split evenly between being "moderate" and "conservative." Likewise, half of the students reported being from families making less than \$100,000 USD per year, with two reporting family incomes of less than \$25,000 USD per year.

Data analysis was carried out using quantitative and qualitative data analysis software. The qualitative analysis occurred within the context established by the deductive structures of my interview questions. However, I also engaged in an iterative process of inductive coding in which I first created a large number of codes, then consolidated codes based on certain themes I saw emerging from my initial analysis, and finally expanded my coding again to include and differentiate different ideas contained within each theme. At the outset, I think it is important to recognize that questions like those I asked in this study, about individual interpretations, beliefs, and judgments are the sorts of queries that "resist simple, formal explanation" (Buckland 2017, p. xiii). As such, my findings are shaped by my own experiences and the way I, in turn, interpreted the data collected from my participants. Additionally, my sample size was small, my participants all self-selected, and my police respondents were unusually representative of higher ranks. I can't avoid the fact that these factors contributed my findings and diminish my ability to generalize my findings more broadly.

INITIAL FINDINGS

There was a significant difference in perceived police legitimacy between police officers and students on the APLS ($t_{13.490} = -4.031, p = .001$). Student participants, on average, reported lower levels of perceived police legitimacy ($M = 5.0039, SD = 1.07405$) than did police officer participants ($M = 6.3235, SD = 0.36370$). Most participants reported watching real-life police videos at least occasionally; students most commonly viewed such video through social media, while officers most commonly viewed police video on professional police-oriented websites (eleven reported viewing videos from these sources at least "sometimes," with four reporting frequent viewing via such sites) but also occasionally viewed such video on social media as well. Seven of the twelve student participants had been contacted by the police within the prior five years (five participants reported having been pulled over for a traffic violation and two reported having been arrested at some point in their past). Only one student participant reported having ever been the victim of a crime. On average, student participants who reported prior contact with the police indicated that they received a fair outcome ($M = 5.57, SD = 1.718$; on a 7-point scale) and that the outcome they received was in accordance with the law ($M = 5.14, SD = 1.676$) and was deserved ($M = 4.86, SD = 2.193$).

After viewing the video, half ($n = 6$) of the student participants stated they believed the police officer's actions were unjustified (including all three minority participants), while the other half felt it was justified. When asked to rate how appropriate the police officer's conduct was, on a scale from 1 (not at all appropriate) to 10 (completely appropriate), students had very mixed reactions (Median = 7.000; $M = 5.792, SD = 2.824$) with responses ranging from 1 to 9. The two Black students and the White/Native American student rated appropriateness at 2, 4, and 2, respectively. Only one White student rated appropriateness below a six (reporting the lowest score at 1). As expected, most officers reported that the depicted officer's actions were justified. However, of the eleven officers who viewed this video, three indicated that they felt the officer's actions were *not* justified. When asked to rate how appropriate the depicted officer's conduct was, officers' responses ranged from 1 to 10 (Median = 8.500; $M = 7.545, SD = 2.593$; there was not a detectable statistically significant difference between these responses and those of the students).

Perhaps the most interesting initial findings from this study are found in unpacking why the participants responded the way they did to the questions noted in the previous paragraph and how these differed between the interview groups (officers and students) and within the students based on race. Admittedly, samples sizes here very low, limiting the generalizability of these findings, but they do suggest some interesting paths forward for future research. When making judgments about the appropriateness of the depicted police conduct, the police officer participants focused much more on things like police training, procedure, and legality. Students reporting lower levels of

satisfaction with the police officer's actions focused on officer demeanor, stating that the officer should have been calmer and may have escalated the situation by not explaining clearly why he had initiated the stop. For example, one student remarked, "I don't understand why you wouldn't want to, like, back off and try to communicate better instead of immediately being like, you're being arrested." Interestingly, however, this sentiment was shared by at least some of the officers as well. For example, when asked to describe what this video depicted, one officer responded: "Police harassment. [laughs] ... I didn't really hear any reasonable explanation from the officer as to why he was doing what he was doing. And, I think because this gentleman was agitated, rightfully so with him, it created, caused the officer to get defensive. ... That was a bad interaction." Most officers, however, responded quite differently. Some cited procedural justifications for engaging in investigative ("Terry") stops and what they saw as reasonable detention based on the suspect's agitated and defensive response to the officer. For example, one officer stated that the stop and detention was reasonable because the suspect "kept blading away, was very belligerent. Hey, I think it's reasonable at that point to, to escalate the detention to handcuffs, not necessarily placing somebody under arrest, but if they're continuing with these sort of belligerent actions. And then like I said, it's all those nonverbal cues that, that the suspect was giving off that I think that's perfectly reasonable."

These non-verbal cues were interpreted quite differently by one of the Black student respondents, who described the suspect as being confused and not able to get a straight answer out of the cop. "He was acting like a, like a typical person that doesn't know what's going on. ... He's just shocked and doesn't know what's going on in the first place and why everything's escalating that fast and he just wants to get away from the situation 'cause, as a black man, a man who is black, this is not a really good history with that. So, he's just going with what he knows." This respondent also explained his perception that both the officer and the suspect were acting based on their distinct, unconscious biases, described as "Black men are threatening" and the perception that Black men are "getting arrested for like no reason, really no reason," respectively. For the other Black student, recent history has sent a "clear ... message [that] you'll be fine [in a police contact] as long as you're not African American." Despite that history, this student also noted that they initially leaned more in favor of the police officer (justifying the initial stop): "in the beginning, ... I was leaning more towards the officer because I was, like, well [the suspect is] screaming at him. But then he started chasing him for like no reason. And, I'm pretty sure you don't have to stay and talk to them. Like that's one of your rights and stuff unless they have probable cause."

CONCLUSION

The findings presented here are early, exploratory findings from an ongoing study and analysis of data. The sample sizes are also very small. As such, I hesitate to make any strong conclusions here. However, the difference in responses between students and officers, and between the White and non-White student participants warrant additional study. Law enforcement agencies, and the officers they employ, do not always reflect the communities they police. Beyond differences in race—for example, mostly White police officers working in much more diverse communities—the police should also strive to understand how their policies and training are put into practice, and how the communities they serve perceive that practice. If public perception within a community is that certain police practices are inappropriate, but police officers continue to explain such conduct away by referencing police training, procedures, or policy, perhaps that training and policy should change to become more in tune with the intentions and values of the local community. Additionally, while BWCs do promise to make police conduct more visible, and some accountability for misconduct more likely, we must also remember that it is important to not ascribe "too much positive potential" to supposedly emancipatory technologies, like BWCs, and that technology "takes its meaning from social context, how it is used and defined" (Manning, 2018, p. 290).

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AI Literacy: Definition, Teaching, Evaluation and Ethical Issues

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ABSTRACT

Artificial Intelligence (AI) is at the top of the agenda for education leaders today in educating the next generation across the globe. However, public understanding of AI technologies and how to define AI literacy is under-explored. This vision poses upcoming challenges for our next generation to learn about AI. On this note, an exploratory review was conducted to conceptualize the newly emerging concept “AI literacy”, in search for a sound theoretical foundation to define, teach and evaluate AI literacy. Grounded in literature on 18 existing peer-reviewed articles, this review proposed four aspects (i.e, know and understand, use, evaluate, and ethical issues) for fostering AI literacy based on the adaptation of classic literacies. This study sheds light on the consolidated definition, teaching, and ethical concerns on AI literacy, establishing the groundwork for future research such as competency development and assessment criteria on AI literacy.

KEYWORDS

AI literacy; AI learning and teaching; AI in education; AI ethics; AI literacy questionnaire.

INTRODUCTION

Artificial intelligence (AI) was first defined as “the science and engineering of making intelligent machines” in 1956 (McCarthy, 2007, p.2). Throughout several decades of the 20th century, AI has evolved progressively into intelligent machines and algorithms that can reason and adapt based on sets of rules and environment which mimic human intelligence (McCarthy, 2007). Wang (2019) broadened the definition of AI which can perform cognitive tasks particularly learning and problem-solving with the exciting technological innovations such as machine learning and neural networks (Zawacki-Richter et al., 2019). Currently, the use of AI has spread across industries (e.g., business, science, art, education) to enhance user experience and improve efficiency. Applications of AI exist in many parts of our everyday life (e.g., smart home appliances, smartphones, Google, Siri). Vast majority of the public acknowledges the existence of AI services and devices, but seldom do they know about the concepts and technology behind, or aware of potential ethical issues related to AI (Burgsteiner et al., 2016; Ghallab, 2019). Similar to classic literacy which includes reading/writing and mathematical abilities, AI literacy has emerged as a new skill set in response to this new era of intelligence. As a small number of existing articles found in the Web of Science and Scopus databases, Google Scholar search is used to identify the dramatic increase in AI literacy publications from 2014 to 2021 (see Fig. 1).

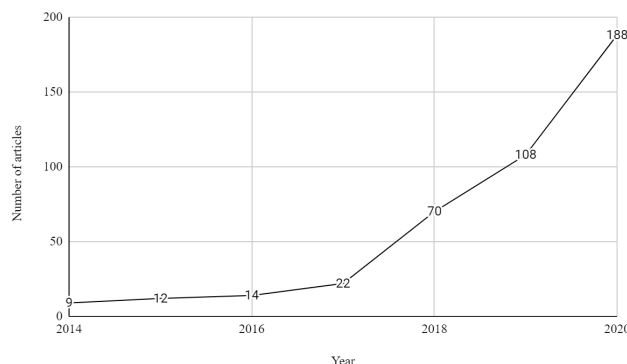


Figure 1. AI Literacy Articles from Google Scholar Published by Year

As AI becomes more and more important, researchers began to define AI literacy based on the term ‘literacy’ which has been applied to define skill sets in varied disciplines (Long & Magerto, 2020). However, few studies have provided comprehensive explanations on how to conceptualize AI literacy. To fill this gap, this study reviewed the relevant literature, and analyzed how scholars define “AI literacy”, how it can be learned, and what are the ethical concerns. Specifically, the present study poses the following four research questions: 1. How do researchers define the term “AI literacy”?; 2. How do educators help learners develop AI literacy?; 3. How do researchers evaluate students’ AI literacy skills?; 4. What are the ethical concerns in the domain of AI literacy?

METHOD

In search for literature on AI literacy, both peer-reviewed scholarly articles and conference papers from K-12 to higher education levels published from 2016 to 2021 through the *Web of Science* and *Scopus* were included in this review. The aforementioned databases were considered among the world's most trusted citation indices platforms for evidence-based quality scientific research and hence helped us to ensure the inclusion of quality scientific content (Mongeon & Paul-Hus, 2016). The articles that contained the phrase “AI literacy” in either the title, the abstract, main text or keywords were downloaded and reviewed by the researchers. The search resulted in 20 articles. After excluding irrelevant studies, as of Apr 11, 2021, a total of 18 articles were identified. Through studying the main content in the selected articles, similar meaningful concepts were identified and extracted for further thematic analysis. To establish coding reliability, six (30%) of the articles were randomly picked, blind-coded and analyzed by the two researchers. Disagreements were resolved through discussing the disputed studies.

RESULTS & DISCUSSION

RQ 1: How do researchers define the term “AI literacy”? Of the 18 articles, 12 articles defined AI literacy based on the ideas of ‘literacy’. Since the 1970s, computer applications have gained popularity across industries. It was necessary for users to become competent in using computer systems related to their specific task or job. As such, the term “digital literacy” emerged to assess basic computer-related concepts and skills. The importance of digital literacy increases as more people depend on the use of computer technologies to develop new social and economic opportunities (Leahy & Dolan, 2010). In succession to digital advancement, AI started to arise and imitate human intelligence in machines for computers to learn, reason and perceive. It was initially used in scientific research and academic environments but had yet become ubiquitous in our daily lives. Four aspects of fostering AI literacy were identified from the review (see Table 1).

AI literacy	Definitions	f	Sample references	Sample studies
Know & understand AI	Know the basic functions of AI and how to use AI applications in everyday life ethically.	18	<i>Even though transparency in algorithms and AI in general has been acknowledged to be ethically important, the public lacks understanding of even the basic functions of AI. Efforts to make AI more comprehensible exist (Robinson, 2020).</i>	Lee et al. (2021); Kandlhofer et al., 2016); Robinson (2020).
Apply AI	Applying AI knowledge, concepts and applications in different scenarios.	18	<i>Apply k-means clustering in science contexts... explore the mapping relationship between facial features and data values and apply the concept to brainstorm other objects such as Lego (Wan et al., 2020).</i>	Druga et al. (2019); Julie et al. (2020); Vazhayil et al. (2019).
Evaluate & create AI	Higher-order thinking skills (e.g., evaluate, appraise, predict, design) with AI applications.	12	<i>Design & build experiences: Technology exploration and creation activities supported students in making sense of the underlying AI concepts. (Lee, 2020).</i>	Druga et al. (2019); Han et al. (2019); How & Hung (2019).
AI ethics	Human-centered considerations (e.g., Fairness, Accountability, Transparency, Ethics)	9	<i>“AI for social good” measures an individual’s perception of the social environment surrounding the behavior, which is related to subjective norms (Chai et al., 2020).</i>	Chai et al. (2020); Druga et al. (2019); Gong et al. (2020).

Table 1. Coding Framework of AI Literacy

Know and understand AI: All 18 articles conceptualize AI literacy as educating learners about acquiring fundamental concepts, skills, knowledge and attitudes that require no prior knowledge. On top of being the end users of AI applications, learners should understand the technologies behind. Burgsteiner et al. (2016) and Kandlhofer et al. (2016) defined AI literacy as the ability to understand the basic techniques and concepts behind AI in different products and services. Many students know these AI-empowered services, but they were not familiarized with the underlying concepts such as computational thinking concepts, data structures. Sound knowledge about AI and principles of computer science will be of vast importance for their future careers (Burgsteiner et al., 2016; Kandlhofer et al., 2016). Moreover, some researchers associate AI literacy with perceived abilities, confidence and readiness in learning AI. In K-12 education, Druga et al. (2019) and Lee et al., (2021) designed learning curriculums and activities that foster AI literacy that focuses on how learners gain AI concepts.

Apply AI: All articles emphasized the importance to educate learners to know how to apply AI concepts and applications in different contexts (e.g., Druga et al., 2019; Lee et al., 2021). For example, Rodríguez-García et al. (2020) evaluated LearningML, a machine learning model builder, to educate citizens to understand AI applications and how it can affect our lives, as well as knowing the ethical issues regarding AI technologies. In addition, half of

the studies (n=9) discussed the human-centered considerations and focused on using AI concepts and application ethically, which would be further discussed in RQ4. Three out of 18 articles borrowed the ideas of computational thinking to interplay AI literacy and AI thinking (see Appendix 1). AI thinking refers to the construction of logic and algorithms in order to support students' understanding of how to use knowledge bases for problem-solving, processing semantics and handling unstructured data (Vazhayil et al., 2019). For example, How and Hung (2019) leveraged AI thinking through conducting data analytics with computing and interpreted new findings from the machine-learned discovery of hidden patterns in data.

Evaluate and create AI: AI augments human intelligence with digital automation and 12 articles alluded AI literacy to engage learners in higher-order thinking activities. Other than knowing and using AI with concepts and practices, some studies had extended AI literacy to two other competencies that enabled individuals to critically evaluate AI technologies, communicate and collaborate effectively with AI (e.g., Long & Magerko, 2020). For example, Han et al. (2019) enhanced students' scientific and technological knowledge which then was applied in scientific research-based learning to solve practical problems. Long et al. (2019) engaged citizens in co-creating AI amenities in public spaces to broaden their public AI literacy and experiences. Students with the ability to evaluate and create AI could infer from, connect, manipulate, and categorize AI concepts together in novel ways. Overall, although these articles showed slight variations on the definition of AI literacy, they support the notion that everyone, especially K-12 children, acquire basic AI knowledge and abilities, and enhance motivation and career interest (Chai et al., 2020b). In addition to knowing and using AI ethically, AI literacy serves as a set of competencies that enables individuals to critically evaluate AI technologies, communicate and collaborate effectively with AI (Long & Magerko, 2020).

RQ 2. How do educators teach and learn AI? In K-12 education, researchers (n=12) designed learning curriculums and activities that foster AI literacy that focuses on how learners gain AI concepts, as well as using AI to incorporate into their own applications (e.g., Druga et al., 2019; Lee et al., 2021). Long and Magerko (2020) and Rodríguez-García et al. (2020) mentioned Touretzky et al (2019)'s five "big ideas" of AI which provide a strong foundation for future research on fostering AI literacy (see Appendix 2). In another study, Rodríguez-García et al. (2020) evaluated LearningML, a machine learning model builder, to develop critical thinking, and K-12 children on AI fundamentals to understand what can be made with AI, how it can affect their lives, and the ethical issues regarding AI technologies. In higher education, two researchers claimed that AI knowledge and skills become more advanced to meet the future job demands. Kandlhofer et al. (2016) and Burgsteiner et al. (2016) listed a set of AI concepts that has potential to become the basis for careers in science and engineering: automata, intelligent agents, graphs and data structures, basics of computer science, machine learning, etc. based on the AI bible written by Russell and Norvig (2009). Four studies mentioned the importance of educating citizens on fundamental AI concepts, and the impacts of AI technologies on their everyday lives. For example, Robinson (2020) mentioned that the Norwegian policy document titled "AI for everyone: Elements of AI" (p. 44) asserts the government will make AI learning courses globally accessible in 2020, which conceptualizes AI literacy as educating their citizens about the elements of AI that require no prior knowledge (Robinson, 2020).

Learning artefacts: Given the complexity of AI, age-appropriate learning artefacts were important to scaffold students' AI conceptual understandings, and enhance their motivation and interest in learning AI. In recent years, there has been an increase in hardware and software that enhance AI concepts accessible to younger learners. Appendix 3 provides an overview of the types of AI learning artefacts ranging from hardware (n=5) to software-focused artefacts (n=3), intelligent agents (n=4) and unplugged learning tools (n=5). The democratization of current AI technologies encourages students to make intelligent agents and machine learning models without needing to program (Long & Magerko, 2020). In this context, we can see an opportunity for educators to democratize access to AI literacy and reinforce the AI concepts through these emerging tools. Alternatively, educators designed unplugged learning activities to foster students' AI literacy without using a computer through engaging approaches such as case study, role-playing and storytelling (e.g., Julie et al., 2020).

RQ 3. How do researchers evaluate students' AI literacy skills? Among 18 studies, 11 articles adopted quantitative (n=9) and qualitative (n=6) evaluation methods to examine how students enhance their literacy skills (see Appendix 4). To evaluate K-12 students' AI literacy, one important component is to promote their intention to learn and possess basic knowledge about AI. Nine studies assessed the knowledge acquisition of K-12 and university students via group discussion and pre- and post-knowledge tests (e.g., What are the characteristics of depth-first search?), and students' perceived abilities (e.g., How would you rate your knowledge about search algorithms?) (Kandlhofer et al., 2016; Wan et al., 2020). Other than self-reported questionnaires, the study assessed students' output that used artefacts such as computer programs, documentations and presentations of their experiments. Five researchers also collected qualitative data by taking pictures, field notes during teaching, and interviewing students to understand their motivations, expectations and lessons learned. Druga (2019) recorded students' interaction with AI agents through field observations and adopted a three-attribute AI perception questionnaire to evaluate how 102 children (7-12 years old) interacted and perceived their AI agents in their lessons.

These 3 attributes measure whether the agents are smarter, truthful and understand them. Three studies discussed other aspects such as confidence in using AI, motivation, AI for societal good. In another study, Chai et al. (2020a) measured AI literacy as students' perception of their knowledge and skills of using AI technology, and designed and administered an instrument to 545 students (aged 13-18) with 7 aspects. Dai et al. (2020) further included 'relevance' as the eighth aspect that is associated with AI literacy. They considered AI literacy as the knowledge foundation that provides students with a perception of AI technology.

RQ 4. What are the ethical concerns in the domain of AI literacy? As AI plays an important role in day-to-day decision making, misused or poorly designed AI could cause irreparable harm to humans and the society (Fourtané, 2020). AI-concerned scientists and engineers like Elon Musk expound on the horrors that future AI technologies may wreak on humanity in decades to come (Johnson, 2019). However, only half of the studies in this review had mentioned human-centered considerations and raised attention to educate citizens to become socially responsible (Ahmad et al., 2020). Gong et al. (2020) found that students pay little attention to ethical concerns such as bias in AI and legal responsibility (8%), and intellectual property (9%). As such, educators should not only focus on enhancing students' AI abilities and interests, but also help students to realize the societal impact and ethical concerns.

To bring up future responsible citizens who compete in using AI in a reliable, trustworthy and fair way, computational techniques must be facilitated in an innovative and responsible manner, while prioritizing issues of fairness, accountability, transparency, and ethics by drawing on fields with a sociotechnical orientation (Hagendorff, 2021; Microsoft, 2021). AI literacy in K-12 education is at its starting point. It highlights how people comprehend AI concepts and apply AI. Broadening participation in AI for all is necessary to ensure that the design and utilization of AI technologies are inclusive to address under-representation of people of colour and women in AI. For example, Lee et al. (2021) designed a middle-school AI literacy curriculum on ethics education that incorporates algorithmic bias, ethical design of recommender systems, unanticipated consequences into a series of AI learning activities such as training models with Teachable Machine, generating texts and redesigning videos. A student gave a feedback during the interview: "If people who make the AIs don't think enough through it, they can have bad consequences. They will get sued if they don't check over or get into damages" (p.194). The study envisioned that the foundation of future AI industries would be built on "principles of inclusivity, provide equitable access, include consideration of multiple stakeholders and potential users, and minimize the potential for bias" (p.191). Another study conducted by Druga (2019) engaged 108 children (aged 7-12) from different countries and social economics status to construct a guideline to discuss how educators can design inclusive learning activities such as avoiding deceiving technologies, offering ways for children to customize and program the machine, and encouraging reflection and collaboration by allowing children to share and modify each other's projects. Moreover, Robinson (2020) conducted a document analysis and pointed out that a guiding framework for AI government policy is important for citizens to have a common ethical, responsible and human-centered basis to better support the development of AI technology in their society. With the democratization of current AI technologies, educators should not only teach students to build machine learning models, but also guide them on how to implement these emerging technologies ethically. To summarize, conceptualizing AI literacy with human-centered considerations is crucial to building a future inclusive society.

CONCLUSION

In this review, a variety of definitions of AI literacy was noticed. The most common approach to define AI literacy is to base on different types of 'literacies' which have recently been applied to define skill sets in varied disciplines. In our review, most researchers advocated that instead of merely knowing how to use AI applications, learners should be inculcated with the underlying AI concepts for their future career, as well as the ethical concerns of AI applications to become a responsible citizen. Since AI literacy is an emerging field that there is a lack of journals published in this field, several limitations are found in this review. The keyword search limits the scope of domain specificity within the AI context without focusing on other subfields of AI like machine learning, neural network, etc. Some authors designed interventions and learning programs to discuss how to foster AI literacy in their studies without explicitly defining it. Although we believe there is a larger pool of studies concerning the development of AI literacy, they may not be entirely captured to avoid any misinterpretation of their underlying concepts in AI literacy. In addition, future studies are needed to examine effective means to foster students' AI literacy, its assessment criteria and ethical concerns. We hope this review will inspire scholars, educators, and government officers to begin the discussion on how to define, implement and evaluate AI literacy in the future.

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APPENDIX 1–5

For more details, please visit <https://bit.ly/3dsiJ4g>.

Journals as Communities: A Case Study of Core Journals in LIS

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ABSTRACT

This paper proposes an indicator for measuring the level of commitment to academic journals. The indicator is demonstrated on a sample of core LIS-journals. By monitoring authorship patterns over a 20-year period, it is shown that some journals have a higher frequency of returning authors than others, consequently showing a larger degree of community commitment. The paper discusses how the indicator may be applied when studying factors influencing researchers' journal selection decisions.

KEYWORDS

Bibliometrics; Library and Information Science; Scholarly communication; Scientific communities.

INTRODUCTION

Philosophical Transaction of the Royal Society of London is generally considered to be the first real academic journal (Meadows, 1998). It was originally composed by the secretary of the Royal Society, Henry Oldenburg, and published for the first time in 1665. It functioned originally as a platform for communicating research among the members of the society. Many subsequent journals have since followed with similar purposes of acting as platforms for other scientific communities and their members. Such community-specific journals of course still exist. Yet, most modern journals no longer require membership of certain communities in order to get a paper published. Nevertheless, modern journals may also be seen as representing communities of researchers—but now in a more tacit or implicit manner. Memberships or subscriptions are therefore no longer quite as valid representations of such communities. Other indicators are therefore needed if one wants to track the community around a certain journal, and the strength of engagement among its members.

Having published a paper in a particular journal obviously qualifies as one important aspect of commitment to that particular journal. Consequently, the author(s) may therefore be viewed as community member(s). Yet, a single publication in the journal hardly qualifies as real commitment to that community. That would certainly require more publications in the journal, and a record of accomplishment of publications in the same journal over a longer period of time. Ni, Sugimoto and Jiang (2013, p. 269-270) examined how authors tend to repeatedly publish their papers in certain journals and concluded that researchers “stick to familiar ground and engage in repeated publications with a few favorite venues. As they do this, communities begin to form[.]” Drawing on this work Hsieh (2017) explored the publishing choices of a set of scholars to identify ecological journal characteristics and found a strong focus on a small number of journals.

In this paper we will propose a method for measuring the level of commitment to academic journals, and demonstrate it using a selection of core LIS-journals. By monitoring authorship patterns over a 20-year period, we will demonstrate that some journals have a higher frequency of returning authors than others. This, we argue, may be taken as an indicator of community commitment, and may be a supplementary tool when studying factors influencing researchers' journal selection decisions.

We start out with a brief overview of related literature, and then explain how we calculate the indicator. We then demonstrate the indicator by presenting results from a case study of ten LIS-journals. Finally, we provide specific ideas for follow-up studies that might implement the proposed indicator.

RELATED RESEARCH

Garvey and Griffith (1971) were among the first to characterize the submission and resubmission decision process as reward maximization. They argued that authors get to know the hierarchy of journals as they get more experienced with publishing. If they fail with a journal in the upper level, they will resubmit to a journal at a lower level; Seldom do they submit a manuscript rejected by a lower-level journal to a journal on a level above. Moreover, as the years go by, many authors discover their ecological niche in this hierarchy, and seldom venture beyond it (Garvey and Griffith, 1971, p. 358). Consequently, authors are believed to seek reward maximization and therefore they will choose the most prestigious journal from amongst those which they feel would accept their papers. Should

the manuscript be rejected they will work their way down the hierarchy of journals until acceptance is secured (Salinas & Munch, 2015; Heintzelman & Nocetti, 2009). More than three decades ago, Kochen, and Tagliacozzo (1974) and Oster (1980) presented mathematical models that can be used to determine an optimal publication strategy. The mathematical models consist of various incentives to publication which depend on a number of factors. Kochen, and Tagliacozzo (1974) suggest the following factors to include when authors decide on a journal: Relevance, acceptance rate, circulation, prestige and publication lag. Oster (1980) suggests the following four factors: Prestige Index, familiarity Index, mean waiting time and acceptance probability.

The view of the selection process as reward seeking where researchers start by submitting to top journals in the first submission and if necessary, resubmits to journals lower in the hierarchy until the manuscript is accepted has been questioned by Gordon (1984) who argued that researchers select journals based on how the journal works as media of communication. Consequently, Gordon argued that his study does not lend support to the view of submission and resubmission as a simple model of reward maximization. Luukkonen (1992) tested if authors are attempting to publish in the most prestigious journals possible and thus seek an optimal level in the hierarchy of publications. Contrary to Gordon's findings, Luukkonen found that the reward and communication functions of scientific publishing were equally important in the selection of journals. Yet, the publishing behavior in some fields fitted the maximization of professional rewards strategy best.

On the basis of empirical studies, Pepermans and Rousseau (2016) organized the factors that could drive an author's decision to submit to a given journal into three categories:

1. Author characteristics (e.g. past submission success)
2. Journal characteristics (e.g. publication delays, rejection risk, author charge, prestige)
3. Other research characteristics (potential impact or visibility of the paper, ethical issues).

More recent studies have included similar factors when exploring what determines an author's decision to submit to a given journal, but some have also added new perspectives. Salinas and Munch (2015) argued that authors decide their submission order based on an intention to maximize citation count while minimizing the number of resubmissions on one hand, or the amount of time it takes from submission to publication on the other hand. The work by Wong, Srikrishnan, Hadka and Keller (2017) stressed the tension brought on by multiple rationalities surrounding co-author values including time horizon and perceived probability of being scooped. Authors can thus be particularly impatient or risk-averse and the optimal submission order is determined accordingly. Finally, underinvesting in the practices and processes around peer review and thus resulting in poor peer review reputation may lead to smaller submission numbers (Gaston, Ounsworth, Senders, Ritchie & Jones, 2020).

Rowley, Sbaffi, Sugden & Gilbert (2020, p.14) concluded that "journal choice is becoming an increasingly important and complex decision" and argued that [authors] "bring varying levels of experience, competence and personal career objectives to the journal selection process". Cheung (2008) also considered the past submission success of the author as a factor when an author decides on a publication outlet and included both having been rejected by the journal as well as having previously published in the journal.

Many of the existing studies on choice of publication outlet have been based on author surveys (e.g. Cheung, 2008; Rowlands & Nicholas, 2005; Rowley, Sbaffi, Sugden & Gilbert, 2020; Tenopir, Dalton, Fish, Christian, Jones & Smith, 2016). Some are bibliometric analyses of a set of authors (e.g. Ni, Sugimoto & Jiang, 2013; Hsieh, 2017). Finally, some studies are based on analyses of submission data from a set of journals (Gaston et al., 2020; Wong, Srikrishnan, Hadka & Keller, 2017; Salinas & Munch, 2015).

METHOD

We propose to measure the level of commitment to academic journals by calculating the proportion of returning authors. To begin with, this of course requires a definition of the concept *returning author*. Obviously, a returning author is an author that has published twice in the same journal. Thus, the second paper marks the return. Yet, seeking to quantify the level of engagement also requires a way to measure *commitment*. We will argue that this should entail a time period. If there are many years between the two papers, the returning author is not showing real commitment to the journal in question and should therefore not count when measuring the level of community commitment. This raises the question of the length of the time period. Should it be one year, three years, five years, ten years ...? We have settled for a 3-year publication window. A shorter period may be too strict, and a longer period too loose.

Thus, finding the number of returning authors in a set of journals require four years of journal data. For each journal the authors are matched with authors in the same journal the preceding three years. If an author match is found, this is treated as an act of journal commitment. Of course, an author may have published more than two papers in the four-year period. Yet, the indicator is binary and therefore only counts whether the author has published in the same journal in the preceding three-year period or not.

To illustrate the indicator, we have conducted a study of ten core journals in LIS. In order to show potential dynamics over time, we have collected 23 years of journal data (1997-2019), allowing us to track the development of journal commitment over a 20-year period (2000-2019). The ten core journals in questions were taken from the list provided by White and McCain (1998). We adjusted the list according to title changes and excluded discontinued titles. Thus, the study includes the following journals: *Data Technologies and Applications*; *Electronic Library*; *Information Processing & Management*; *Information Technology and Libraries*; *Journal of Documentation*; *Journal of Information Science*; *Journal of the Association for Information Science and Technology*; *Library and Information Science Research*; *Library Resources and Technical Services*; *Scientometrics*.

The journal data were collected from searches in the database *Scopus*, limited to include three document types (article; review; note). To ensure precise author matching we used the *Scopus Author Identifier*. This tool distinguishes between ambiguous author names by assigning each author a unique number. Thus, matching was done using these unique numbers and not the actual author names. For each journal and each year (2000-2019) the retrieved author-ids were matched with the author-ids from the same journal the preceding three years. To exemplify: Retrieved author-ids from *Journal of Documentation* (2000) were matched with retrieved author-ids from *Journal of Documentation* (1997; 1998; 1999), retrieved author-ids from *Journal of Documentation* (2001) were matched with retrieved author-ids from *Journal of Documentation* (1998; 1999; 2000), etc. Finally, the proportion of matching author-ids was calculated as a percentage. For example: We found 49 unique author-id's in *Journal of Documentation* (2000). 14 of these matched an author-id from *Journal of Documentation* (1997; 1998; 1999) equaling 28,57%

RESULTS

The percentage of returning authors varies between journals. Figure 1. shows the mean percentage of returning authors calculated for the entire period (2000-2019) with a 3-year publication window. The dots provide the means; The lines indicate the space between maximums and minimums.

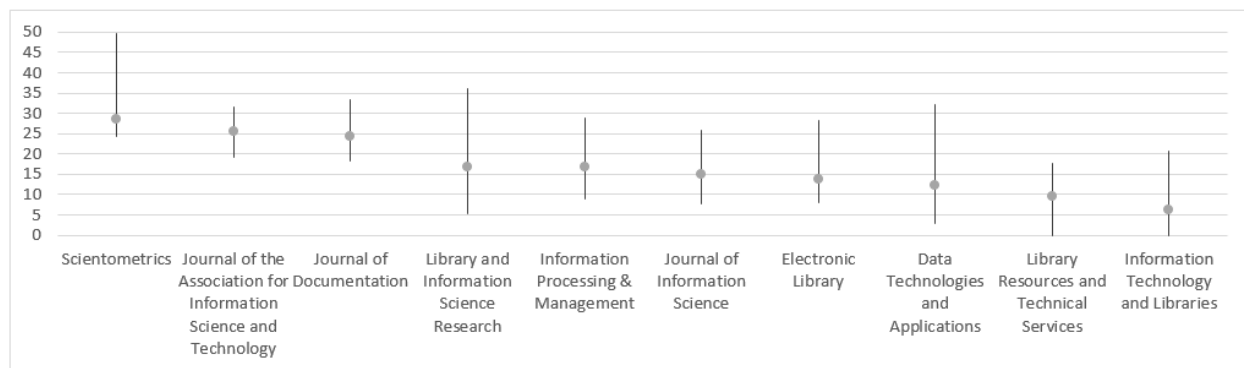


Figure 1. Mean percentage of returning authors (3-year publication window)

Scientometrics displays the highest mean (28,49%); *Information Technology and Libraries* display the lowest mean (6,35%). As can be seen, the variation is larger in some journals compared to others. *Library and Information Science Research* and *Data Technologies and Applications* display the largest variance; *Journal of the Association for Information Science and Technology* and *Journal of Documentation* display the lowest variance.

Figure 2. shows the percentage of returning authors over time. Note that the curves have been smoothed by calculating the percentages as averages over the previous (if available), actual, and subsequent (if available) year. In the beginning of the investigated period, *Scientometrics* displays the largest share of returning authors, but then drops to about the same levels as *Journal of the Association for Information Science and Technology* and *Journal of Documentation*. Three other journals (*Data Technology and Applications*; *Information Processing & Management*; *Library and Information Science Research*) display rising tendencies during the first part of the investigated period, but then gradually falls back to their initial levels again. The four remaining journals (*Electronic Library*; *Information Technology and Libraries*; *Journal of Information Science*; *Library Resources and Technical Services*) display more stable tendencies in the lower to middle parts of the scale.

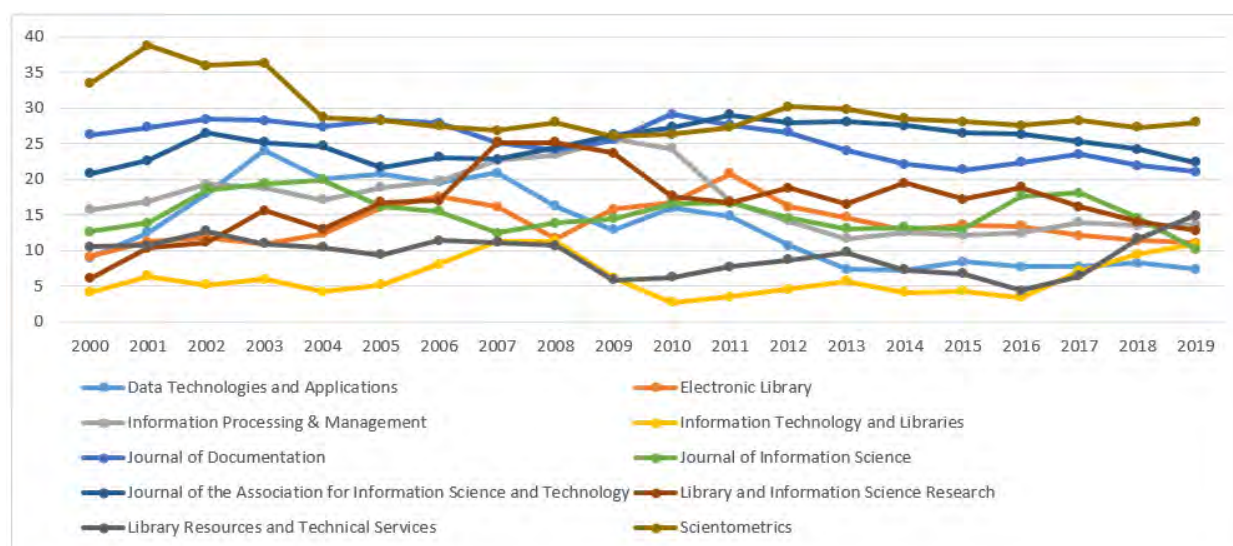


Figure 2. Percentage of returning authors over time (3-year publication window)

DISCUSSION

Our results demonstrate the applicability of the proposed indicator for measuring journal commitment. There are clear differences between journals, yet the ten LIS-journals in our study display rather stable shares of returning authors over time. It might be worth investigating other fields of research in order to explore the proposed indicator further. Perhaps researchers in other fields are even more committed to publishing in the same journals over and over again? When conducting further studies of the indicator, the publication window might also be investigated further. In this study we operate with a 3-year publication window because we assessed that to be suitable for the field of LIS. Others might try operating with a shorter/longer publication windows if deemed suitable.

Instead of limiting the study to returning authors, journal by journal, another follow-up could operate with a collection of journals, and then investigate to what extent authors return to the collection (and not just to one particular journal) over time. This might be a way to test the “familiarity hypothesis” reviewed in the related research section. As this hypothesis concerns the return to more than just a single journal, our results are not optimal in this regard. Nevertheless, we do find that eight out of ten journals display a rather high (>25%) proportion of returning authors some years, and three journals even display mean percentages over the entire period (2000-2019) around the 25% level or higher.

It might also be worth investigating whether authors tend to return to high impact journals rather than returning to low impact journals. In the related research section we also reviewed the so-called “reward maximization hypothesis”. According to this hypothesis, authors will tend to go after publishing in journals with a higher potential for maximizing citation counts. Implementing our indicator and comparing results with journal impact factors may consequently be a way to test the hypothesis. We have not obtained actual impact factors for the ten journals in our sample of journals. Yet, according to memory, the three journals displaying the highest mean percentages of returning authors have traditionally also been known to be among the journals with the highest impact factors in the field of LIS...

Finally, other journal characteristics that have been said to influence an author’s decision to submit to a given journal (publication delays, rejection risk, author charge, etc.) could also be studied from a returning authors perspective.

In short: Our indicator might be a valuable supplement to the toolbox when investigating factors influencing researchers’ journal selection decisions.

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Reconciling Authority and Agency through Information Practices Research

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ABSTRACT

Authority and Agency have been central concepts in information science since its beginnings in 19th century documentalism. This paper begins with a brief historical overview of how these concepts have been constructed in the traditional and user-centred paradigms. It will then explore how an information practices perspective affords the possibility of seeing authority and agency not as oppositional but rather as synergistic: two sides of the same theoretical coin. This exploration will be contextualised by examples drawn from the author's own research over more than two decades across a range of studies. This body of research includes studies of academic, artistic and serious leisure communities.

KEYWORDS

Information Practices; Foundations of Information Science; Power/knowledge; Information Theory.

INTRODUCTION

Theories around what constitutes authoritative information and the agency of information users have been a central concern of the discipline since its beginnings in 19th century documentalism (Briet, 2006). This paper begins with a brief historical overview of how these concepts have been constructed in the traditional and user-centred paradigms (Dervin & Nilan, 1986). It will then explore how an information practices perspective (Savolainen, 2007; Lloyd, 2012) affords the possibility of seeing authority and agency not as oppositional but rather as synergistic: two sides of the same theoretical coin. This exploration will be contextualised by examples drawn from the author's own research over more than two decades across a range of studies. This body of research includes studies of academic, artistic and serious leisure (Stebbins, 2007) communities.

Questions around the nature of authoritative information have been at the heart of debate among information professionals and researchers since at least the advent of the documentalist movement in the 19th century. Whilst traditional information theories tended towards a positivist epistemology (Brookes, 1980; Briet, 2006), in more recent times a growing number of information researchers have adopted social constructivist approaches to information research (Olsson, 2010; Lloyd, 2011; McKenzie, 2005; Talja, 2005). In doing so, they have developed an understanding of how an individual's relationship with information is a product of the discourses, practices, and cultural norms extant in their social context.

Yet in both positivist and constructivist epistemologies, understanding the role of individual agency, a person's ability to challenge, reinterpret or reject established, authoritative 'truth', has continued to be a problematic issue. Critics (Smart, 1982) have argued, for example, that influential social constructionist approaches, such as Foucault's discursive regimes of power/knowledge, leave little room for personal agency. Whilst the author, like the majority of Foucault scholars, would regard such critique as problematic in its characterisation of Foucault's regimes of truth, it must be acknowledged that Foucault's focus was macro-sociological, giving little direct attention to individual's actions and agency.

However, whilst all the present author's studies adopt a social constructivist conceptual framework, drawing heavily upon Foucauldian and critical discourse analysis (Foucault, 1978; 1979; 1980, Fairclough, 2003), their findings do not support Smart's contention that such approaches eradicate individual agency, at least when viewed from the micro-sociological perspective adopted by information practices research. Furthermore, their findings suggest that authority and agency need not be seen as automatically antithetical to one another. Across all the different communities and contexts the author has studied, participants showed themselves adept at using their knowledge of the established regimes of truth, and the discursive rules which underpinned them, to their own advantage.

The paper argues that authority in the context of people's relationship with information should not be seen either, as in Positivist perspectives, in terms of its supposed correlation to objective reality, or, as in Smart's (1982) critique of Foucault, as vested in monolithic regimes of truth impervious to individual agency. Rather, it puts forward the view that authority and agency are interdependent: that prevailing discourses in establishing "the rules of the game"

(Rabinow, 1984) provide individuals with opportunities to accepted discursive knowledge and practices to further their own interests.

THEORISING AUTHORITY AND AGENCY

From its birth in 19th century documentalism (Briet, 2006), information science has regarded the question of what constitutes authoritative information as one of its most important questions. The theoretical origins of modern information science can readily be traced even further back to the rationalist, positive philosophies of 18th century thinkers such as Diderot (Furbank, 1992) and Kant (Vanzo, 2013), who drew on classical Aristotelian principles to argue for rationalist, systematic empirical enquiry as the most effective means to discover and describe the objective reality of the world we live in. Diderot's *Encyclopédie*, as well as the classification schemas of pioneering natural philosophers such as Linnaeus and Cuvier, can be seen as the progenitors of the universalist classification schemes of the late 19th and early 20th centuries, such as the Dewey Decimal and Library of Congress Classification systems which have been so central to both information science and the information professions. Such positivist approaches to classification continue to underpin many 21st century classification systems, including metadata schema such as Dublin Core.

The implications of such an epistemological approach for constructions of both authority and agency are far-reaching. Claiming that they capture and objectively describe reality affords such systems an almost unassailable authority, and effectively eradicates system users' agency in relation to determining the quality of the information provided. Indeed, as feminist historians such as Garrison (2003) have pointed out, systems such as Dewey Decimal Classification also became effective tools to reduce the agency of members of the increasingly feminised profession of librarianship in the early 20th century, by requiring them to strictly follow the prescriptions of the system rather than their own judgement, as had been the norm amongst scholarly (male) librarians in the previous century.

Give this epistemological framework, it is hardly surprising that for many decades information science research and the models that flowed from it assessed the effectiveness of library/information systems users' searching behaviour by quantifying the percentage of system-determined relevant documents their search found. Such a worldview simply does not afford the information researcher a conceptual framework through which to consider the possibility that the research subjects' construction of relevance may differ from that of the 'objective' system.

In some ways, the user-centred paradigm described by Dervin & Nilan (1986) can be seen as a conceptual shift towards acknowledging the agency of information users. Yet considering the powerful influence of Brooks' (1980) Popperian conception of the nature of information, most notably his notion of 'objective knowledge', one might argue that much research in the influential cognitivist school of user-centred elaborates rather than challenges the positivist tradition of evaluating information users' information behaviour as a representation of the 'objective knowledge' found in information systems.

This criticism does not apply to Dervin's own work. Sense-Making is constructed on an explicitly constructivist epistemological framework, and Dervin explicitly describes the actor in terms of her focus on their agency:

...an expert in her world (e.g. in her body, her work, her life) ...Sense-Making assumes the actor as theorist of her world, with hunches, hypotheses, and generalizations about how things connect to things and how power flows. (Dervin, 1999, 740)

INFORMATION PRACTICES AND THE SOCIAL TURN

The second half of the twentieth century saw a significant shift in epistemological thinking in philosophy and the social sciences, especially in Europe. The widespread influence of the work of scholars across a variety of fields, such as the phenomenologists Berger & Luckmann (1966), sociologist Bourdieu (1976), discourse analytic scholar Foucault (1977; 1978, 1980) and postmodern theorist Lyotard (1984) has led to a growing critique of the objectivist claims of modernist research and a significant philosophical shift towards social constructionism.

The emergence of information practices, an overtly social constructivist approach, as a critical alternative "*umbrella discourse*" to information behavior (Savolainen, 2007) can be seen as the extension of this movement into information science. Savolainen explicitly frames information practices as part of the social turn:

It shifts the focus away from the behaviour, action, motives of monological individuals. Instead, the main attention is directed to them as members of groups and communities that constitute the context of their mundane activities. (Savolainen, 2007, 120)

Researchers associated with information practices research, including McKenzie (2003), Lloyd (2011), Savolainen (2007) and the author, also demonstrate their affiliation with this paradigmatic shift in the social sciences through their use of the works of writers such as Foucault (1977; 1978, 1980), Bourdieu (1976), and Berger & Luckmann (1966) as central to their conceptual frameworks.

This paper therefore raises the question of whether information practice research is open to the same critique raised by Smart (1982) of social constructionist approaches elsewhere in the social sciences. Does its focus on social practices and information as a social construct lead to a conceptual framework which precludes the possibility of personal agency? As a long-standing information practices researcher, who has also written extensively about the utility of Foucault and critical discourse analysis in information research (Olsson, 1999; 2010a), I feel that I am well qualified to address this question. Drawing on my research over the last 25 years, the paper will argue that an information practices perspective, far from precluding the possibility of considering the role of individual agency, actually enhances it. Examples drawn from a range of studies, carried out in disparate contexts, suggest that an information practices conceptual framework allows the researcher to see the relationship between authority and agency in a different and more fruitful way.

RESEARCH FINDINGS

In this section, I will use examples drawn from my own research projects over the last 25 years to illustrate how an information practices perspective has allowed me to develop an understanding of the complex inter-relationship between authority and agency in the information practices of the members of a range of disparate communities. Although my earliest research was undertaken before reading Savolainen's 2007 work caused me to identify my research with the new umbrella discourse, the social constructivist theoretical framework of the work I had already undertaken, most notably the strong influence of Foucault on its conceptual framework, leads me to now regard it as also part of this emergent research tradition.

These studies have allowed me to appreciate how the micro-sociological focus of information practices research affords the researcher more detailed, nuanced insights into the relationship between knowledge and power, authority and agency, than is possible from the more macro-sociological viewpoint of scholars such as Foucault and Lyotard. This has allowed me to see that critics such as Smart (1982), who characterise discursive regimes of truth as erasing individual agency, are taking an overly simplistic construction of the dynamic nature of discourses and of community members agency within them. The findings of all my studies include many examples of "micro-emancipations" (Alvesson & Willmott, 2002; Gallagher & Olsson, 2019) where the participants engage with existing regimes of power-knowledge as a means of asserting their own distinct knowledge and identity in the context of the communities they engage with.

The dynamic nature of participants' relationship with prevailing discourses in their field became apparent to me in my doctoral work, which examined how information researchers made sense of the work of a prominent author in their field, Brenda Dervin (Olsson, 2005;2007; 2008). It was certainly true that the practices participants used to make sense of Dervin's work drew heavily on their understanding of prevailing research discourses:

one of the things that fascinated me [about the author's work], it was possible to use the ideas from other fields of social science, social psychology, sociology... And actually, I have studied sociology... it's my second discipline... so I could relate it to that (Olsson, 2007)

However, to acknowledge that participants' sense-making was the product of their relationship with existing discourses and discursive rules should not be taken to mean that they lack agency. Participants described a range of ways in which they used their knowledge of existing power/knowledge structures to achieve their own ends:

...using Dervin in your research, citing her papers, gives your own work a certain credibility in the eyes of other researchers ...they already know—or think they know—her ideas ... her name gives the work more weight—you need that, especially when you're starting out. (Olsson, 2008)

This is another example of what the research labelled 'Trojan-Horse-ing'. The participant's aim was to introduce an unfamiliar and/or divergent theory or approach to the information research community. In order to render the new approach/theory more "acceptable" to its intended audience, the participant chose to emphasise its relationship to Dervin's work—to cloak the unfamiliar in the power/knowledge of an established author construct:

The first reason [for citing the author] is ... because she is a widely cited author, has a strong position. ... and also of course because I want to make ideas that are not so familiar in information studies, to get them known, to get them more familiar, because you are able to read Dervin's work as well from the ... social constructivist point of view, as well as from the constructivist point of view ...using Dervin makes my new ideas more acceptable... (Olsson, 2008)

My other studies have also demonstrated that using awareness of existing regimes of truth to achieve individual recognition/discursive authority is not confined to the academy. My study of theatre professionals making sense of Shakespeare (Olsson, demonstrated that all participants drew on multiple, even contradictory discourses to justify their decisions and practices. For example, all participants at different times made use of an *authenticity* discourse, which derived its authority from claiming to be true to Shakespeare's original intention:

Shakespeare actually tells you how to speak the lines! If you look at the blank verse, it shows you when to pause, what to give emphasis to ... He does the work for you... (Olsson, 2010b, 277)

At the same time, all participants also drew on a range of creativity/contemporary relevance discourses that appear at first glance to be antithetical to the authenticity discourse:

You need to find new settings, new approaches to the design ... get away from 'pumpkin pants' Shakespeare! (Olsson, 2010c, 277)

The findings of the study demonstrated that this engagement with a range of sometimes contradictory discourses actually afforded theatre professionals, both individually and collectively as a company, considerable agency. It allowed them to create productions that could be seen by audiences both as creative, relevant to them and authentically Shakespearean.

My study of the information practices of enthusiast car restorers in collaboration with X (Olsson & Lloyd, 2017; 2019; Lloyd & Olsson, 2019) also demonstrated members of a serious leisure (Stebbins, 2007) community could draw on a wide range of restoration discourses to inform and justify their own decisions as to how to restore their own cars. These ranged from the 'factory original' approach, which sees a person seeking to restore their car to be as close as possible to the way it was when it first left the factory; through a 'perfection' discourse, where the restorer aims for a standard of craftsmanship far higher than was possible/feasible when the car was new, making the finished restoration a kind of Platonic ideal; to a 'fit for purpose' discourse which argues that the selective application of more modern technology, such as brake upgrades or electronic ignition, which makes the car safer, more reliable or enhances the driving experience, is entirely appropriate. On an autoethnographic note, my own practices in restoring my classic Alfa Romeo were informed by elements of all these discourses, without precisely conforming to the dictates of any of them.

CONCLUSION

The aim of this paper has been to demonstrate that an information practices perspective, informed by social constructionist theories from across a range of disciplines, affords information researchers the opportunity to reconceptualize authority and agency not as innately antithetical to each other but as inter-related facets of the complex, dynamic relationships between people, information and the social worlds they live in. In doing so, it aims not only to make a contribution to the development of this emergent umbrella discourse but also to inspire discussion across the information science community more broadly as to how the core concepts of authority and agency might most usefully be redefined to meet the challenges of research in the 21st century.

ACKNOWLEDGMENTS

The author wishes to thank all the volunteers and all publications support and staff who wrote and provided helpful comments on previous versions of this document.

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Named Entity Disambiguation for Archival Collections: Metadata, Wikidata, and Linked Data

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ABSTRACT

Representing archival metadata as linked data can increase the findability and usability of items, and linked data sources such as Wikidata can be used to further enrich existing collection metadata. However, a central challenge to this process is the named entity disambiguation or entity linking that is required to ensure that the named entities in a collection are being properly matched to Wikidata entities so that any additional metadata is applied correctly. This paper details our experimentation with one entity linking system called OpenTapioca, which was chosen for its use of Wikidata and its accessibility to librarians and archivists with minimal technical intervention. We discuss the results of using OpenTapioca for named entity disambiguation on the Belfer Cylinders Collection from the Special Collections Research Center at Syracuse University, highlighting the successes and limitations of the system and of using Wikidata as a knowledge base.

KEYWORDS

Archival item-level metadata; named entity disambiguation; Wikidata; linked data; entity management.

INTRODUCTION

Metadata descriptions for archives have traditionally focused on the collection level in the form of finding aids. Even though items in an archival collection may be digitized to become individual digital objects, the presentation of archival collection content tends to fall into one of the three modes: the embedded model in which digitized items are embedded in the arrangement of archive content in a finding aid, the segregated model that presents digitized content separately from the finding aid, and the parallel model that allows both finding aids and item-level metadata to be searchable (Zhang & Mauney, 2013). While each model has its pros and cons, issues remain regarding archival content discoverability, named entity management, and relations between entities and subjects across archival collections. Archival collections typically involve a large number of persons, organizations, events, and places that are often unique, sometimes obscure due to factors such as social and cultural biases and discrimination, which make metadata creation and proper description of marginalized groups even more difficult.

As the “format-specific metadata management based on curated text strings in bibliographic records understood only by library system is nearing obsolescence, both conceptually and technically” (Smith-Yoshimura, 2020, p. 1), the need for better representations of archival content, digitized or otherwise, is growing fast, and there is an increased emphasis on the findability and reusability of archival data. In the effort to reach this goal, we started the Linked Archives project three years ago as an experiment in the transformation of format-specific metadata into linked data structure so that the metadata can be more easily reused and repurposed for application development (Dobreski et al., 2019; Dobreski et al., 2020). One of the tests we performed was to import the transformed metadata into Wikidata via Wikibase platform for metadata enrichment. However, we ran into several obstacles in utilizing Wikidata to enrich the entity metadata and one of them is the named entity disambiguation. This paper reports the experiment of using Wikidata for entity metadata enrichment and focuses on the named entity disambiguation issue in this process.

RELEVANT LITERATURE

Research surrounding named entities has accumulated a large body of literature. Natural language processing (NLP) and machine learning have been the dominant approaches used in this research field. Named entity recognition, named entity detection, entity linking, and named entity disambiguation are frequently used in research literature. In NLP, named entity recognition involves using a wide variety of computational methods to detect and extract entity names from different types of documents and in different languages (Nadeau and Sekine, 2009). Most studies on named entity disambiguation (NED) use some knowledge base such as Wikipedia to detect, extract, and disambiguate entities from unstructured text by applying machine learning techniques, for example, Cucerzan’s

(2007) large-scale NED study based on Wikipedia data and Wang and Iwaihara's (2019) application of deep neural networks to jointly recognize and disambiguate named entities against Wikipedia and other semantic sources.

The NED work in library, archival, and museum (LAM) metadata is traditionally done by using the name authority control approach, mostly manual work performed by trained metadata professionals. The name authority records are established by verifying and cross-referencing entities who share the same name and by collocating entities who have used different names (Niu, 2013). The increase in "inside-out" collections in LAM institutions and advances in linked data technologies since the beginning of this century are shifting the authority control work and format-based metadata creation to entity management, which includes a series of work in identifying, disambiguating, cross-referencing, and publishing the entity data by using various methods and techniques (Smith-Yoshimura 2020). The conceptual and technical shift to entity management will benefit the representation of "inside-out" collections, a term coined by Smith-Yoshimura (2020), especially archival collections that often have a large amount of local people, organizations, and places involved but not covered by traditional name authority databases.

LINKED ARCHIVES PROJECT

The NED for Archival Collections project developed as part of the Linked Archives project at Syracuse University. Initiated in 2018, the Linked Archives project centers on three collections from the Syracuse University Libraries' Special Collections Research Center (SCRC) and seeks to remodel the metadata from these collections as linked data. The three archival collections under consideration are described by Dobreski et al. (2019) as follows:

- 1) The Belfer Cylinders Collection: music and spoken word recordings dating from 1890 to 1929. There are 1729 physical item records, 1729 digital item records, and 3000 name records for individuals, groups, and other entities in various roles.
- 2) The Ronald G. Becker Collection of Charles Eisenmann Photographs: photographs of 19th century sideshows, circuses, and performers, most taken by Charles Eisenmann or his successor Frank Wendt, dating from 1836 to 1960. There are 1,414 physical item records, 1,416 digital item records, and 1,504 name records describing various roles.
- 3) The Ted Koppel Collection: videos of ABC News television programming with Ted Koppel, including approximately 6,600 episodes of Nightline (March 1980-November 2005). There are 7416 physical item records, 13,610 digital item records, and 72,988 name records of individuals appearing in various roles.

The project focuses specifically on item-level metadata, with the goal of making it easier for researchers to discover the context of these items by using linked data to overcome data silos. Like many other archival collections, these three collections contain a large number of persons who appeared in the archival items in various roles. The local, historical, and unique nature of some of these persons resulted in sparse metadata description for these persons. To enrich the metadata for named entities and allow for rich linking between the entities and between entities and archival objects, we decided to experiment with using Wikidata as the knowledge base to extract pertinent data for individual entities. However, the first obstacle we encountered is the disambiguation of named entities retrieved from Wikidata.

METHODS

The decision to use Wikidata, the site where structured data related to various Wikimedia projects and other services is stored, to enrich item-level metadata and disambiguate named entities was made mainly for its ability to work with encoded ontologies. Unlike other potential knowledge bases, such as Wikipedia or DBpedia, the data in Wikidata are structured in the linked data format that is relevant to the Linked Archives project overall. Specifically, our experimentation focused on evaluating an existing NED application using Wikidata in order to keep our methods accessible to those in the library and archival fields without extensive technical knowledge of natural language processing techniques. This would allow us to evaluate the ability of librarians and archivists to use existing tools for entity management in special collections or identify gaps where more specialized technologies might be necessary.

For our testing, we selected the open source named entity linking system OpenTapioca (Delpuch, 2020), an application that allows users to input a short string of text and returns an annotated version of that text with links to potential Wikidata matches. The system is easily accessible through a web interface and provides a score for each candidate entity indicating the likelihood that a given entity is a match. This made OpenTapioca the more suitable option over the other accessible Wikidata entity linking program we considered, Falcon 2.0, which did not provide scores for analysis and proved too inaccurate for our specialized purposes after an initial evaluation. Further, unlike many other tools that use static knowledge bases derived from Wikipedia or DBpedia, OpenTapioca uses Wikidata exclusively and stays up to date as Wikidata is updated (Delpuch, 2020, p. 1), which is a particularly useful feature. However, OpenTapioca, like many similar systems, was largely tested on datasets such as news excerpts and

research article information (Delpuch, 2020, p. 7), so linking entities in archival metadata is a novel task for the system.

In order to evaluate the accuracy of OpenTapioca, we first manually checked in Wikidata whether or not matches existed for the person names listed in our collection. For our case study, we focused on the Belfer Cylinders Collection in which, of the 3000 name records listed, 731 names had potential matches in Wikidata. This meant that at least one entry in Wikidata had a label equal to the name listed in the collection metadata. In order to determine whether or not any of those entities were a match, we primarily used the Wikidata description of the person, the dates of birth and death, and the occupation, where those properties existed in order to establish relevance to the collection.

The manual matching results were then compared to OpenTapioca's results. Because OpenTapioca performs NED based on free text rather than structured data, we wrote a Java program to read in the data from the Linked Archives ontology into Java objects and produce sentences describing the person objects. To keep these sentences short, which was important for the accuracy of OpenTapioca, we focused on two attributes related to the person entity: role and subject. For simplicity, we forewent grammatical perfection and automatically generated sentences in the following format, with bracketed phrases being replaced by our data: "<person name> has role <role> is related to <subject term>", with the "has role" and "is related to" clauses being repeated for each role and subject respectively that is linked to the person in question. These sentences were pasted into the OpenTapioca annotation interface in order to see what the system selected as candidate entities and the scores given to each.

RESULTS

Of the 731 person entities in the Belfer Cylinders collection whose names matched the label of a Wikidata entity, the team was able to identify a correct match with reasonable confidence for 579 (79%) of those entities. In other words, 579 person entities in our collection can potentially be enriched with additional properties extracted from Wikidata. On the other hand, 96 person entities (13%) were confirmed to have no corresponding Wikidata entry, meaning that the Wikidata items with the matching label had other properties that indicated it was not the person related to our collection. The final 55 people (8%) were designated "unknown," because the candidate Wikidata entities did not have enough information available to confidently confirm or deny whether or not the entity in question corresponded to the person entity from our collection metadata.

Of the 579 persons for whom we were able to manually confirm matches in Wikidata, OpenTapioca correctly recognized 495 (85%) of those matches, meaning that the correct Wikidata item received the top score in OpenTapioca's output. However, these top scores varied significantly, from above positive 1, which would indicate a high confidence that the match is correct, to below negative 1, which would indicate low confidence. Figure 1 below shows the distribution of the top scores given by OpenTapioca where the top scoring item is the correct matching entity. Figure 2, however, illustrates the distribution of scores given by OpenTapioca to the top candidate where that candidate is not the proper the top score to matching Wikidata entity. OpenTapioca chose an incorrect Wikidata entity for 79 person entities (14%). The final 1% of entities were not properly recognized by OpenTapioca, so no candidate entities and scores were reported, and these are not represented in either figure below.

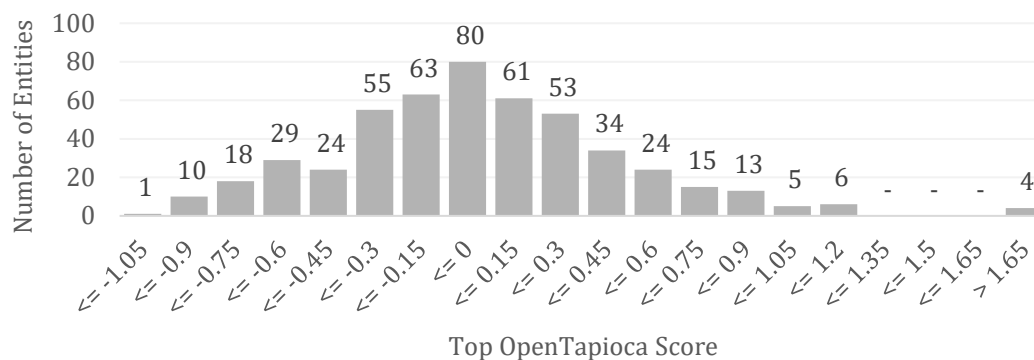


Figure 1. Top Score Distribution for Correct Matches

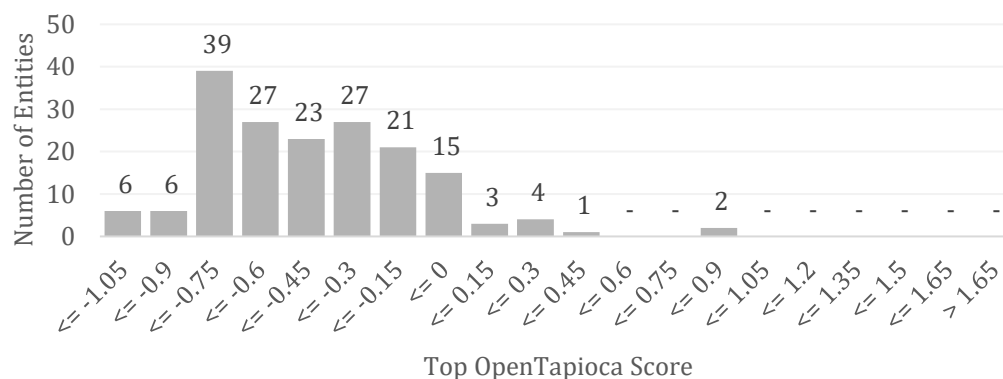


Figure 2. Top Score Distribution for Incorrect Matches

DISCUSSION

There are not very many existing tools for named entity disambiguation or entity linking using Wikidata that are accessible to those in the library and archive context without technical expertise related to natural language processing. The most useful and accessible tool we discovered was OpenTapioca, which had limited success with correctly linking the people related to the Belfer Cylinders Collection based on our metadata to corresponding Wikidata elements. Though the top scoring candidates for the majority of the tested entities were indeed the correct match, many of those top scores were negative or otherwise low and were only the top scores because there was only one candidate entity. This means that OpenTapioca was unable to reliably and confidently determine a match in many cases. Further, while the top scores for incorrect entities did trend lower than those for correct scores, there was still quite a bit of overlap in the scores. In its current state, it would be incredibly difficult to fully automate a system using OpenTapioca to accurately determine whether a Wikidata entry is a correct match for the corresponding person in our collection, because relying on the current scoring system to evaluate results is insufficient in this context. However, a modification to this system that more closely considers the specific properties deemed relevant in a given domain, or alternatively a modification to the metadata schema in question, could potentially result in a higher success rate. This suggests a need for greater collaboration between the librarians or archivists and developers to resolve this incompatibility.

It is also important to consider the limitations of Wikidata as a knowledge base. The contents of Wikidata are dependent upon the contributions of Wikidata editors, so it would stand to reason that more well-known modern figures would be more common in the database than the people relevant to specialized archival collections. Those entities would likely be more complete in terms of properties than those about whom less information is commonly available. Indeed, there are tradeoffs associated with matching persons related to archival collections to Wikidata, because while it may be easier to manually confirm whether an individual is related to a more specialized collection like the Belfer Cylinders Collection or the Ronald G. Becker Collection of Charles Eisenmann Photographs from the Linked Archives Project, those individuals might be less likely to appear in Wikidata. This was evident when we were only able to find 579 of the Belfer Cylinders Collection's 3000 name records in Wikidata. On the other hand, the third Linked Archives collection, the Ted Koppel Collection, contains a wider variety of individuals associated with comparatively recent current events that might be more likely to appear in Wikidata. However, that variety makes it more difficult to determine whether or not a Wikidata entity is a correct match because there is far less consistency in fields like date of birth or occupation that could be used to confirm an entity's relation to the collection in question.

CONCLUSION

Our experimentation with the Linked Archives Project and the OpenTapioca entity linking system reveals several limitations that may inhibit the ability of librarians and archivists to perform named entity disambiguation and linking using Wikidata without a specialized tool trained for their particular collections. While developing an original entity linking application is outside of the scope of this paper, our work suggests the need for future research to explore the possibilities of NED that may be more accessible and useful for entity management in libraries and archives.

ACKNOWLEDGMENTS

We thank the Syracuse University Libraries for providing the item-level metadata records for three archival collections.

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LEADING the Way: A New Model for Data Science Education

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ABSTRACT

Addressing the data skills gap, namely the superabundance of data and the lack of human capital to exploit it, this paper argues that iSchools and Library and Information Science programs are ideal venues for data science education. It unpacks two case studies: the LIS Education and Data Science for the National Digital Platform (LEADS-4-NDP) project (2017-2019), and the LIS Education and Data Science-Integrated Network Group (LEADING) project (2020-2023). These IMLS-funded initiatives respond to four national digital platform challenges: LIS faculty prepared to teach data science and mentor the next generation of educators and practitioners, an underdeveloped pedagogical infrastructure, scattered and inconsistent data science education opportunities for students and current information professionals, and an immature data science network. LEADS and LEADING have made appreciable collaborative, interdisciplinary contributions to the data science education community; these projects comprise an essential part of the long-awaited and much-needed national digital platform.

KEYWORDS

Data science education; pedagogy; Library and Information Science; iSchools; data science.

INTRODUCTION

The Institute of Museum and Library Services recently envisioned a National Digital Platform to benefit libraries, archives, and museums (Erway et al., 2015; T. Owens et al., 2018; Rudersdorf et al., 2018). IMLS enjoined stakeholders to parlay local, often siloed efforts into a broader collaborative, sustainable, national, and global community and infrastructure, to develop a computationally literate professional workforce that embraced continuous, lifelong, experiential learning, and to foreground diversity, equity, and inclusion (DEI).

Even as IMLS advocated for a national digital platform, Library and Information Science programs increasingly embraced the field of data science (Greenberg et al., 2017; Marchionini, 2016; Wang, 2018). The iSchool curriculum includes foundational data science topics such as the data lifecycle, architectures and ontologies, human-centered system design and development, human information interactions, metadata, project management, privacy and security, ethics, and archiving and curation (Marchionini, 2016; Song & Zhu, 2017).

This convergence between data science's burgeoning importance in LIS and the exigent need for a national digital platform sparked Drexel University's IMLS-funded LIS Education and Data Science for the National Digital Platform (LEADS-4-NDP) project (2017-2019). Its successor, the LIS Education and Data Science-Integrated Network Group (LEADING) project (2020-2023), accelerates LEADS's momentum.

This paper contends that LIS programs can and should play an essential role in nationally coordinated, interdisciplinary, and lifecycle-based data science graduate education. First, we justify our methodological approach. Next, we define data science and trace the need for data science education in Library and Information Science. Third, we set forth best practices for data science curriculum design. Fourth, we unpack the IMLS-funded LEADS and LEADING projects and their efforts to address four national digital platform challenges: a need for LIS faculty prepared to teach data science and to mentor the next generation of educators and practitioners, an underdeveloped infrastructure to support such a pedagogy, disparate and inconsistent data science education opportunities for current information professionals, and an immature data science network. Finally, we offer conclusions and directions for future research.

METHODS

This paper reports on two case studies. Case studies seek a holistic, multi-faceted understanding of contemporary, in-depth, and contextually situated phenomena (Schwandt & Gates, 2018; Yin, 2009). We rely upon multiple sources of documentary evidence to promote trustworthiness. Available, stable, and contextually grounded, documents may prove more accurate than self-reports, and they may contain information not available in other types of data (Hodder, 2000; Lincoln & Guba, 1985; Shenton, 2013; Wildemuth, 2009). We procured documents in this study through berrypicking: iterative searches involving a wide variety of techniques—footnote chasing, citation

searching, journal run browsing, database searching and browsing (e.g. by subject, keyword, and author)—and varied sources, including internal project documentation (Bates, 1989). In line with exploratory research best practices, our analytical approach is grounded and inductive (Bernard & Ryan, 2010). Not statistically generalizable, our findings are theoretically transferable (Pickard, 2013).

DATA SCIENCE AND DATA SCIENCE EDUCATION

In 2001, Cleveland announced “a plan to enlarge the major areas of technical work of the field of statistics,” and proposed the term data science to denote it (p. 21). Stanton (2012) subsequently defined data science as “an emerging area of work that concerned with the collection, preparation, analysis, visualization, management, and preservation of large collections of information” (p. ii). Davenport and Patil (2012) meanwhile defined a data scientist as “a hybrid of data hacker, analyst, communicator, and trusted adviser” (p. 73). Data science soon coalesced as a revolutionary field for both science and industry (National Academies of Sciences, Engineering, and Medicine (U.S.), 2018).

By the late 2010s, institutions of higher education apprehended data science’s importance for research and the workforce (Berman et al., 2018). Degree programs, departments, centers, divisions, and schools had mushroomed (Berthold, 2019; Raj et al., 2019), yet data science education remained in its formative stages (Kim, 2016; National Academies of Sciences, Engineering, and Medicine (U.S.), 2018). Institutions adopted different approaches to depth, breadth, and curricular emphasis; this militated against consensus on strategies for focused growth, much less best practices (Cao, 2019; Danyluk et al., 2019; Demchenko et al., 2017; Irizarry, 2020; National Academies of Sciences, Engineering, and Medicine (U.S.), 2018; Raj et al., 2019; Wing et al., 2018).

Suffice it to say, there existed a troubling disjuncture between the amount of available data—much of which was unstructured, mobile-based, and user-generated—and the talent available to exploit it (Burton & Lyon, 2017; Dumbill et al., 2013; Kim, 2016; Lyon & Brenner, 2015; Manyika et al., 2011; Song & Zhu, 2016; Tang & Sae-Lim, 2016). This problem demanded a “transformative re-engineering of data education, training and skills” (Lyon & Brenner, 2015, p. 119). Only then could librarians leverage their bundled technical skills and domain knowledge into transformational professional roles (Burton & Lyon, 2017).

The data talent gap offers iSchools a tremendous—perhaps unique—leadership opportunity (Bishop et al., 2019; Han & Zhu, 2017; Shah et al., 2021; Wu, 2019); to this end, the iSchool Data Science Curriculum Committee coalesced in 2019 to gather information and propose common curriculum content (Oh et al., 2019; Shah et al., 2021; Song et al., 2019, 2020).

DATA SCIENCE CURRICULA

Despite burgeoning LIS interest in data science, curriculum coverage in the 2010s remained desultory (Durr, 2020; Kim, 2016; Ortiz-Repiso et al., 2018; Si et al., 2013; Tang & Sae-Lim, 2016; Varvel et al., 2012; Wiktorski et al., 2016). Funded research projects provided much-needed momentum for curriculum development (Bishop et al., 2019). But the number of courses nonetheless varied among institutions, degrees, and programs; individual course content varied greatly as well.

An optimal data science education framework rests on three pillars: data, technology, and people (Song & Zhu, 2016). Embracing both theory and practice, courses should be user-centric, tool-based, application-based, and project-based (Demchenko et al., 2017; Song & Zhu, 2017).

Grounded in computational thinking and data-driven paradigms, a robust curriculum should address programming languages (high-level such as Python, R, and Spark, and low-level such as C++) and data science tools, big data infrastructures (e.g., Hadoop, MapReduce, NoSQL, NewSQL, in-memory and cloud computing, databases, big data warehousing, and data virtualization), the big data analytics lifecycle (e.g., business analysis, data understanding, data preparation and integration, machine learning, data mining, statistical analysis, model-building, evaluation, deployment, and monitoring), data management and governance (e.g., data modelling, relational database knowledge, and stewardship, curation, and preservation), research methods (develop research questions, employ the scientific method, and evaluate outcomes), domain knowledge, ethics, human-centered data science, and the behavioral disciplines (soft skills, e.g., collaboration, thinking critically and empathically, asking creative questions, project management, communicating with domain experts) (Cao, 2019; Chen et al., 2019; Demchenko et al., 2017; Irizarry, 2020; Song & Zhu, 2016, 2017; Wing, 2019; Wing et al., 2018). Finally, an ideal curriculum includes authentic real-world project experience, for example through practica or capstone work requiring data collection or wrangling (Berman et al., 2018; Chen et al., 2019; Irizarry, 2020; Song & Zhu, 2016; Wing et al., 2018). These recommended curricular components underpin LEADS and LEADING.

LIS EDUCATION AND DATA SCIENCE FOR THE NATIONAL DIGITAL PLATFORM (LEADS-4-NDP)

The IMLS-funded LIS Education and Data Science for the National Digital Platform (LEADS-4-NDP) (2017-2019) tackled two pervasive challenges: a lack of LIS faculty prepared to teach data science and mentor the next generation of educators and practitioners, and an immature infrastructure to support such a pedagogy.

LEADS-4-NDP imbricated data and library and information science. First, the project addressed the data science learning gap of future LIS faculty members. These individuals needed to learn to leverage data science questions and methods for data cleaning, descriptive and predictive data analytics, machine learning, and data visualization not only to guide and assess the daily operations of information organizations, but also to present the results to a range of stakeholders.

Second, not only were faculty in short supply, but also lacking was an appropriate shared, sustainable national infrastructure—datasets, tools, techniques, and demonstrations—for data science instruction in LIS. Hence LEADS aimed to develop and propagate a transferable, extensible, and cost-effective educational model encouraging diversity.

Cultivating a national cohort of future faculty, LEADS augmented current LIS doctoral pedagogy iteratively and holistically through multiple targeted channels. Over two years, 21 diverse doctoral students undertook an online Python-based curriculum via Blackboard, a rigorous, intensive, three day face-to-face bootcamp, and a ten-week immersive, hands-on, collaborative research-based summer internship with a mutually selected project partner. LEADS culminated with a public Forum event at Drexel University.

Promoting the national digital platform, LEADS's learning outcomes included understanding and demonstrating competence with major data science tools and technologies over the course of the data science lifecycle; applying mathematical, statistical, machine learning, and data mining techniques to data preprocessing (cleaning and transforming), modelling, predictive and visual analytics, decision support, and problem solving; leveraging those techniques to discover knowledge and to evaluate and to disseminate it; and communicating and collaborating with project partners and domain experts. Curriculum and bootcamp modules (including case studies) that supported these learning outcomes included Introduction to Data Science, LIS Data and Data Management, Metadata, Data Quality, and Integration, Data Pre-Processing, Data Mining and Machine Learning, Data Visualization and Visual Analytics, Large-scale and Parallel Computing, Cloud-Based Automated Data Analysis, and Data Clinics and Method Consultation. Drexel University's Metadata Research Center made all curriculum materials openly available.

Putting the model curriculum into practice, over the course of two years LEADS attracted partner-cum-mentoring nodes such as the Online Computer Library Center (OCLC), the California Digital Library, the Free Library of Philadelphia, the Historical Society of Pennsylvania, the Digital Curation and Innovation Center (University of Maryland), Biodiversity Heritage Library (Smithsonian), and the Digital Scholarship Center (Temple University).

LEADS's diversity, equity, and inclusion (DEI) efforts included recruitment (for example, consultation with the American Library Association's Office for Diversity, Literacy, and Outreach Services), outreach (the Dornsife Center for Neighborhood Partnerships), and data science application (e.g. partnering with the Mapping Inequality project). Fully one-third of LEADS Fellows were from underrepresented populations.

LIS EDUCATION AND DATA SCIENCE-INTEGRATED NETWORK GROUP (LEADING)

As a survey of Fellows demonstrated, LEADS proved a robust proof of concept. What was more, the 21 Fellows parlayed their mentored work at partner sites into both individually and collaboratively authored publications. The Academy of Natural Sciences (Cheng, Dilliplane, et al., 2020), the Biodiversity Heritage Library (Cheng, Hoang, et al., 2020; Stahlman & Sheffield, 2019), the Digital Scholarship Center at Temple University (Grabus et al., 2019; Logan et al., 2019; Pascua, 2019), the Historical Society of Pennsylvania (Gamble, 2020), Montana State University (Arlitsch, Wheeler, Parulian, et al., 2020; Arlitsch, Wheeler, Pham, et al., 2020; Pham, 2020), the University of Pennsylvania Libraries (Ma & Li, 2020; Ridenour et al., 2019)—each of these mentoring partnerships yielded important scholarly contributions. Nonetheless, upon LEADS's conclusion challenges persisted in the data science education ecology. Perhaps most important, front-line information professionals show an increased interest in continuing data science education opportunities. Moreover, their participation is essential to the development of a national data science network.

The LIS Education and Data Science-Integrated Network Group (LEADING) project extends and enriches LEADS in five ways. First, it expanded its diverse national cohort not only in size (from 21 to 50), but also in scope (bringing into the fold early- and mid-career librarians as well as LIS PhD students).

Second, in addition to fleshing out the LEADS-vetted Blackboard-based online curriculum, LEADING extends LEADS's bootcamp to four days and its 10-week immersive, mentored internship to six months. Online curriculum modules include Python and key packages (NumPy, SciPy, and Scikit-learn); Software Set up and Introduction; and

Project-based Data Preparation and Exploration Skills. Bootcamp modules included Data Science Overview, Data Management: SQL and NoSQL, Data Cleaning and Preprocessing, Text Processing / Mining / Search, Data Integration and Quality, Data Preservation / Curation, Graph/Network Models, Large-Scale Data Intensive Computing, Deep Learning, and Human-Centered Data Science, and Visual Analytics.

Third, LEADING amps up collaboration and team, cohort, and community development. Drawing on the NSF's Big Data Innovation Regional Hub model (<https://bigdatahubs.org/>), LEADING features Drexel as the central coordinating and educational hub, OCLC as a co-educational hub, Montana State University (specializing in Research Metrics and Analysis) and University of California, San Diego (Big Data and Data Mining) as community hubs, and 14 member nodes that serve as mentoring sites. This model brings together diverse stakeholders—educators, researchers, front-line information professionals, administrators, and doctoral students—from various hubs and nodes to promote coalescence into a full-fledged network and thus to spur national digital platform efforts.

Fourth, LEADING homes in on sustainability. For example, as noted above, LEADING adapts National Science Foundation's (NSF) Big Data Innovation Regional Hub model, which features both partner hubs and membership nodes, thus encouraging sustained growth. Further, LEADING's bootcamp curriculum aligns with that of EDISON, which is similarly helpful for developing and expanding networks and thus for promoting sustainability (Demchenko et al., 2017, 2016; Manieri et al., 2015; Wiktorski et al., 2017, 2016). Finally, LEADING features yearly (2021 and 2022) OCLC-sponsored data science challenges, in which Fellows and other students and information professionals will generate and share via LEADING's GitHub page curriculum materials based on OCLC data, and a summative PI- and Fellows-led outreach workshop, the curriculum work of which will also be shared via GitHub. Sustainability and community-building will be mutually reinforcing once more.

Fifth, building on LEADS and in line with IMLS priorities, LEADING foregrounds diversity, equity, and inclusion (DEI), a crucial need in data science (I. Owens, 2005; Sands et al., 2018; Wing et al., 2018). One-third of LEADS participants, for example, were underrepresented minorities; LEADING will make even further progress. In fact, project leaders established a DEI Task Force comprising LEADS Fellows. The Task Force will facilitate recruitment and ensure DEI issues remain at the core of LEADING. Further, Fellows will have access to diverse social justice-centered collections (the Movement Alliance Project for Social Justice and densho.org).

To ensure the full realization of its contribution to community-building, sustainability, and DEI, LEADING features multiple rounds of surveys, focus groups, and interviews. Undergirded by the United States Government Accountability Office's (2012) recommendations, LEADING's evaluation activities center on project communication and curriculum, mentor engagement, individual and collective learning outcomes, mentors' feedback on Fellows' performance, a mid-point assessment of the Fellows, an overall assessment of LEADING, and assessment of project sustainability plans.

CONCLUSION

LEADS and LEADING show the potential for Library and Information Science—especially iSchool—leadership in developing a robust digital platform and thus meeting an urgent global as well as national need. Preparing the next generation of faculty and practitioners, stimulating community and collaboration, and building a sustainable model for data science education—LEADS and LEADING have foregrounded each of these priorities.

Currently, LEADING stakeholders are aligning applicant and mentor skills and preferences to choose Fellows and are iteratively developing and refining online and bootcamp curriculum content. Periodic meetings with members of the Advisory Board, the DEI Task Force, community hubs, and partner nodes ensure constructive collaboration.

Directions for future research include four. First, following Carter & Sholler (2016), how might more empirical studies of data science work in varied LAM environments suggest strategies for refining data science curricula? Second, how might longitudinal studies of LEADS and LEADING Fellows contribute to further assessment of these projects' longer-term professional impact? Third, how might iSchools further enrich and standardize their curricula on bachelors, Master's, and doctoral levels to shore up their claim as the locus of optimal interdisciplinary data science education? Finally, how might stakeholders encourage further hub and node development in service of national—and international—platform and infrastructure?

In defining data science two decades ago, Cleveland (2001) emphasized “how valuable data science is for learning about the world” (p. 24). LEADS and LEADING have given rich life to this insight in Library and Information Science; these projects redound to the benefit of the long-awaited national digital platform.

ACKNOWLEDGEMENTS

This project was made possible in part by the Institute of Museum and Library Services (RE-70-17-0094-17 and RE-246450-OLS-20). Sincere thanks to LEADING PI Jane Greenberg, co-PIs Kenning Arlitsch, Weimao Ke, Erik Mitchell, Andrew K. Pace, Il-Yeol Song, Erjia Yan, and Jake Williams, senior advisors Mat Kelly and Lei Wang, doctoral student Sam Grabus, and members of the LEADING advisory board and the LEADING Diversity, Equity, and Inclusion Task Force.

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Using Future Work Sentences to Explore Research Trends of Different Tasks in a Special Domain

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ABSTRACT

Research trend detection is an important topic for scientific researchers. Future work sentences (FWS), as direct descriptions of future research, aren't fully utilized in research trend detection. Therefore, this article uses FWS to investigate research trends of different tasks in a particular domain. Taking the conference papers in the natural language processing (NLP) field as our research objects, we obtain the FWS in each paper to build the corpus and classified them into 6 main types. After that, the task of each paper is annotated, and a task system with 29 categories is constructed to compare the FWS in different tasks. The results show that the proportion of *method* mentioned in FWS is the highest, and different tasks focus on different FWS types: emerging tasks need more *resources*, while mature tasks prefer *method* and *application*. This study provides researchers a reference to understand the research trend of specific tasks and is helpful to compare different tasks.

KEYWORDS

Future work sentences; Construction of task systems; Content analysis.

INTRODUCTION

Exploring the future trend of academic research is an important aspect of the current academic evaluation work, and also a topic of common concern to scholars. It can help researchers to accurately obtain emerging research directions and cutting-edge literature, while providing information support for the development of science and technology. With the development of NLP field, several major technologies for forecasting future trends have been developed, such as the term-based approach and citation-based approach. However, the data of these works is not directly related to the future trend.

We use FWS of scientific papers to explore future research trends. FWS are sentences in which authors discuss the possible future research direction and predict the development trend of the whole field. Most FWS are mentioned in the conclusion or future work section—essential sections for predicting future research trends. We develop a classification system for the tasks of conference papers in the field of NLP and construct an FWS corpus. A combined analysis of these two corpora can reflect the future research direction in a specific task and help researchers keep abreast of the cutting-edge trend. In addition, this article provides a manual annotation corpus for automatic task extraction of scientific literature in the future.

RELATED WORKS

Much interest has been focused on task extraction from the scientific literature. Jain et al. (2020) developed a new corpus SciREX which included annotations for four types of entities: task, dataset, metric, and method. Hou et al. (2021) proposed a new corpus (TDMSci) and developed a TDM marker to extract tasks, data, and metrics from NLP papers. These researches have automatically extracted the task of scientific literature, but the results are quite different, and there is no settled standard of task classification system. In this paper, we manually extract tasks from the official manual of the conference. Some scholars targeted on the recognition and classification of FWS. Hu and Wan (2015) proposed a regular expression-based method to extract FWS and classified FWS into four different categories. Li and Yan (2019) formulated a series of rules to extract FWS from academic papers. Hao et al. (2020) extracted and classified FWS in ACL proceedings by manual annotation. These works, serve as an overall analysis of the literature collection in a particular field, didn't focus on FWS of a special task to analyze the differences between tasks at a more granular level. This paper focuses on specific tasks, to finding information by comparing the differences between tasks and analyze the research trends from a unique perspective.

METHOD

This paper takes the NLP field as an example and identifies the FWS and task in each article. Furthermore, FWS are classified to explore the type of distribution of them in various tasks.

Construction of FWS corpus

The FWS corpus is constructed based on papers of ACL, EMNLP, and NAACL published from 2000 to 2020 by manual annotation and automatic extraction. The specific process is shown in Figure 1. The final FWS corpus consists of three parts.

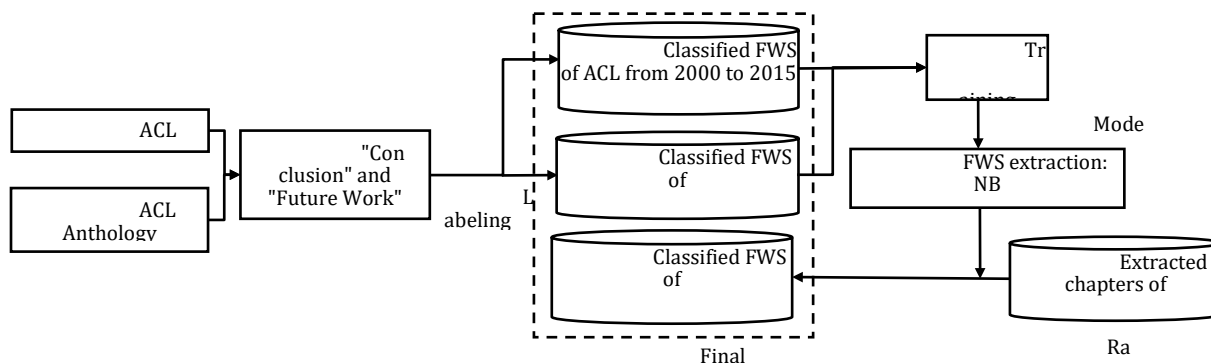


Figure 1. Flowchart of corpus construction

First, classified FWS of ACL from 2000 to 2015 are obtained from the *ACL FWS-RC* (Hao et al., 2020).

Second, we obtain classified FWS of EMNLP and NAACL from 2000 to 2019 by manual annotation with the method of the previous work (Hao et al., 2020). Specifically, we obtain full text of all XML or PDF papers from ACL Anthology (<https://www.aclweb.org/anthology>) and ACL Anthology Reference Corpus (<https://acl-arc.comp.nus.edu.sg/>). Since FWS are mostly mentioned at the end of a paper, we only consider FWS in sections related to conclusions such as "conclusion" and "future work". After manually obtaining these sections, we formulate a series of labeling guidelines, according to which the FWS are tagged with tags <FR>...</FR> and all FWS are obtained after consistency testing. Based on grounded theory, we use the coding function of NVivo11 to classify the FWS. After multiple rounds of iterations and corrections of the classification results, FWS are classified into 14 types. By sorting out the potential logical connections between the categories, these types are classified into six main types: *method*, *resources*, *evaluation*, *problem*, *application*, and *other*. The results are shown in Table 1. According to the taxonomy, we obtain classified FWS of EMNLP and NAACL from 2000 to 2019 by manual annotation. The Kappa values of the three-to-two labeling results are 0.709, 0.742, and 0.745.

Main Type	SubType
Method	Model; Algorithm; Feature; Other
Resources	Optimize resources; Expand resources; Change resource type; Other
Evaluation	Evaluate current work; Improve evaluation means; Expand evaluation areas; Other
Application	Applied for other tasks; Expand application areas
Problem	-
Other	-

Table 1. Taxonomy of Future Work Sentences ("-" means no subtype exists in this main type.)

Third, we use machine learning methods to obtain classified FWS of ACL 2016-2020 and EMNLP 2020. We use the two manual annotation corpora as training corpus and select two classification models with the best results for identification and classification by model selection (Hao et al., 2021). We use the Naive Bayesian based on the embedded feature selection method for automatic recognition of FWS. The method achieves the best F1 score of 93.95%. For automatic classification of FWS, we use Bert to represent the data's features and input the obtained feature vector into Soft Maxlayer (Devlin et al., 2018). The weighted average F1 score of each category is 85.91%. The reliability of the data has been verified by sampling with a rate of 10%. The final corpus contains 13,035 papers and 11,438 FWS.

Construction of task category in NLP domain

There are many different research tasks in NLP field, such as machine translation, information extraction, etc. The conference manual by the conference organizer such as *2020.acl-main* (<https://www.aclweb.org/anthology/2020.acl-main.pdf>) provides some information about the conference, including each paper's display time, source, session name and so on. According to the manual, the session name of each paper is used as the standard task category of the paper. To ensure accuracy of labeling, papers with multi-label (such as "*Tagging, Chunking, Syntax and Parsing*") and unlabeled papers are not considered at present. We count all the single-label categories that appear in the conference manual and sort them by frequency, then select the categories with a frequency of more than 10 and merge the categories that have synonymous relationships or subordination relationships. Specifically, we merge the categories iteratively based on grounded theory and verify them through expert review and group discussion. Some of the task labels are pre-defined by the conference, others are summarized by experts according to the Oxford Handbook of Computational Linguistics (Mitkov, 2003). We retain the mapping between the original label and the final task category shown in Table 2. Finally, we obtain 5634 articles in a single task and construct a task system with 29 categories.

Original Label	Final Category	# (Papers with Original Label)
Generation	Natural Language Generation	211
Sentiment Analysis	Sentiment Analysis and Opinion Mining	109
Dialogue and Interactive Systems	Dialogue	93
Machine Translation and Multilinguality	Machine Translation	70
Social Media	NLP for the Web and Social Media	65

Table 2. Top-5 label Mappings between the Original Label and the Final Task Category

RESULT

FWS distribution for specific tasks in the NLP domain

Table 3 lists the top-5 tasks ranked by the number of the FWS. We calculate the occurrence times of FWS (Noted as #FWS) in different tasks and the average number (Noted as Avg) of FWS mentioned in each paper. The Oxford Handbook of Computational Linguistics divided tasks into FUNDAMENTALS, APPLICATIONS and PROCESSES/ METHODS/RESOURCES (Mitkov, 2003). More than half of the top-15 tasks belong to APPLICATION tasks. "*Semantics*", "*Machine Translation*" and "*Information Extraction*" mention FWS more frequently, which indicates that there are more articles related to them. Therefore, these tasks are more attended to in the field of NLP.

No.	Task	#FWS	Avg
1	Machine Translation	672	0.74
2	Semantics	619	0.88
3	Information Extraction	342	0.75
4	Sentiment Analysis and Opinion Mining	206	0.71
5	Question Answering	176	0.67
6	NLP for the Web and Social Media	161	0.96
7	Dialogue	156	0.69
8	Natural Language Generation	144	0.61
9	Parsing	143	0.67
10	Summarization	137	0.69
11	Information Retrieval	120	0.98
12	Resources and Evaluation	86	0.43
13	Discourse	63	0.71
14	Spoken Language Processing	62	0.73
15	Natural Language in Multimodal and Multimedia Systems	55	0.54

Table 3. FWS Distribution for Top-15 Tasks in NLP Domain

In different tasks, the frequency of FWS mentioned per paper is also different. The average number of FWS mentioned in "*NLP for the Web and Social Media*" and "*Information Retrieval*" is higher, indicating a rapid development stage for these tasks, as researchers in these tasks are more inclined to propose future improvement measures. Comparing our task system with 37 tasks proposed by the Oxford Handbook of Computational Linguistics (Mitkov, 2003), there are more researches on "*Sentiment Analysis and Opinion Mining*" in the 21st century, and more researchers begin to analyze contents obtained by online social media.

Type distribution of FWS for special tasks

We calculate the average proportion of FWS's main types and compare the FWS's proportion in the top-5 tasks. The results are shown in Figure 2. On average, more than half of the FWS (56%) in the corpus mentioned *method*. It can be indicated that most researchers believe the improvement of method is important in the NLP field, and *method* would help further discover new research directions. Among the other five main types, researchers tend to propose future works about *resources* and *application*.

In different tasks, researchers tend to mention different types of FWS. In the future work of "*Semantics*" and "*Information Extraction*", the proportion referring to *resources* is lower than the average level, while the proportion referring to *method* and *application* is higher. "*Question Answering*" is just the opposite: the number of FWS referring to *resources* is higher than the average, and few researchers mention *application*. The reason could be that "*Semantics*" and "*Information Extraction*" have been developing for a long time, resulting in a smaller demand for data. Their main research content turns to the direction of improving methods and putting them into practice. With the continuous development of the Internet, more and more data are created and opened, and "*Question Answering*" is based on those updated data. Therefore, these two tasks still need perfect and diverse data resources. Task "*Sentiment Analysis and Opinion Mining*" is closely related to business intelligence, automatic recommendation, and other practical applications. It also relies on the latest data resources. Therefore, the FWS proposed by the task pay more attention to *resources* and *application*.

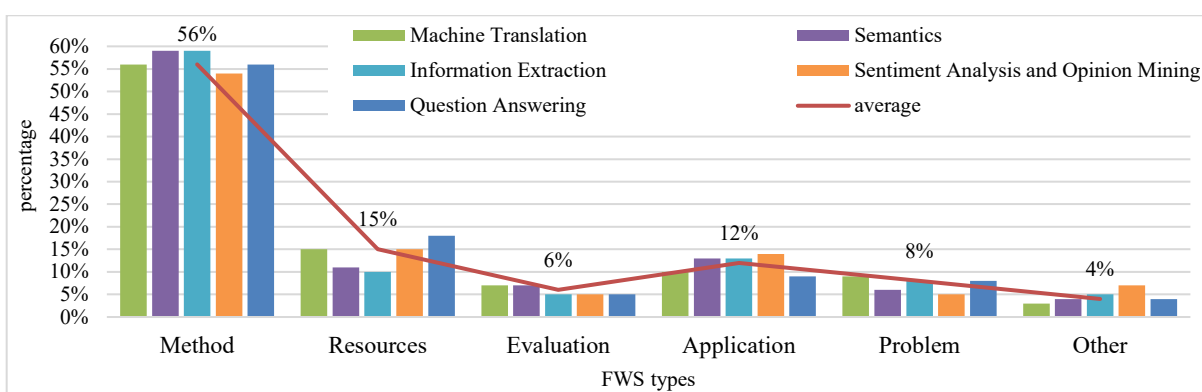


Figure 2. Distribution of FWS of Main Categories in Top-5 Tasks

CONCLUSIONS AND FUTURE WORKS

We use conference papers in NLP to construct a task system with 29 categories and analyze the type of distribution of FWS under different tasks. The results show that tasks related to APPLICATION are dominant in the three conferences, and *method* has the highest proportion in the FWS of each task. We also find that tasks differ in the authors' willingness to mention FWS and the distribution of FWS. This study combines task and FWS to explore the distribution of FWS types in different tasks for the first time. It should be noted that our method is also suitable for data-driven researchers, although we only take NLP as research objects. Additionally, this paper provides more targeted information in future research trend for researchers of specific tasks and reveals the differences between tasks from the perspective of FWS. This study is only a simple statistical analysis, with no further empirical research on the causes of differences in the distribution of FWS types among tasks and how they can be used to predict research trends systematically. In the future, we will use automatic classification and other methods to classify unlabeled articles, further expanding the corpus and analyzing the topics of FWS to see its effectiveness on research trend prediction.

ACKNOWLEDGEMENT

This work is supported by National Natural Science Foundation of China (Grant No. 72074113).

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Content Moderation of Speech in Political Discussions

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ABSTRACT

Social media platforms have been hailed as “politically disruptive communication technologies” (Hong & Nadler, 2012). Individuals express opinions and engage with politicians, the press, and each other on social media, sometimes using offensive language (Rossini et al., 2020). Content moderation has been adopted by many social media platforms to screen and evaluate offensive speech. In the present study we trained offensive speech classifiers to analyze offensive speech examples by integrating three archival datasets. We then used the trained classifier to examine a large body of comments about YouTube videos posted during the 2018 midterm election cycle. This provided information on the prevalence of various kinds of offensive comments and the pattern of content moderation used by YouTube. We also examined comment negativity using offensive speech lexicons. Our results showed systematic variance in the prevalence of offensive speech topics depending upon the political orientation of the content. Language use was significantly different between left and right-leaning videos for comments related to sexism.

KEYWORDS

Content moderation; hate speech classification; political discussion; YouTube comments; political orientation.

INTRODUCTION

Social media experiences have become embedded in everyday life (Ogan et al., 2008) in ways that have motivated greater political engagement (Towner, 2012). Using survey data from a presidential election year, the Pew Research center estimated that 74% of registered voters participated in politics on a social media site, with the vast majority of these on Facebook (Pew Research center, 2012). Widespread use of social media for political messages enables comparisons between parties: For example, during the 2016 U.S. presidential debates, one campaign made personal attacks and name-calling a common occurrence (Rossini et al., 2020). Similar phenomena have been observed in other countries: Ben-David and Fernández found that Spanish extreme-right parties posted discriminatory language on Facebook, which spurred followers to post hate speech attacking certain groups (Ben-David, 2016). Studies like these highlight the occurrence of offensive speech in the context of political discourse. Companies such as Facebook and Twitter have responded by establishing content moderation for their sites.

Content moderation is defined as, “governance mechanism[s] that structure participation in a community to facilitate cooperation and prevent abuse” (Grimmelmann, 2015). Social media platforms use moderation to evaluate user-generated content (Çömlekçi, 2019). Ideally, moderation helps to ensure an environment where multiple perspectives can be voiced respectfully (Çömlekçi, 2019). Thus, one goal of moderation is ostensibly to prevent the posting and/or spread of material that is likely to make a plurality of users sufficiently uncomfortable to leave a conversation (Saha et al., 2019). Particularly with respect to political speech, however, it is difficult to balance the value of free speech with the value of preventing offense. Content moderation also raises complex questions about the democratic accountability of tech companies and their role in representing societal values such as freedom of expression and diversity (Gillespie, 2018)(Gorwa, 2019)(Helberger et al., 2018). In the U.S. and elsewhere, constitutional protections limit the *government’s* ability to censor political speech, but social media platforms are typically private, for-profit companies. Presumably, these companies develop their moderation approaches with a goal of maximizing profit – including the avoidance of governmental regulation of their approaches to managing offensive speech. Given these complex and sometimes contradictory forces, the ability to differentiate between political speech that is acceptable or unacceptable to a social media platform’s audience is highly challenging.

In the present study, we built upon previous research on offensive speech detection to analyze the moderation of comments under videos with political messages. To accomplish this, we trained multi-topic classifiers to predict controversial topics for YouTube comments that were “alive” (i.e., still posted) and comments that had been deleted in the process of content moderation. We also used an offensive speech lexicon to compare word-level language use of moderated comments published under different political leaning videos (i.e., left and right). Results showed broad categorical differences in content moderation decisions between messages with different political orientations.

RELATED WORK

Language Use in Political Discourse

Graham, Haidt, and Nosek observed that, “Words do the work of politics” (Graham et al., 2009). Previous literature has shown that liberals and conservatives use different words to frame political positions, ostensibly in an effort to establish the superiority of their positions (Lakoff, 2004). Luntz (2007) argued that the capability of the U.S. Republican party to find “words that work” contributed substantially to that group’s political victories in the 1990s.

As the number of social media users has increased and politicians’ use of the platforms has become commonplace, social media has served as a productive source of data in the area of political discourse research. For example, Pennacchiotti and Popescu proposed a machine learning framework to classify social media users based on their interests. Using topic analysis, they found that on Twitter, Republicans concerned themselves with different issues than Democrats did. Republicans tended to use value-laden vernacular such as “Obamacare” when discussing wedge issues (Pennacchiotti & Popescu, 2011). Sylwester and Purver found that Democrats used language emphasizing their views of uniqueness. Content posted by Democrats also included more profanity, more anxiety-related words, and more emotion-related words than Republicans. Conservative language emphasized group membership and contained more achievement-oriented and religious content (Sylwester & Purver, 2015).

Content Moderation on Social Media Platforms

When discussing content moderation, scholars have tended to frame the process in one of three ways: as digital labor, civic participation, or oligarchy. Literature in digital labor describes volunteer moderation as unwaged labor in the digital economy or donated labor in collaboration communities such as Wikipedia (Terranova, 2000)(Postigo, 2003)(Menking & Erickson, 2015). Legal scholars and digital media scholars consider moderators as civic leaders who build public spheres for their communities (Kelty, 2005). For example, Grimmelmann described moderation as governance mechanisms that “structure participation in a community to facilitate cooperation and prevent abuse” (Grimmelmann, 2015). Moderators influence norm setting for their communities (Grimmelmann, 2015). Finally, the oligarchic perspective considers the power dynamics of the moderator role. For instance, Shaw and Hill found that as wiki communities became larger, a small number of members consolidated and exercised a monopoly of power by occupying authoritative positions, conducting a greater proportion of administrative activities, and by using their authority to restrict contributions from other community members.

In the present day, social media platforms use a range of approaches to moderate user-generated content. All three of the above perspectives are potentially relevant, but additional complications arise from the use of automation in content moderation. Offensive speech, including hate speech, is the usual focus of content moderation. Social media companies such as Facebook, Google, and Twitter have made efforts to combat offensive speech for years (BBC News, 2015). Hundreds of millions of dollars are invested every year on measuring and countering such speech (PTI, 2019)(Errick, 2020). These companies’ content moderation approaches include removing offensive content such as incitement to physical violence and/or property damage, personal offense with no physical violence, incitement of discrimination, and collective offense with moral damage (Miro-Linares and Rodriguez-Sala, 2016).

Based on this literature review, we offer the following research questions addressing the detection of offensive speech in the context of commentary on political videos:

RQ1: What is the prevalence of various offensive topics in political comments?

RQ2: What topics draw the greatest proportion of content removal decisions in political comments?

RQ3: What topical differences appear between moderated comments under different political orientations?

RQ4: What differences in moderation patterns appear in videos from different political orientations?

METHOD

In this study, we trained several classifiers based on topics of offensive speech. Using these classifiers, we predicted topics of YouTube comments collected by Jiang et al (Jiang et al., 2020), which identified the moderated comments and which included a label for the political orientation of the video. To investigate the difference in word-level language and semantic meaning between comments, we used word embedding to compare the distance between each comment and examples from a lexicon of offensive speech.

We obtained training data from three previous projects: Waseem & Hovy (2016), Gomez et al. (2020), and Ousidhoum et al. (2019). We integrated the speech typologies to ensure that labels for different topics were consistent across the three datasets. This integration resulted in four topical categories: disability, origin, sexual orientation, and sexism. The “disability” category included many insults, mainly about mental disabilities. We placed slurs about ethnicity and geographical origins in the “origin” category. For “sexual orientation,” most sentences we collected were homophobic. For “sexism,” the vast majority of the examples were misogynistic. Together the integrated dataset comprised 12,750 English sentences.

Next, our data on content moderation decisions came from Jiang et al (2020). Their dataset contained 84,068 comments posted under 258 political videos on YouTube, labeled as “alive” (meaning still posted) or “moderated” (meaning that a moderation decision had been made to remove the comment). The videos and the comments pertained to the midterm election two years into the Trump administration. The political leaning of the video under which the comment was posted was labeled according to Robertson et al. (2018). Those researchers linked a video’s publisher to a corresponding political party and used a computed ideological score to designate its political leaning as either left or right.

We combined three lexicons to conduct linguistic comparisons between comments and offensive speech: (1) HurtLex, a lexicon of offensive, aggressive, and hateful words (Bassignana et al. 2018); (2) Lexicon of domain-independent abusive words (Wiegand et al., 2018); and (3) the Reddit hate lexicon (Chandrasekharan et al., 2017).

Model Development

We trained Logistic Regression, LSTM and BERT multi-class classification models using the merged datasets summarized in section Data. For each model training process, we held back 15% of the labeled data set to evaluate model performance with F1 scores for each category. The best performing model is selected to generate scores and predictions for each YouTube comment collected by Jiang et al (2020). To verify the classifier’s performance on YouTube comments, we manually annotated 20 comments per category. Roughly 80% of the human labels were the same as the classifier’s prediction, which suggests that the classifier’s performance is adequate on YouTube comments. After generating a category related to hate speech related controversial topics for each comment, we compared comments under YouTube videos with different political orientations by examining the tallies of comments assigned to various categories. Using the list of hate speech related lexicons, we also generated a word embedding representation for each of the words in the lexicons with a 200-dimensional GloVe pretrained model. We measured the negativity of each YouTube comment by calculating the mean average cosine distances between each word in the comment and each word in the lexicons. We then compared these distances between left- and right-leaning videos.

RESULTS

As Table 1 shows, BERT had the best performance. We examined the percentage of comments fitting different categories (Disability, Origin, Sexism, and Sexual Orientation) between videos of different political orientations. Table 2 shows the number of comments in different hate speech related controversial topics. In Table 2, values in parentheses indicated the percentage of the grand total for each cell, rounded to the nearest integer.

Models / F1 Scores	BERT	LSTM	TF-IDF & Logistic Regression
Disability	0.907285	0.899522	0.873684
Origin	0.896321	0.870466	0.874109
Sexism	0.929293	0.852942	0.879357
Sexual Orientation	0.993378	0.958763	0.957747

Table 1. F1-Scores for Different Categories and Models

Political leaning of videos	Moderation Result	Sexism	Sexual Orientation	Origin	Disability
Left-leaning	Retained comments	4,429 (15%)	112 (00%)	7,597 (26%)	3,233 (11%)
	Removed comments	262 (01%)	16 (00%)	334 (01%)	256 (01%)
Right-leaning	Retained comments	5,352 (19%)	126 (00%)	3,798 (13%)	2,730 (10%)
	Removed comments	168 (01%)	7 (00%)	143 (00%)	114 (00%)

Table 2. The Number of Comments in Different Offensive Speech Categories

These results show that retained comments about ethnic origins were the most prevalent category overall, with retained sexist comments coming in a close second and disability comments third. The BERT model detected only a negligible number of offensive comments pertaining to sexual orientation. Notably, the overall number of removed comments was less than 5% of the total. A chi-square test of retained comments, comparing left- and right-leaning videos, was significant (chi-squared=998, df=3, $p<.001$). Right-leaning videos attracted more comments containing sexist material, whereas left-leaning comments contained a higher proportion of comments about ethnic origins. Likewise, a chi-square test of removed comments, comparing left- and right-leaning videos was also significant (chi-squared=9.9, df=3, $p<.05$). In parallel to the previous test, right-leaning videos had a greater proportion of comments removed with sexist content, whereas more of the left-leaning video comments were removed with comments about ethnic origins. Finally, a chi-square test examining whether left- or right-leaning videos were more likely to have comments removed was also significant (chi-squared=56.6, df=3, $p<.001$). Left-leaning videos had comments removed twice as frequently as right-leaning videos.

We compared the semantic information and negativity of each comment using word embeddings. A t-test showed that comments related to sexism had significantly different semantic negativity when comparing comments on left-leaning videos and comments in right-leaning videos ($p<.001$): Language negativity related to sexism was stronger

when directed at left-leaning videos. For sexual orientation, origin, and disability, no significant differences appeared between comments on left-leaning videos and comments in right-leaning videos.

DISCUSSION AND CONCLUSION

In this study, we trained classifiers to identify hateful topics in both retained and removed comments published under political videos. The BERT classifier achieved the highest accuracy levels across all four categories of speech. We used this BERT classifier to analyze the linguistic content of a novel data set, namely material obtained from politically oriented YouTube videos posted during the 2018 midterm election. The YouTube dataset allowed us to examine linguistic content both from comments that were “alive” (i.e., still posted) and from comments that had been deleted. This provided a unique opportunity to examine how YouTube’s content moderation decisions unfolded based on different types of offensive content. In a similar vein, because each video had been tagged as containing either left-leaning or right-leaning political content, we could examine whether differences emerged in the commenting patterns of users who addressed these two broad categories of videos.

It is important to keep in mind that our knowledge of the left-leaning or right-leaning content in the videos *does not* signify the political persuasions of the users who posted the comments. It is highly likely that users from all points of the political spectrum viewed and commented on some video content to which they were opposed. Thus, the content removal patterns and linguistic patterns we detected should be interpreted only with respect to the video content to which they were directed, rather than the political orientation of the user who posted them.

With this caveat in mind there were several distinctive patterns. First, right-leaning videos attracted more comments containing offensive language with sexist themes, whereas comments on left-leaning videos contained a higher proportion of comments about ethnic origins. As mentioned in the data section of the method, the vast majority of sexist content was misogynistic. This pattern was approximately the same regardless of whether one considered the distribution of linguistic material within retained comments or within removed comments. Commenters on right-leaning videos tended to say offensive things about women, while commenters on left-leaning videos tended to say offensive things about ethnic minorities. Given some of the hot button issues in the 2018 midterm elections, this provides modest statistical evidence documenting a particular kind of political polarization among social media users.

Second, the content moderation pattern differed based on the political orientation of the video. Considering offensive comments of all types directed at videos, the likelihood of removal was twice as high for comments directed at left-leaning videos. While this opens the possibility of bias in the application of content moderation decisions, a second piece of evidence must also be considered. In particular, our linguistic analysis showed a distinctive pattern for sexist comments. The sentiment directed at left-leaning videos was notably more negative than the sentiment directed at right-leaning videos. Thus, it is possible that the differential moderation rate may be attributable to the harshness of language used by commenters.

These results provide new insights into the prevalence of different kinds of offensive speech in political discourse posted on social media. The partisan nature of public dialog was clearly operative as manifested in the different kinds of content directed at videos coming from the right or left side of the spectrum. These results also show that surface patterns of differences in “moderation rates” (i.e., the likelihood of a comment being removed) are not sufficient on their own as documentation of biased content moderation policies. The intensity of the language used in comments must also be taken into consideration when explaining moderation rates. Platform providers should consider language habits of different groups of users when designing community moderation rules and enforcement.

These results also suggest several avenues for further exploration. A promising frontier would be to find or collect data that would indicate the political orientations of the commenters as well as the video content to which their comments are addressed. It would also be valuable to compare comments collected during different presidential election cycles to understand how the prevalence of different kinds of offensive linguistic content varies over time.

ACKNOWLEDGMENTS

We thank Saheb Singh and Tanishk Parihar for providing feedback on the data analysis. We appreciate the valuable comments from reviewers and publication support from editors. This work was supported by a “CUSE” research grant awarded by Syracuse University.

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Patterns of Subject Metadata Change in MARC 21 Bibliographic Records for Video Recordings

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ABSTRACT

Study reported in this paper analyzed over twenty thousand machine-readable library metadata records in MARC 21 bibliographic format that are based on Resource Description and Access (RDA) standard. The focus of this analysis is on change in subject metadata—data elements designed for representing the aboutness of information objects—over a 6-year period between 2014 and 2020. The analyzed dataset is the entire population of the records representing English-language video recordings in DVD format in WorldCat database as of one year after official transition to RDA data content standard in library metadata creation. Analysis of metadata representing audiovisual materials is needed as audiovisual metadata practices tend to differ from those for other materials due to high occurrence of unique resources. The study includes quantitative and qualitative analyses into the change in the application of data elements (fields and subfields) over time and categorizes the observed change.

KEYWORDS

Subject representation; Metadata evaluation; Metadata change; Bibliographic metadata.

INTRODUCTION AND BACKGROUND OF THE STUDY

As an important part of metadata, subject metadata deals with intellectual content of information objects through the use of words and phrases from controlled vocabularies or natural language that represents “aboutness” (e.g., Fairthorne, 1969; Wilson, 1968). Traditionally, metadata is available in library systems in the Machine-Readable Cataloging (MARC 21) data encoding and transmission standard. The MARC 21 standard currently includes over 30 fields for subject representation in bibliographic metadata records. The process of creation of library metadata records is governed by data content standards. The currently used data content standard is Resource Description and Access (RDA), which was officially implemented in March of 2013.

Over the years, several broader studies of MARC 21 bibliographic metadata, mostly completed before transition to RDA, also examined subject representation in library metadata records. This included Taylor and Simpson's (1986) comparisons of the US Library of Congress Cataloging-In-Publication bibliographic records with other records; Mayernick's (2009) examination of application of MARC 21 fields in the US Library of Congress catalog; Intner's (1989) comparative analysis of metadata records quality in OCLC and RLIN databases; Moen et al. (2006), Eklund et al. (2009), and Smith-Yoshimura et al. (2010) evaluation of use of MARC 21 fields and subfields in OCLC WorldCat. A small number of works focused specifically on subject metadata. For example, Zavalin (2020), Zavalin and Miksa (2021, in press) examined patterns of application of subject metadata—fields and subfields, including Linked-Data-supporting elements, in RDA-based MARC 21 records created in early 2020; Hoffman (2001) examined the practice of creation of individual records with more specific subject headings for each work in a multi-work item. Kiraly (2019) analyzed 126 million records representing books in 14 catalogs in USA and Europe and discovered using nonstandard elements and inconsistent application of controlled vocabularies and encoding schemes.

The RDA standard that guides creation of library metadata continues to evolve to meet the user needs. To address the need for a more flexible framework for bibliographic description that would be useful in different environments, the BIBFRAME, a Linked Data model for bibliographic description is being developed to eventually replace MARC 21 (El-Sherbini, 2018). This development potentially improves discoverability of information through metadata records, including subject access through subject metadata. Both RDA and BIBFRAME place emphasis on expressing relations and using unique identifiers such as Uniform Resource Identifiers (URIs) to support expression of these relationships between various works, their instances, and important entities related to work such as subjects and agents.

While BIBFRAME currently remains an initiative, MARC 21 continues to be the predominantly used encoding standard (El-Sherbini, 2018). It constantly evolves to reflect the changes in library cataloging practice: new data elements (fields and subfields) are added regularly to support the functionality of RDA and BIBFRAME. Content designator history published by the US Library of Congress MARC Standards Office for each group of MARC 21

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bibliographic fields (e.g., <https://www.loc.gov/marc/bibliographic/bd01x09x.html>), traces these additions. This resource shows that in the years between the beginning of the RDA development and the most recent revision to MARC 21 bibliographic standard (December 2020), ten data elements have been added to expand subject representation. This includes 6 fields: 083 Additional Dewey Decimal Classification number (added in 2008), 085 Synthesized classification number components (added in 2008), 522 Geographic Coverage Note (added in 2008), 647 Subject Added Entry - Named Event (added in 2016), 662 Subject Added Entry - Hierarchical Place Name (added in 2005), and 688 Subject Added Entry - Type of Entity Unspecified (added in 2019). This also includes 4 subfields 75% of which were added to support Linked Data functionality: \$g Miscellaneous information (added in 2014), \$0 Authority record control number or standard number (added in 2007, redefined in 2010 to allow for URI as a data value), \$1 Real World Object URI (added in 2017), \$4 Relationship (added in 2005 as Relator code, renamed and redescribed in 2017 for recording of relationship URIs). In the years after official transition to RDA, the library cataloging community has been encouraged to actively use these subfields (e.g., Shieh & Reese, 2015; Boehr & Bushman, 2018).

Major changes in metadata standards usually prompt change in existing metadata records to bring them to conformance with the new standards (e.g., Thornburg & Oskins, 2007). Several studies examined the change in small samples of library metadata records in response to transition to RDA (Zavalina, Shakeri, & Kizhakkethil, 2015; Zavalina, Zavalin, & Miksa, 2016; Zavalina and Zavalin, 2018). The only study so far that focused specifically on change over time in subject metadata in RDA-based bibliographic records (Zavalina, Shakeri, & Kizhakkethil, 2016) relied on a small sample and did not examine any changes in records after 2015. That study concluded that longitudinal analyses are needed to assess how the patterns of subject metadata change vary as time passes. The study reported in this paper aimed to start addressing this need for developing understanding of the trends in application of the MARC 21 subject metadata fields and subfields in bibliographic records since official transition to RDA. It explored changes over a 6-year period (2014 - 2020) and focused on records representing video recordings as audiovisual metadata practices tend to differ from those for other materials due to high occurrence of unique resources (Smith-Yoshimura, 2020).

METHOD

The entire population (20443 records) of OCLC WorldCat MARC 21 bibliographic records that represent English-language video recordings, are catalogued with English as a language of cataloging, and follow RDA cataloging rules was obtained from OCLC Research Services in April of 2014. The later versions of the same records were collected directly from OCLC WorldCat via Z39.50 protocol using MarcEdit Z39.50/SRU tool in June of 2020 based on record IDs extracted from the 2014 dataset. The second data collection resulted in 20440 records; 3 records from the original 2014 dataset were not found in OCLC WorldCat database in 2020—they likely had been deleted or merged with other records representing the same information objects as part of the deduplication processes run by the OCLC Quality Control team.

To obtain the quantitative data on the overall level of metadata change, first, the distribution of the number of editing events in the records was analyzed. This was achieved by comparing the number of instances of subfield \$d Modifying agency in field 040 Cataloging Source in the 2020 version of the records to the same indicator for the 2014 version of the dataset. Then, for each of the two sets of records, the level of application of the fields and subfields used for subject representation (including Linked-Data-enabling subfields \$0, \$1, \$2, and \$4) was assessed and compared. A random sample of 394 records in two versions of the dataset (2014 and 2020) was selected for manual qualitative content analysis with the focus on examination and categorization of observed change in subject metadata fields. The MARC 21 metadata change framework developed by Zavalina et al. (2016) was adapted for subject metadata change categorization in this study which included determining the nature of change for each of the subject metadata fields: major categories (addition, deletion, and modification) and subcategories of change (e.g., amendment or replacement of a data value, addition of a subfield not previously included in the field instance, etc.). The records were analyzed and coded by two researchers. The levels of occurrence of 3 metadata change categories and 17 subcategories were measured overall and separately for each subject field.

FINDINGS AND DISCUSSION

A total of 27 subject metadata fields were observed in 20443 MARC 21 records in the 2014 dataset. The same records (n=20440) in their 2020 version were found to contain 5 additional recently added to MARC 21 Bibliographic Format standard subject metadata fields—083 Additional Dewey Decimal Classification number, 085 Synthesized Classification Number Components, 522 Geographic Coverage Note, 647 Subject Added Entry-Named Event, and 656 Index Term-Occupation—for a total of 32. Four of these 5 fields were added in only either 1 or 2 records in the dataset. The fifth—field 647—was added in a substantial number of instances (n=905 or 4.43%). The 2020 version of the dataset was found to include one or more instance of each of the standard subject metadata fields in the latest at the time of data collection edition of MARC 21 bibliographic format standard, with the exception of 662 Subject Added Entry-Hierarchical Place Name, and 69X Local Subject Access Fields.

Overall, the highest levels of application was observed for fields 650 Subject Added Entry - Topical Term (contained in over 95% of records in both 2014 and 2020), 655 Index Term - Genre/Form (78% in 2014 and almost 81% in 2020), 082 Dewey Decimal Classification Number (51% in 2014 and almost 56% in 2020), 050 Library of Congress Call Number (42% in 2014 and over 52% in 2020), 651 Subject Added Entry - Geographic Term (over 47% in 2014 and almost 49% in 2020), and 043 Geographic Area Code (almost 33% in 2014 and 43% in 2020). Total number of instances of this field in a dataset increased in 2020 compared to 2014 for 25 subject metadata fields. The most substantial increase was observed for fields 650, 655, 651, and 600 Subject Added Entry - Personal Name. For five more fields, over a thousand new instances appeared in the 2020 version of the dataset: 043, 050, 082, 610 Subject Added Entry - Corporate Name, and 648 Subject Added Entry - Chronological Term. No change was observed in the total number of instances of field 072 Subject Category Code. Interestingly, three subject metadata fields exhibited decrease in the number of instances between 2014 and 2020: 090 and 092 (locally assigned LCC-based and DDC-based call numbers respectively) and 611 Subject Added Entry - Meeting Name.

A total of 148 subfields of subject fields were observed: 130 in the 2014 version, and 142 in the 2020 version of the dataset. Eighteen new subfields absent in the 2014 dataset appeared in the 2020 dataset. Sixty percent of these were the subfields of the recently defined MARC 21 fields (083\$a, 085\$a, 522\$a, 647\$a, 647\$c, 647\$d, 647\$o, 647\$2, 656\$a, and 656\$2), and others included: 055\$b, 600\$1, 650\$g, 650\$i, 650\$3, 650\$4, 655\$b, and 655\$c. On the other hand, 6 subfields of subject metadata fields that appeared in one or more instances in the 2014 dataset were absent in the 2020 versions of those same records: 086\$z, 610\$c, 648\$o, 650\$b, 651\$d, and 651\$f. In two cases (651\$d and 651\$f), removed subfields were invalid, not defined by the MARC 21 Bibliographic Format. However, it is unclear why 4 other subfields were removed, including the Linked-Data-supporting subfield \$0 Authority record control number or standard number in field 648. The average number of instances of a subfield per record that includes the field increased for most (58.87%) of the 124 subfields observed in both 2014 and 2020 datasets, remained the same for 16.13% of these subfields, and decreased for 39.5%. Surprisingly, this indicator decreased for Linked-Data-enabling subfields \$0 (in 4 fields: 611, 630, 650, and 651), \$2 Source of heading or term (in 7 fields: 082, 086, 092, 611, 648, 650, and 651), and \$4 Relation in field 600.

The overall level of change in the dataset of 20440 records was high. At the time of 2014 data collection, the records had been edited 29673 times collectively (average of 1.45 per record). These same records in 2020 had 161736 editing events collectively (or 7.9 per record on average). This indicates that an average record in the dataset got edited over 6 times between two data collection points in April 2014 and June 2020. In-depth content analysis of a sample of 394 records revealed change in a total of 18 subject metadata fields out of 30. The fields with the highest overall level of change included 650 (n=368), 655 (n=315), and 651 (n=173). In 12 additional subject metadata fields, change was observed in 1 or more records: 600 (n=62), 648 (n=42), 050 (n=41), 043 (n=38), 610 (n=26), 082 (n=23), 647 (n=14), 611 (n=3), 090 (n=2), and 630 (2). The following 3 fields were changed in one record each: 045, 055, and 096.

As shown in Figure 1, each of the 3 major categories of metadata change—addition, deletion, and modification—was observed. A total of 11 subcategories of change were observed: 4 subcategories of addition and modification each, and 3 subcategories of deletion. Six additional subcategories defined by the framework of subject metadata change were not observed in any records in this sample. The Modification category of change was observed the most often, with 896 total observed occurrences. Amending existing data value (MAMD) (i.e., changing some parts of it but keeping other parts the same) was the most common subcategory of modification, with 801 total occurrences. It happened the most often in field 650 (n=350), followed by 655 (n=225), 651 (n=159), 600 (n=35), and 610 (n=20). It was also observed at the low level in fields 082 (n=7), 050 (n=2), 611 (n=2), and 090 (n=1). To the contrary, the complete replacement of a data value in a field (MRD) was observed much less often than amendment: in 38 occurrences, including in field 655 (n=35), and 650 (n=3). Modification by replacement of a field tag with the new one for the same data value (MRFT) was observed 52 times total, in fields 050 (n=18), 600 (n=16), 647 (n=13), 655 (n=2) and 082 (n=3). Modification by replacement of a MARC 21 indicator in an existing field with new (MRIF) was observed in 5 occurrences: in fields 050 (n=1), 082 (n=1), 600 (n=1), 630 (n=1), and 655 (n=1).

Deletion of subject metadata was observed the least often: a total of 72 times. Deleting a second or further instance of an existing repeatable field intended for subject representation (DEFI) was observed the most often (n=67), in five fields: 655 (n=37), 650 (n=22), 610 (n=3), 651 (n=3), and 600 (n=2). Deletion of a field (DF) (e.g., removing all existing instances of a field from a record) was observed twice. The deleted fields included 651 (n=1), and 630 (n=1). Three occurrences of subfield deletion (DS) were observed. The fields with deleted subfields included 651 (n=2), and 655 (n=1). No occurrences of deletion of a second or further instance of existing subfield were observed.

The Addition category of subject metadata change was observed a total of 460 times. Three hundred and one occurrences of addition of a second or further instance of an existing repeatable variable field (AEFI) were observed making it the most common subcategory of Addition. These changes happened in 6 fields: 655 (n=263), 650 (n=21), 610 (n=7), 600 (n=6), 050 (n=2), and 651 (n=2). Addition of a new variable field (ANF) intended for subject

representation was observed in 142 occurrences in 14 fields. The subject metadata fields added to the records included 655 (n=16), 648 (n=42), 043 (n=38), 050 (n=18), 082 (n=9), 600 (n=6), 651 (n=5), and 650 (n=2). Six fields were added in 1 record each: 055, 090, 096, 610, 611, and 647. Addition of a new subfield (ANS) was observed in 11 occurrences in 4 fields: 651 (n=6), 655 (n=2), 650 (n=2), and 610 (n=1). No occurrences of addition of a new instance of existing subfield were observed. Addition of an indicator to the existing variable field (AIF) was observed in 4 records: occurrences of this subcategory of change were found in fields 082 (n=3), 650 (n=1), 655 (n=1), and 050 (n=1).

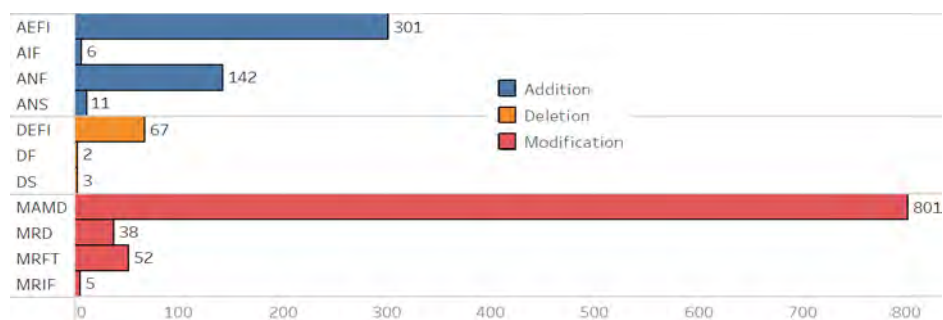


Figure 1. Distribution of observed subject metadata change categories and subcategories

CONCLUSION AND FUTURE RESEARCH

Results demonstrate that library metadata records in WorldCat have undergone substantial editing as expressed not only in the overall change frequency but also in the variety of observed kinds of change. The high levels of subject metadata change fields in this study is similar to findings of previous studies which suggested that subject metadata is one of the most frequently edited parts of metadata records. One of the groups of metadata elements that experienced the most editing was the group 6XX subject access fields. For example, addition of these fields, their instances, and their subfields observed in our study can largely be attributed to the ongoing since 2013 OCLC Research activities on enhancing WorldCat metadata records by automatic or semi-automatic generation of Faceted Application of Subject Terminology (FAST) headings: topical, geographical, name (personal or corporate), event, genre, and chronological (e.g., Mixter & Childress, 2013). Moreover, non-6XX subject metadata fields (e.g., those included in 01X-09X group), which are not addressed by this OCLC large-scale initiative, have often exhibited metadata change between 2014 and 2020. Fields containing classification numbers (most notably, Library of Congress classification) and geographic area codes (043) were frequently added and less frequently modified or deleted. However, the deletion of instances of these fields (especially those in the 6XX range) that we also observed cannot be easily explained by and requires further investigation. Also, further research is needed into the reasons for deletion of valid subfields, especially those that support Linked Data functionality. The amendment of data values which had been frequently observed in the previous studies of library metadata change only infrequently, was surprisingly by far the most common subcategory of change observed in this study. Future research is needed with the focus on at amendments, their patterns, and their reasons.

Emphasis on subject metadata in revision of the WorldCat metadata records might indicate realization of the growing importance of subject access. Our study results contribute to further developing the understanding of how subject metadata changes and of the relation between its change and improved overall metadata quality and access to information. This project analyzed a rather homogeneous group of metadata records—those representing English-language DVD video resources and created by catalogers in English-speaking countries. Future studies need to comparatively evaluate the subject metadata change for this and other types of information objects (other visual materials such as posters, photographs, etc.; audio recordings; maps; monographs; continuing resources; notated music; electronic resources) in various languages and expand the selection criteria to include the records created in non-English-speaking countries.

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Recognition and Analysis of Emotional Words in Ancient Chinese Poetry under Different Themes

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ABSTRACT

The emotional connotation in ancient poetry is a valuable human spiritual culture, adopting the key semantic technique to parse the emotional word in poetry under different themes is beneficial to discover the relationship between poetry theme and emotion. In a “cold environment” (without learning corpus) of Tang poetry, this work presents, for the first time, the automatic recognition and analysis of large-scale humanistic emotional words within ancient Chinese poetry from different themes. A “cold start” automatic citation method for character sequences is proposed to obtain the learning corpus. The best F1 and F1_distinct of trained BERT-BiLSTM-CRFs model respectively reach 96.27% and 86.04%. Deep learning expanded imagery words that convey emotion to realize knowledge discovery. The relationships between theme and emotion word show that Chinese poetry is good at using natural objects to express various sentiments to people, with each theme of poetry owns distinguished emotion feature.

KEYWORDS

Ancient poetry; Theme; Cold environment; Emotional word recognition; BERT.

INTRODUCTION

Ancient poetry reflects the emotions of ancient peoples regarding political backgrounds, historical events, folk customs, and landscapes (Hong, Hou, Wu, & Han, 2020). It is significant to mine the knowledge of emotion from the view of semantic association. Currently, mainstream work is primarily focused on its automated classification, including via the poetic genre (Zhu, Qi, & Dong, 2016), theme (Jamal, Mohd, & Noah, 2012), and rhythm (Al-shaibani, Alyafeai, & Ahmad, 2020). But these studies were based on the external structures of poetry. In this regard, Ahmad constructed a deep learning model based on the attention mechanism and classified poems into different emotional states such as love, joy, hope, sadness, and anger (Ahmad, Asghar, Alotaibi, & et al. 2020).

But researchers cannot explore the relationship between external themes and the internal emotion of poetry. Besides most studies were based on the chapter level, which cannot sufficiently provide insight into the fine-grained humanistic knowledge embedded in poetry. To achieve a more accurate analysis of humanistic emotion in poetry, it is imperative to overcome the automatic recognition of the deep emotional words (e-words) in the text. The main difficulties of this task are that machine learning technology is primarily adopted for the recognition of massive numbers of words, but the “cold environment” (lack of a learning corpus) of poetry makes it difficult to begin the learning task. To this end, transfer learning has emerged (Wang, Zhang, & Fu, 2020), which aims to migrate labeled data or knowledge structures from relevant domains to complete the learning task in the target domain; a typical example of this is Google's BERT model (Devlin, Chang, Lee, & Toutanova, 2018). Based on it, the BERT-BiLSTM-CRFs model has been effectively used in solving large-scale entity recognition in recent years (Song, Tian, & Yu, 2020).

Based on the poetry emotion from different themes, an automatic annotation method for character sequences in cold environments is proposed to obtain the learning corpus. The BERT-BiLSTM-CRFs deep learning model is used to automate the recognition and application of e-words in poetry text, then put it into theme-emotion analysis.

DATA AND METHODS

As presented in Figure 1, a “cold start” method is proposed for learning corpus acquisition in a cold environment to realize the automatic recognition and application of e-words in poetry with different themes.

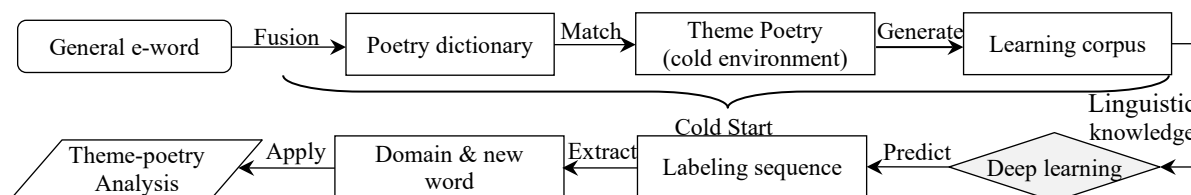


Figure 1. Research Framework

Data Sources and Preprocessing

The poetry text with theme label was downloaded from an open website (https://github.com/shuizhonghaitong/classification_GAT/tree/master/data); It includes 3,206 Chinese poems of the Tang Dynasty, within 8 poetry themes of Bo udoir, Recalling antiquity, Cherishing people, Landscape, Homesick, Farewell, describing objects, and War.

Because word recognition belongs to the task of sequence labeling, it was necessary to perform sentence segmentation. The punctuation marks “.”, “?”, and “!” were considered as the segmentation criteria, which resulted in 25,925 text paragraphs. Finally, the class was set to “0” for all paragraphs to form the initial cold corpus.

Generation of Learning Corpus based on the Cold Start

The cold start is to segment the text (0/1) by matching e-words in the corpus with the emotion dictionary (e-dictionary) and mapping text fragments to character sequences and annotating their roles, thereby obtaining the learning corpus.

(1) E-dictionary. This is used for word matching and role labeling in the domain text and is mainly derived from the general e-dictionary, including the HowNet, Li Jun e-dictionary of Tsinghua University, the e-word ontology database of the Dalian University of Technology, and the Taiwan University e-dictionary (Hu, Cen, & Wu, 2018).

(2) Character labeling model. because the character is the smallest unit of the Chinese language, as compared with words, it can mine more fine-grained semantic features. Therefore, the character labeling model BMESO was adopted to map the text sequence space, namely the beginning (B), middle (M), end (E), and outside (O) of the word.

(3) Labeling of sequences. This task aims to parse text into character and role sequences via automated labeling logic. For a paragraph in the text and the class (0), word matching is achieved by indexing the e-words within a text paragraph and marking the text paragraph with matched words as “1”. The sequence mapping is implemented by intercepting single-character intervals in segments.

Word Recognition Algorithm

The BERT linguistic model was embedded into the BiLSTM-CRFs deep learning model to realize automatic feature recognition, as shown in Figure 2.

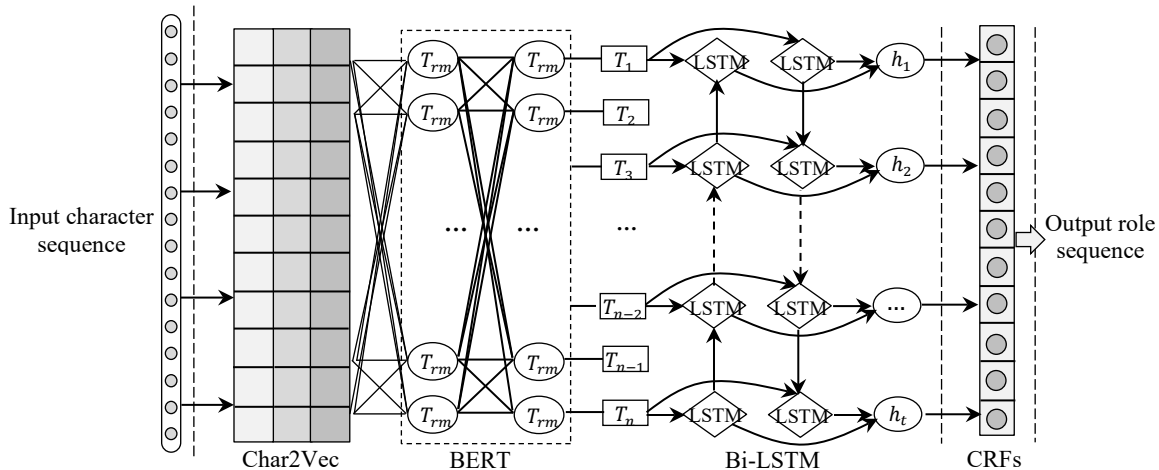


Figure 2. BERT-BiLSTM-CRFs Algorithm based on Tang poetry text

The model is composed of the BERT layer, BiLSTM layer, and CRFs layer. BERT is a pre-trained linguistic model, and it encodes Chinese characters to realize the Char2Vec (character to vector). The BiLSTM is used to bi-directionally encode the character-vector input by the BERT layer to represent context-related semantic information. Finally, the CRFs layer can decode the semantic vector trained by the neural network, output the label sequence with the highest probability to correct the character sequence, and finally obtain the character-role space to extract words.

Evaluation Indicator and Identification Rule

(1) The evaluation indicators include the recall rate (R), precision rate (P), and F-measure. Because repetitive words make the indicator falsely high, the distinct properties of words are additionally considered, the recognized original words are de-duplicated, and each evaluation indicator is computed. The indicators are: $R = \frac{TP}{TP+FN}$, $R_distinct = \frac{TP_distinct}{TP_distinct+FN_distinct}$, $P = \frac{TP}{TP+FP}$, $P_distinct = \frac{TP_distinct}{TP_distinct+FP_distinct}$, $F_1 = \frac{2RP}{R+P}$, $F_{1_distinct} = \frac{2R_distinctP_distinct}{R_distinct+P_distinct}$. FN, TP, and FP represent the numbers of unrecognized, correctly recognized, and incorrectly recognized words. The

first two are calculated to obtain R, and R_distinct is obtained after deduplication; the latter two are calculated to obtain P, and P_distinct is obtained after deduplication. Finally, F1 and F1_distinct are calculated.

(2) The new word identification rule lays a foundation for the discovery of emotional knowledge. A pre-experiment for the observation of the labeling and predicted sequences were conducted, and we found: For the labeled sequence is made up of {O/S}, the predicted sequence is {B/M/E}; Thus, a new-word identification rule was specified: for a word recognized from the predicted sequence, if the first character of the labeling sequence is B/S/O and the last character is E/S/O, and if the labeling sequence is not equal to the predicted sequence, it can be regarded as a new word candidate.

RESULTS AND ANALYSIS

The experiment was realized by the BERT-BiLSTM-CRFs algorithm by Python 3.7 tools and TensorFlow 1.15 framework. Finally, the corpus was distributed in a 4:1 ratio to form a training set and a testing set.

Result of Transfer Learning

To prevent the model under-fitting or over-fitting caused by insufficient or excessive training rounds, the result was calculated every 10 epochs. We found that F1 and F1_distinct have got top after 40 epochs, with the former is 96.27% and the latter is 86.04%.

Knowledge Discovery of New e-word

Unlike the use of a dictionary for word matching, deep learning can extract unregistered words not included in the e-dictionary via model training. Based on the rule of new word identification, the deep learning model was used to extract new e-words; it obtained 163 candidate new words. We counted the top 18 high-frequency words in Table 1.

Candidate	Frequency	Translate	Candidate	Frequency	Translate
功夫	3	efforts	狼虎	1	ferocious
相许	3	loyal and steadfast	焕朗	1	bright
俯瞰	2	overlook	灾变	1	cataclysm
咄咄	2	aggressive	灭国	1	destroy the country
贼兵	2	enemy soldiers	疾患	1	disease
酣战	2	fierce battle	痛愤	1	hate bitterly
义军	2	volunteer army	沉著	1	calm
隆隆	2	rumble	泪点	1	tear
天王	2	emperor	清严	1	honest and upright

Table 1. A portion of the Candidates for New words in Tang Poetry Text.

As presented in Table 1, the new e-words were extracted from the test text of War poetry. The new words generally exhibited a good emotional trend. The deep learning model expanded many imagery words that convey emotion; for example, words “efforts,” “fierce battle,” “rumble,” “ferocious” often express the intensity of wars, words “overlook,” “aggressive,” “volunteer army” often reveal the majestic momentum, words “cataclysm,” “destroy the country,” “hate bitterly,” “tear” often express the grief for the fate of the country. These findings reflect that the deep learning model is intelligent in the recognition of deep emotional knowledge.

Theme and Emotion Word Analysis from Poetry Text

The poetry theme and e-words analysis aim to realize humanistic knowledge management and service. The best model was adopted to extract e-words from the corpus. Considering the constraint of the rules on new words, their correctness in the application was no longer tested, and they were directly added to the word set to obtain 4,122 distinct words, thereby forming a knowledge base of humanistic emotion. Further, the extracted e-words and original poetry theme labels were linked, and their relationships were stored in the Neo4J database, as shown in Figure 3.

As presented in Figure 3, we can parse it from the generality and discrimination. For the generality, most of 8 themes include “flower,” “cold,” “worry,” “lovesickness,” and “whole life,” which shows that Chinese poetry is good at using natural objects to express various sentiments (love, worry, lonely) to poet’s friends, relatives, and own lives. For the discrimination, each theme of poetry owns an emotional feature. Boudoir poetry uses the e-word of “resentment,” “unbearable,” “tear trace” to express women’s sorrow. Recalling antiquity poetry uses “beauty,” “land of country,” “dreary” to delivery the thought to the ancient. Cherishing people poetry focuses on “bosom friend” to show the poet’s memory. E-word “sun” in landscape poetry can be used to show the ease of the poet. Homesick poetry uses “message of sb,” “meet” to reflect the wish to see friends or relatives. E-word “solitary,” “parting” is used in farewell poetry to show the sadness of separation. Describing objects poetry applies things such as “moon”

to express various sentiments. War poetry tends to “war flag,” “battlefield” to exaggerate the powerful momentum and the cruelty of the war.

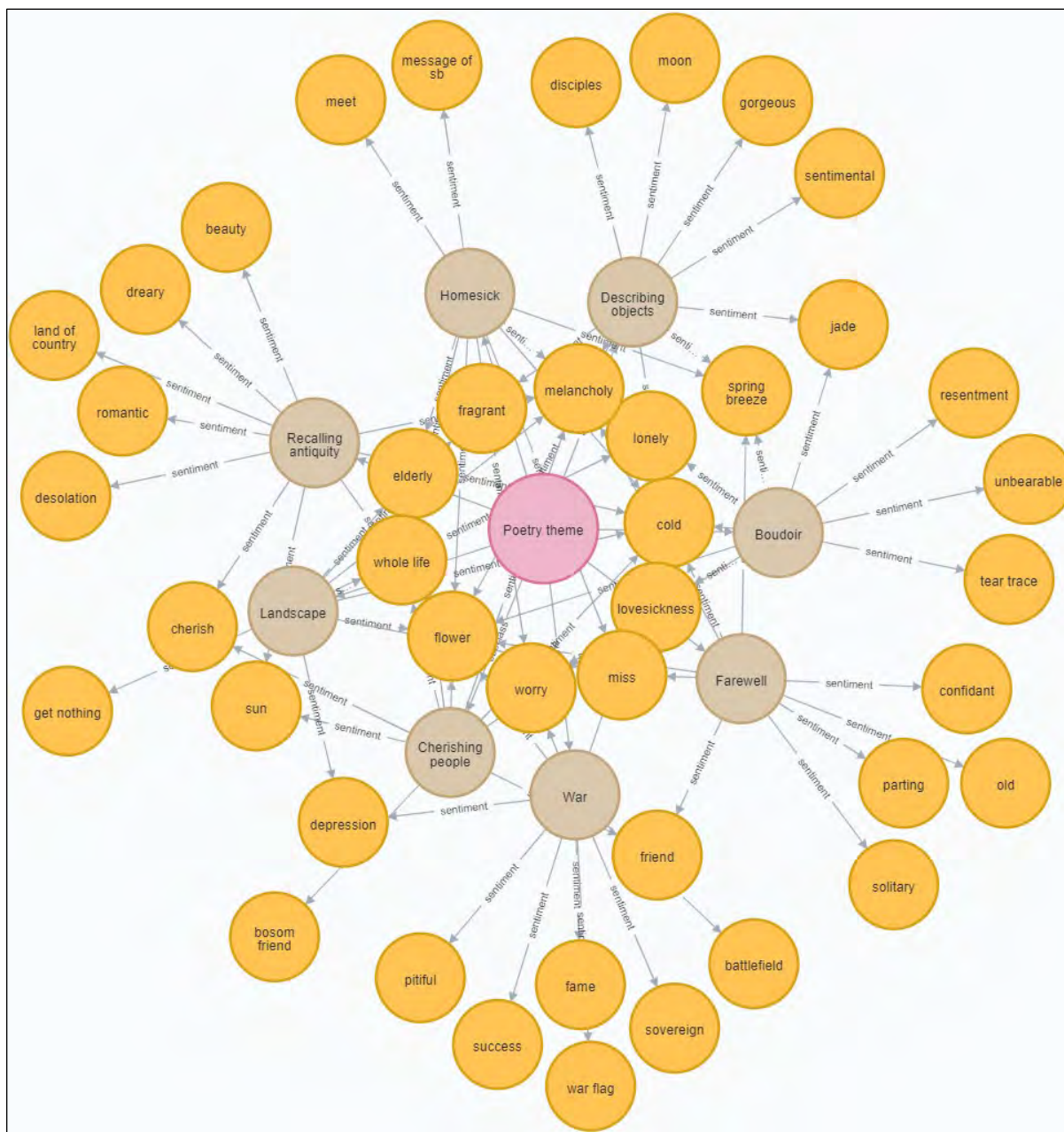


Figure 3. Theme & Emotion Word Knowledge Graph of Poetry

CONCLUSION

In a “cold environment” of Tang poetry, the automatic emotional words labeling, recognition, and theme-emotion analysis were realized in the present work. The method based on “cold start” can provide a reference for learning tasks which is lack of learning corpus. The new emotion word recognition can promote knowledge discovery in poetry. After analyzing the relationships between themes and emotions, the humanistic model and rule were effectively concluded. It also must be beneficial for the literary study and exploration of information resources management.

ACKNOWLEDGMENTS

We thank all the volunteers and all publications support and staff who wrote and provided helpful comments on previous versions of this document. Authors 1 and 2 gratefully acknowledge the grant from NSFC (72074108), as well as Jiangsu Young Social Science Talents and Nanjing University Zhongying Young Scholars and other talent training programs.

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Health Information Behavior in the Context of Medical Decision-making: An Exploratory Study based on Vaccination in Beijing

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ABSTRACT

COVID-19 vaccination could be the most economical and effective public health intervention to prevent and control novel coronavirus. Beijing is one of the first regions in China to implement the COVID-19 vaccination policy, we conducted semi-structured interview on 20 participants with past vaccination AND/OR COVID-19 vaccination decision-making. This study summarizes the consistency and particularity in the context of decision-making in terms of information sources, information content and information behavior.

KEYWORDS

Information behavior; Vaccination decision-making; COVID-19 Vaccine.

INTRODUCTION

On January 31, 2020, the World Health Organization declared that the outbreak of novel coronavirus (COVID-19) constitutes a Public Health Emergency of International Concern (WHO, 2020). Since vaccination is the most economical and effective public health intervention to prevent and control infectious diseases, the development and promotion of COVID-19 vaccine has become an important task of many countries in the world. According to Wang Huaqing from Chinese Center for Disease Control and Prevention, a billion people would need to be vaccinated to achieve herd immunity in China (China Central Television, 2021). The task of popularizing COVID-19 vaccine is important and difficult. In this study, we focused on exploring the consistency and particularity of health information behavior of users in COVID-19 vaccination decision compared with their previous vaccination decisions. We hope to holistically understand the information behavior of users in the context of important health decisions, to help users meet their information needs during the vaccination, and to provide theoretical and practical enlightenment for the control of the COVID-19 epidemic in the world.

LITERATURE REVIEW

Wilson (2000, p. 4) defines information behavior as “the totality of human behavior in relation to sources and channels of information, including both active and passive information seeking and information use.” On this basis, health information behavior can be seen as a series of information behavior that individuals search, obtain, evaluate and use health information, including their health information awareness and needs (Xiao, 2008). At present, there are relatively concentrated research on health information seeking behavior, focusing on the influencing factors of behavior (Sbaffi & Chen, 2020; Peña-Purcell, 2008; Lambert & Loiselle, 2007; Zhao, 2009; Li, Theng & Foo, 2015; Chang & Huang, 2020; Wang & Deng, 2016) and on the process of seeking (Sbaffi & Chen, 2020; Wang & Li, 2016; Peña-Purcell, 2008). Lambert and Loiselle (2007) divided the context of health information seeking behavior into three categories: responding to health threats, participating in medical decision-making, and behavior change and prevention behavior. In this study we adopt Wilson's (2000) perspective on information seeking behavior as entangled with other information behaviors to enable a more extensive analysis of information seeking and the related behaviors in the context of medical decision-making. The comprehensive information behavior perspective enables analysis of both a longer time-span from pre- to post-vaccination and analysis of the diverse information behaviors related to medical decision-making that the interviewees perform in their social contexts. Considering health information behavior as a whole could help users weigh and evaluate different options, reduce uncertainty, and help them identify possible choices (Brown, Carroll, Boon, & Marmoreo, 2002; Huber & Cruz, 2000).

Vaccination is a typical case of medical decision-making. Research on vaccination-related health information behavior can promote the public health communication and enhance the health information service. From the perspective of anti-vaccination believers, inaccurate information on the Internet and lack of trust in health authorities were important causes of their resistance (Kaplan, 2018; Peretti-watel, Larson, Ward, Schulz & Verger, 2015). After achieving information from healthcare professionals, they were likely to change their attitudes (Narayan & Preljevic, 2017). Research on immigrant mothers also reflects the role of healthcare professionals as an information source

(Kowal, Jardine & Bubela, 2015). The Internet is another core source. Many studies affirmed the positive impact of online health information seeking on increasing vaccine-related knowledge (Kontos, Emmons, Puleo & Viswanath, 2012; Mcree, Reiter & Brewer, 2012). However, as mentioned above, information against vaccination was also popular, and social media might even promote the spread of anti-vaccination information (Smith & Graham, 2019), which required users to make judgments on the credibility of the information (Buchanan & Beckett, 2014).

As to specific types of vaccines, children's vaccines are a special case. Parents' information behavior would affect children's vaccination (Huang, Li & Lv, 2020), and safety issues were their top concern (Mus, Kreijkamp-Kaspers, McGuire, Deckx & Driel, 2016). After the 2009-10 influenza A (H1N1) pandemic, a number of studies on H1N1 vaccination emerged, finding that traditional media such as television, radio, and newspapers were the main information sources (Yang, 2012; Walter, Bohmer, Reiter, Krause & Wichmann, 2012; Jung, Lin & Viswanath, 2013). With the increasing incidence of HPV-related diseases in recent years, HPV vaccine has also become a noteworthy research direction. The existing literature has analyzed users' information needs and influencing factors of information adoption (Westbrook & Yan, 2015; Xu, Yang, Zhao & Zhu, 2020). Due to the transmission characteristics of such diseases, the female group received special attention (Westbrook & Fourie, 2015).

Generally speaking, the promotion of vaccination was usually the purpose of vaccination-related health information behavior research. Researchers tended to conduct questionnaire surveys or network data analysis with a large sample to explore the vaccination rate and its influencing factors (users' information behavior was often considered as one of the influencing factors) and users' information needs for vaccines. So far, little research has paid attention to the consistency and changes of users' information behavior in different vaccination decision-making contexts, and the launch of the COVID-19 vaccine brings new conditions which allow us to study on that. Therefore, this study attempts to explore the question: **Compared with the previous vaccination experience, what are the commonalities and differences of users' information behavior in the COVID-19 vaccination decision-making process?**

METHOD

Beijing is one of the first regions in China to implement the COVID-19 vaccination policy. The vaccination is optional and mainly distributed via three types of institutions (colleges, companies and residential communities). We chose young people aged 20-30 in Beijing as the research object. We selected 20 participants based on preliminary investigations of age, gender, past vaccination, COVID-19 vaccination, and vaccination location to ensure that the samples are roughly evenly distributed. The distribution of participants is shown in Figure 1. The past/other vaccinations mentioned in this article refer to voluntary vaccinations given to adults. Among the 12 participants who have had past vaccination, the vaccines involved are HPV vaccine, hepatitis B vaccine, influenza vaccine, varicella vaccine, rabies vaccine and measles vaccine.

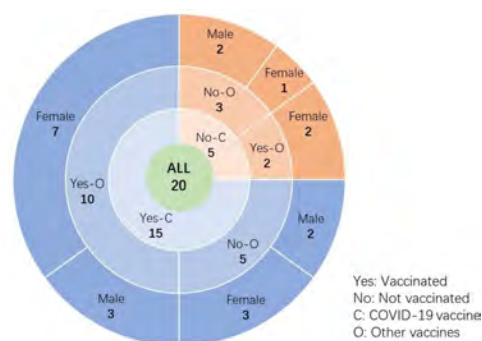


Figure 1. Distribution of participants

Semi-structured interview was used for data collection, and content analysis and case study were used for data analysis. The interview questions included all the information activities in participants' vaccination decision-making process. Using content analysis to process the interview text, their behavior process is divided into pre- and post-decision. Each interviewee's information behavior at each stage was summarized, and the information content, information sources, and information behavior types were extracted. Both researchers independently completed the coding of 20 interview texts and then integrated and adjusted them to ensure the integrity and accuracy of the coding results. A detailed coding table can be found here¹. Through the analysis of the coding results, we summarized the

¹ <https://github.com/yuhao972/Coding>

consistency and differences of interviewees' information behavior between the past vaccination and COVID-19 vaccination.

DISCUSSION

The Consistency of Information Behavior in the Vaccination Process

Through case study of 12 interviewees with past vaccination experience, we found that their information behavior in different vaccination processes have some continuity and consistency, which was reflected in three levels. Overall, the interviewees' enthusiasm for information seeking showed consistency. Active seekers had more information seeking behavior in all vaccination processes, and the information content they cared about was relatively comprehensive (A03, A15). Negative seekers got more information from encountering. Keys words in their interviews included "no more consideration" (A05), "I don't care" (A08), and "out of conformity" (A14). Because of the different information needs brought about by different decision-making situations, the interviewees showed less continuity at the level of information content. But some interviewees expressed a preference for safety-related information. They paid more attention on adverse reactions and the feelings of others after vaccination (A06). At the information source level, interviewees could be roughly divided into three categories: seekers with no preferences, seekers who prefer interpersonal information sources (A01, A19), and seekers who prefer authorities (agencies) (A15). For example, A01 interviewee's most trusted information source was always her father, and a doctor aunt provided most information for A19 interviewee. It is worth mentioning that users' past vaccination experience could also become a new source of information for themselves: some interviewees compared their previous experience during the second vaccination. The pleasant vaccination experience in memory could enhance vaccination willingness (A03), and they did not need to seek more information when the same reaction occurred (A02, A11).

The Particularity of Information Behavior in the COVID-19 Vaccination Process

In this study, we first divided the vaccination process into two parts: pre-vaccination and post-vaccination. During the interview, we found that the process before vaccination was discrete, and that some interviewees might take several years from knowing about the vaccine to being vaccinated (A01, A06, A11). Therefore, we further divided the pre-vaccination process into two parts: before/after vaccination decision-making. Figure 2 shows the information sources, information content and types of information behavior of the interviewees during the whole process.

Before Vaccination Decision-making		After Vaccination Decision-making		Post-vaccination	
Information Source		Information Source		Information Source	
Interpersonal sources	family members, friends, teachers, workmates, taxi drivers	Interpersonal sources	family members, friends, classmates, teachers, taxi drivers	Interpersonal sources	family members, friends
Traditional mass media	TV	Traditional Internet sources	Baidu	Traditional Internet sources	Baidu
Web 2.0 sources	Weibo, WeChat, Bilibili	Web 2.0 sources	Weibo, WeChat, Zhihu, Xiaohongshu	Web 2.0 sources	WeChat, Weibo
Agencies	Hospitals, schools, companies	Agencies	Hospitals, schools, companies	Agencies	National Health Commission
Information Content		Information Content		Information Content	
Vaccine Information	Basic information, vaccine development, related diseases, related companies	Vaccine Information	Basic information, vaccine development, related diseases, related companies	Vaccine Information	Basic information, related diseases
Vaccination Information	Vaccination sites, vaccination requirements, others' experience, others' intention	Vaccination Information	Vaccination sites, vaccination requirements, reservation system , others' experience, others' intention, my/others' medical history	Vaccination Information	Vaccination sites; adverse reactions
Social Environment Information	National economic status, national events, school epidemic prevention policies	Social Environment Information	National economic status, national events, school epidemic prevention policies	Vaccination Experience	Vaccination sites, feelings, adverse reactions
Information Behavior		Information Behavior		Information Behavior	
Information encountering		Information encountering		Information encountering	
Information seeking		Information seeking		Information seeking	
				Information sharing	

Note: The dark-shaded cells represent the content related to information sharing. The bold texts represent the content related to COVID-19 vaccination.

Figure 2. Information behavior during the vaccination process

In the process of vaccination, interviewees relied on multiple sources for information, including Interpersonal sources, Web 2.0 sources and Agencies. Web2.0 sources include not only social media such as WeChat and Weibo, but also Xiaohongshu (User Generated Content Community), Zhihu (Q&A Community) and Bilibili (Video platform). The information content mentioned by the interviewees was coded into three categories: vaccine-related information, context-related information and social environment information. Before decision-making, interviewees focused more on information about related diseases (e.g. transmission routes, morbidity rate, and the consequences of not being vaccinated) in their past vaccination experiences, but they did not mention similar information when it came to COVID-19 vaccination. After decision-making, the interviewees searched for and confirmed information on vaccination sites (address, vaccine supply and qualifications), the history of others' or one's medical history. In the

three stages, there were mainly information encountering and information seeking behavior. After vaccination, the interviewees also shared information on their vaccination sites, feelings and adverse reactions. The particularity of COVID-19 vaccination process was analyzed according to the following three stages.

Before Vaccination Decision-making. Although online resources or interpersonal resources were considered as more important sources of health information (Chang & Huang, 2020; Han, Fan, Luo & Shi, 2018), we found that traditional mass media (TV) also played a role in popularizing knowledge related to COVID-19 vaccine. In terms of information content, interviewees were more concerned about the development of COVID-19 vaccine (A01, A02, A03, A07, A11, A12), such as research and development (R&D) facilities, R&D progress and COVID-19 vaccines in other countries. The vaccination experience and willingness of others were also taken into consideration. Before making the decision, some worried about adverse reactions of COVID-19 vaccine, so information of people who had been vaccinated would be referred to. Such information was derived from oral communication and news reading (A03: *"Some teachers said that they have been vaccinated, and then I would not ask them anything else. Teachers should know more about COVID-19 vaccine than we do. They proved that the vaccine was reliable."*). In addition, information about the social environment mattered. Interviewees needed information about the national economic situation, the Beijing Winter Olympic Games and school epidemic prevention policies to help them judge the necessity of vaccination.

After Vaccination Decision-making. At this stage of COVID-19 vaccination, interviewees showed less information seeking and encountering compared with their previous vaccination experiences. The most common information content was (1) the reasons why others are unwilling to be vaccinated (Some interviewees expressed that the lack of willingness to be vaccinated against COVID-19 among the people around them would conflict with their original cognition, which would lead to an uncertainty in their decision making. Therefore, they would look around for reasons why they refused.); (2) safety problems about inoculating two kinds of vaccines at the same time (e.g. HPV vaccine and COVID-19 vaccine); (3) operations of the appointment system.

Post-vaccination. The frequency of information behavior at this stage would be significantly lower than that of the first two stages. The interviewees did have some adverse reactions after immunization, such as arm ache, fever, somnolence, and extreme fatigue (A02, A03, A07, A15, A016, A19), but having the information obtained in the first two stages or in their previous vaccination experiences, they did not think it was necessary to seeking new information. However, when adverse reactions were inconsistent with the information they had had, some interviewees would look for other information and might share it. For example, an interviewee (A09) had menstrual disorder after COVID vaccination, which was not included in the adverse reactions she had known before. In order to explore whether menstrual disorder was a side effect of the vaccine, she looked for users who had the same symptoms on Weibo, searched online, and asked friends and family members who were also vaccinated. She also downloaded the Vaccine Services in Beijing (An application supplied by Beijing center for disease prevention and control) for feedback and posted her vaccination experience and adverse reactions on social media.

CONCLUSION

This study conducted a semi-structured interview on 20 participants with past vaccination and/or COVID-19 vaccination. Case study and content analysis were employed to analyze the textual data from the interviews. We focused on exploring the consistency and particularity of participants' health information behavior between the two vaccination decision-making processes. The continuity is mainly manifested in three aspects: the level of enthusiasm for information seeking, the preference for information content, and the dependence on information sources. Particularity varies at different stages. Before the decision-making, people pay more attention to the information about the development of vaccine, the willingness of people around to be vaccinated, and social circumstances. There is a significant reduction in frequency of information behavior after decision-making. Information sharing appears after vaccination. There are two deficiencies in this study. Firstly, although we tried to help interviewees recall the whole process of their vaccination experience, there could be some loss due to the passage of time. In addition, this study was conducted in Chinese culture, which might affect the information behavior in vaccination decisions. This study hopes to provide inspiration for further research on health information behavior from the perspective of contrasting different contexts and to offer help for enhancing information services when implementing vaccine policies.

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Text to Insight: Accelerating Organic Materials Knowledge Extraction via Deep Learning

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ABSTRACT

Scientific literature is one of the most significant resources for sharing knowledge. Researchers turn to scientific literature as a first step in designing an experiment. Given the extensive and growing volume of literature, the common approach of reading and manually extracting knowledge is too time consuming, creating a bottleneck in the research cycle. This challenge spans nearly every scientific domain. For the materials science, experimental data distributed across millions of publications are extremely helpful for predicting materials properties and the design of novel materials. However, only recently researchers have explored computational approaches for knowledge extraction primarily for inorganic materials. This study aims to explore knowledge extraction for organic materials. We built a research dataset composed of 855 annotated and 708,376 unannotated sentences drawn from 92,667 abstracts. We used named-entity-recognition (NER) with BiLSTM-CNN-CRF deep learning model to automatically extract key knowledge from literature. Early-phase results show a high potential for automated knowledge extraction. The paper presents our findings and a framework for supervised knowledge extraction that can be adapted to other scientific domains.

KEYWORDS

Organic Materials; Automated Knowledge Extraction; Named-Entity-Recognition; Text Mining; Deep Learning.

INTRODUCTION

Scientific output plays a critical role in sharing and advancing knowledge. Materials science research literature presents a key example, as scientific publications record *material structures, properties* and *processing methods* - essentially the core data required for materials design and predictive analysis. The extensive volume of literature, while exciting, also present researchers with a significant challenge. As of April 13th 2021, a count of 9,861,616 materials scientific outputs have been indexed by the Scopus database. Facing millions of documents, manually reading related literature to extract knowledge is simply not a feasible approach for any researcher. Research using computational approaches to extract knowledge from scientific literature has been pursued for inorganic materials although the body of work is fairly limited (e.g., Kim et al., 2017; Weston et al., 2019). Moreover, there is little evidence of computational knowledge extraction focusing on organic materials. This is surprising, given the urgent needs to automate literature analysis across various research domains including chemistry and biomedicine (e.g., Erekhinskaya et al., 2016; Nuzzo et al., 2010; Zhai et al., 2019).

The research presented in this paper takes initial steps to address this gap by pursuing automatic knowledge extraction for organic materials science, drawing from scientific literature. The research reports on the identification of a set of data-like entities and the framework and approach for building a gold standard, annotation activity, and a baseline analysis. The major novelties and contributions include: 1) a knowledge extraction framework that can be applied to different scientific domains; 2) development of NER method with BiLSTM-CNN-CRF model to automate the knowledge extraction for organic materials literature; 3) publication of the source code. Open access to research corpora and datasets is still limited for materials science, particularly compared to other disciplines (Sang & De Meulder, 2003; Kim et al., 2003; Li et al., 2016; Registry of Research Data Repositories). We collected and have built an original data set from the ground-up (e.g., from scratch) and made source code publicly available at https://github.com/noellzhao/organic_mat_knowledge_extraction.

RELATED WORK

Motivated by the attention to materials and advances in computational research, researchers have started to look at NLP techniques as a potential solution to the knowledge extraction challenge for materials study. For instance, Tshitoyan et al. (2019) discuss the feasibility of using word embedding, which is an unsupervised approach to convert natural language to vectors of real numbers, to discover latent materials knowledge embedded in massive publications. Their result shows that word embedding could have high potential in inorganic materials discovery. Nevertheless, the work conducted by Shetty and Ramprasad (2021) confirms that word embedding can be helpful for polymer predictions too. Rule-based NLP techniques, such as pattern and string matching have also been discussed. Huang and Cole (2020) apply pattern matching techniques to extract properties specially for battery materials. Kim et al. (2017) use a combination of machine learning and pattern matching methods to predict synthesis parameters.

Materials researchers have studied the needs and compared different methods for materials knowledge extraction. Kim et al. (2019) express the urgent needs to facilitate text-mining accessibility, clarity and reproducibility for accurately extracting knowledge from materials literature. By comparing feature-based and neural network-based methods for extracting synthesis procedures, Mysore et al. (2017) suggest that neural network-based models generally have higher performance than models using hand-engineered features.

A review of research literature shows that studies related to materials science and knowledge extraction are a more recent development, and that the research tends to focus on inorganic materials. Additionally, the published results report using unsupervised/rule-based approaches. Of the research reported, there is very little discussion on automated knowledge extraction for organic materials. This study aims to explore the use of supervised, deep learning methods to extract knowledge for organic materials, which can be also adapted to other scientific domains.

METHOD

Research Framework

Figure 1 demonstrates the research framework used to guide this study. Overall, our proposed framework consists of five main components: 1) corpus collection, 2) data annotation, 3) text processing, 4) model training and 5) applications. The first four components are described in the rest of this section, whereas the actual applications part is discussed in the discussion section.

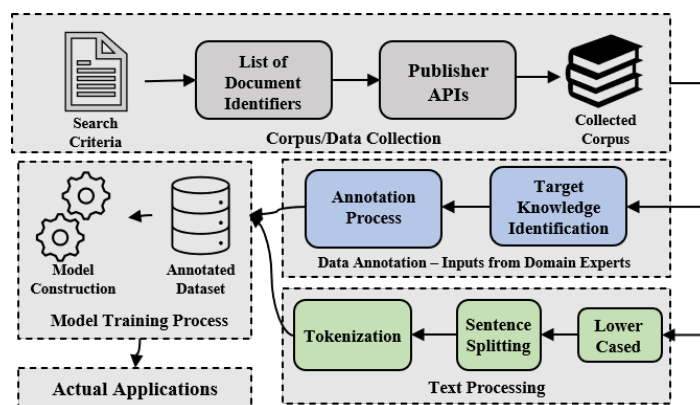


Figure 1. Research Framework for Automatic Knowledge Extraction using Deep Learning

Corpus Collection and Processing

To build our corpus related to organic materials research, we retrieved 92,667 English language scientific literature published between 2000 to 2021 via the Scopus index system. The corpus was collected with keyword search “organic” and “materials science”. Retrieved articles are from publishers such as the *Royal Society of Chemistry*, *Springer-Nature* and *American Chemical Society*. We used Scopus associated API to download their abstracts, which overall contain 708,376 sentences (roughly 18 million tokens). All records are lower-cased, then tokenized by the Python library *ChemDataExtractor* (Swain & Cole, 2016) and *NLTK* (Loper & Bird, 2002).

Data Annotation

A first step for data annotation was to determine target information (entity types) that needed to be extracted. Two scientists with expertise in organic chemistry and organic materials identified the key entity types by first being introduced to the entity used in inorganic materials research (Weston et al., 2019) and then examining the corpus of literature in organic materials to specify relevant entity types. Table 1 presents an initial set of entity types, where definition and examples are also included. Up to now, 855 sentences from the corpus have been manually annotated

and stored under IOB (Inside-Outside-Beginning) tagging scheme. Domain expert annotations were reviewed by a third evaluator (an NLP researcher) to address any discrepancies and confirm annotation consistency.

Entity Type	Definition	Example
Molecule (MOL)	A fundamental unit of a chemical compound	H2SO4; hydrogen peroxide
Polymer (POLY)	A molecule that is majorly composed of multiple similar units	polypyrrole; polyamide
Property (PRO)	Fundamental physical or chemical characteristics of a particular compound	optical absorption; binding affinity
Characterization Method (CMT)	The method to measure physical or chemical properties	X-ray crystallography; NMR spectroscopy

Table 1. Description of Target Entity Types

Word Representations

In this work, both character-level and word-level embeddings are used. We utilized the pre-trained word-level embeddings built by Zhai et al. (2019), which is trained using Word2Vec skip-gram model (Mikolov et al., 2013) with 84,000 unannotated patent documents related to polymer and biomedical science. The character-level embedding is computed using a convolutional (CNN) layer during the training process. At the same time, we are training our word-level embedding based on the collected corpus and FastText (Joulin et al., 2016) model. Since we are still expanding the corpus size, our own word embedding is currently being updated.

Model Description

The architecture of Bi-directional LSTM-CNN-CRF model we built for NER is illustrated in Figure 2. While predicting if any tokens belong to the defined knowledge types, the model takes corresponding word-level embedding and char-level embedding computed by CNN layer as input. For each token, its word- and char-embedding are concatenated then fed to the Bi-LSTM (Bi-directional Long Short Term Memory) layer and Conditional Random Field (CRF) output layer accordingly. The model is built using Python library *Keras* (Chollet, 2015), *Tensorflow* (Abadi et al., 2016) and *Scikit-Learn* (Pedregosa et al., 2011).

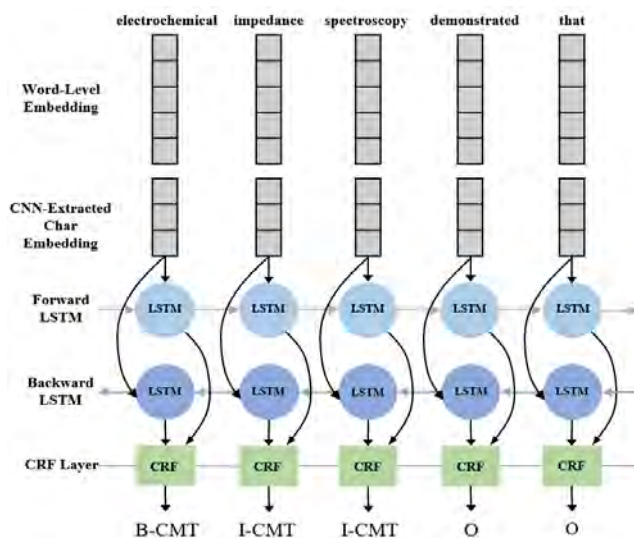


Figure 2. Illustration of the BiLSTM-CNN-CRF model architecture

EXPERIMENT RESULTS

While the collection process is still continuing, we used f-score to evaluate the early-phase performance based on the data we have so far. Table 2 reports the early-phase test result trained on the 684 annotated sentences. We compared the model performance with different embeddings. As shown below (Table 2), the model with our word-level embedding (denoted as “FastText”) demonstrates better performance than the embedding trained on patent documents (denoted as “Word2Vec”). The two results using our word embedding seem to have close performance. However, between the two results using embedding trained on patent documents, we can observe that character-level embedding significantly improved the prediction accuracy by 5%-8% for each class.

Model + Embedding	Molecule (MOL)	Polymer (POLY)	Property (PRO)	Characterization Method (CMT)
BiLSTM-CRF+FastText+No Char	0.67	0.67	0.56	0.74
BiLSTM-CRF+Word2Vec (Zhai et al., 2019)+No Char	0.58	0.56	0.49	0.49
BiLSTM-CRF+Word2Vec (Zhai et al., 2019)+CNN Char	0.63	0.62	0.54	0.57
BiLSTM-CRF+FastText+CNN Char	0.65	0.68	0.53	0.75

Table 2. Test Results from Early-Phase Training Process

The above test results indicate our approach can have a strong impact on the performance. First, the word embedding trained on closely related corpus can improve the accuracy. The word2vec embedding released by Zhai et al. (2019) are trained on biomedical and chemical corpora, the word2vec embedding encodes the semantic knowledge from patent documents, which could have a different writing style and language than scholarly journal/conference articles. The results confirm that the embedding trained directly on scholarly publications tends to perform better. Second, the training dataset matters. While we gathered more annotated data to the training set, we observed a steady increase in model accuracy. Third, domain expertise is the foundation of scientific knowledge extraction studies and domain experts play a key role in determining the target knowledge and annotating domain-specific corpus. Fourth, char-level embedding can further enhance the performance of the model.

DISCUSSION AND CONCLUSION

Recently, the discussion of automated knowledge extraction has expanded across multiple domains. Our research demonstrates the use of supervised learning for knowledge extraction as an approach to address the challenge of manual methods. Additionally, the study helps us to understand what factors can improve the performance of the knowledge extraction model: 1) corpus content; 2) data size; 3) domain expertise and 4) use of embeddings.

Knowledge extraction is gaining attention given the potential in many applications that seek to gain data from unstructured text, such as document retrieval systems. The knowledge extraction process converts unstructured textual data into structured data, and this feature can allow researchers to extract knowledge from large corpora and store the results as a database. We foresee application as part of our future work.

Finally, we note the current size of our annotated corpus is still comparatively small, although we anticipate higher accuracy as we pursue work to increase the size of our dataset. A final future direction is to expand more entity types: our domain experts analyzed the early-stage training results and suggested that detailed information such as numerical values of processing condition, type of reactions can help researchers to extract more details. Hence, we anticipate having more entity types added to the model.

ACKNOWLEDGMENTS

The research reported on in this paper is supported, in part, by the U.S. National Science Foundation, Office of Advanced Cyberinfrastructure (OAC): Grant: 1940239 and 1940307. We also acknowledge the support of Cyra Gallano and Evan Dubrunfaut from Drexel University, Fatemah Mukadam, Haley Dang and Jordan Cox from Northeastern University, for their role to assist data annotation process.

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Measurement of Interdisciplinarity: Quantifying Distance-Based Disparity Using Node2vec

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ABSTRACT

When quantifying the level of interdisciplinarity for scientific research, most established indicators employ a three-element diversity framework, namely variety, balance, and disparity, each of which captures a distinct but insufficient element. Among three, disparity, i.e. how different (dissimilar) the categories within a system are, is the most challenging one due to its calculation cost and conceptual ambiguity. The discriminative power for disparity is found to be weakened in more fine-grained science classification schemes. To address this issue, this paper proposes a new method for quantifying disparity by applying Node2vec on the discipline citation network and retrieving distance between disciplines using embeddings vectors. Compared to cosine-based dissimilarity for disparity, our proposed method exhibited broader distribution and less skewness for disparity values, which could potentially lead to higher discriminative power of interdisciplinarity. A case study for Linguistics is also conducted to show the capability of detecting variations in disparity of the proposed method.

KEYWORDS

Interdisciplinarity; Disparity; Node2Vec; Citation analysis; Scholarly communication.

INTRODUCTION

Despite enormous ambiguity and variance in the definitions of interdisciplinarity, knowledge integration always holds a significant role in recognizing, evaluating, and promoting this much-anticipated phenomenon in science. In many empirical scientometrics studies, researchers quantified the level of interdisciplinarity by investigating the diversity of knowledge that was integrated by a certain entity. The majority of the indicators quantifying interdisciplinarity employed a three-element diversity framework (variety, balance, and disparity) which originates from the field of ecology and then adopted by many scientometricians.

Among three, disparity, dissimilarity (distance) between different categories within a system, is the most crucial but challenging element. The reasons are twofold. First, for every two different disciplines, disparity can be distinguished for many aspects (citation behaviors or semantic similarity), on various levels (authors, papers, journals), for various time windows (2-year, 5-year, or 10-year), and using different measurements (bibliographic coupling, co-citation, cross-citation). Different combinations of measurements would certainly yield inconsistent results for disparity. Secondly, regardless of the choice of measurements, a dissimilarity matrix among all disciplines is required to portray a global “map of science”. The difficulty for calculation grows significantly when adopting a classification system with a greater granularity or more sophisticated measurements.

Besides obstacles in concrete measurements, ambiguities can also be found in the conceptualization of disparity. Researchers normally employ dissimilarity or distance interchangeably to refer to disparity. However, they are fundamentally different and should be distinguished in interpretations. The most significant difference between dissimilarity and distance is transitivity. Dissimilarity is not transitive, at least not so from the current methodology, which means if A is similar to B, and B is similar to C, yet A is not necessarily similar to C. On the other hand, distance is transitive in a way that if A and B are both close to C then they are rather close to each other as well. Such discrepancy is more prominent in practice due to different measurements of disparity. Under the dissimilarity branch, disparity is often quantified as the cosine similarity between two categories in a matrix, for instance, a cross-citation matrix (Zhang et al., 2016). Therefore, dissimilarity considers only the angle between two vectors and their relative position in the entire vector space, not their relationships with the other vectors in specific. As for distance, a rather literal implementation of distance as disparity is conducted by Larivière et al. (2015), who calculated the actual distance using the x-y positions for 554 subdisciplines on the UCSD map. The subdisciplines are represented as nodes in a network and nodes that are similar to each other are located in adjacent areas, hence transitivity.

Last but not least, Thijs et al (2021) found that quantifying disparity (dissimilarity) in a more fine-grained classification system exhibits high skewness and low discriminative power, which will eventually distort the discriminative power of the interdisciplinarity measurement itself.

In this paper, our goal is to propose a new method for quantifying distance-based disparity with better discriminative power when encountering classification schemes with greater granularities. To be specific, we applied Node2vec on the discipline citation network and retrieved distance between disciplines using embeddings vectors as disparity. An empirical study on publications from 2005 to 2009 is conducted. Compared to cosine-based dissimilarity for disparity, our proposed method exhibited broader distribution and less skewness for disparity values, which could potentially lead to higher discriminative power of interdisciplinarity. The rest of the paper is organized as follows: we first introduce the dataset and methodology. The next section presents the results, followed by conclusions. The last section discusses limitations and future work.

DATA AND METHODOLOGY

As shown in Figure 1, the analysis is conducted in three steps. First, a discipline citation matrix (network) is constructed based on the citation relationships between publications and their corresponding discipline labels. To do so, we employed data from Microsoft Academic Graph (MAG, Wang, et al., 2020) as a case study, specifically 33,584,914 publications published from 2005 to 2009 and their corresponding citation relationship and discipline labels. MAG assigns each publication with multiple discipline labels for different granularities. We extracted the second layer of labels which consists of 294 disciplines recognized by MAG (e.g., theoretical physics, biochemistry, and Macroeconomics), yielding 294 nodes in the discipline citation network.

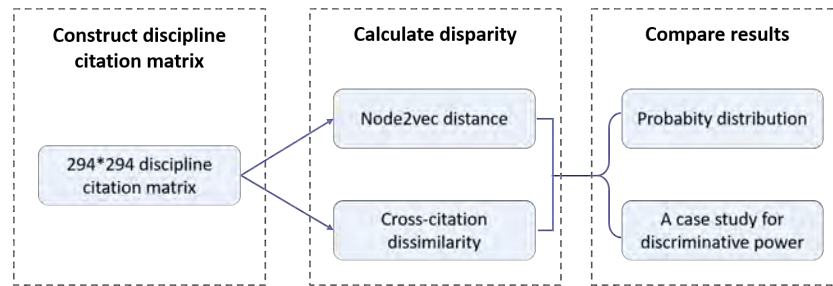


Figure 1. Research framework

In the next step, we calculated the disparity value between 294 disciplines (e.g. i and j) using two methods, namely cross-citation dissimilarity (CD, Zhang et al., 2016) and our proposed Node2Vec distance (ND). $CD(i, j)$ is defined as $1 - \cosine(i, j)$ in the retrieved citation matrix.

To get $ND(i, j)$, we need to first apply Node2Vec on the retrieved citation matrix (directed and weighted network) and generate embedding vectors for each node (discipline). This graph representation learning framework is based on Word2Vec Mikolov et al. (2013) and proposed by Grover and Lesovec (2016) to represent networks. The core idea behind this algorithm is initiating a biased random walk to explore the neighborhood for each node so that they can be represented by not only themselves but also their adjacent nodes and corresponding edges between them. The output of Node2Vec on a network is a matrix of vectors with each row denoting a node in the network. It offers several parameters such as walk length, return probability, and inout probability to balance the randomness between exploring remote regions and exploiting local regions. Nonetheless, it provides us an opportunity to transform dissimilarities to distances that take their situated neighborhood into account. The hyperparameters for our algorithm are as follows: dimensions: 50, walk length: 40, number of walks: 40, window size: 10, return probability: 1, inout probability: 0.5.

After the representation learning, each discipline (node) is represented by a 50-dimension embedding vector. The $ND(i, j)$ between every two disciplines is denoted as $1 - \cosine(i, j)$ between their embeddings.

To examine the validity and performance of our proposed method, we compare ND with CD regarding two aspects, namely distribution, and discriminative power. First, we plotted the probability distribution of disparity values among all 294 disciplines and compare the results between two methods regarding their skewness and variance. Furthermore, we examine the discriminative power of two methods through a case study, in which the retrieved disparity results between linguistics and other disciplines and main fields are analyzed.

RESULTS

Distribution

Figure 2 compares the distribution for disparity results between our proposed ND and CD. ND (left subplot) appears to be more widely distributed between 0 and 1 than CD and exhibits two peaks. The highest peak is associated with a larger disparity value (around 0.65) while the secondary peak denotes a smaller disparity (around 0.1). The secondary peak shows a small distance and relatively strong relationship between the focal discipline and its affiliated local community, which is formed by a small proportion of adjacent nodes. The highest peak illustrates their relatively weak relationship and large distance between a certain node and the rest of the network, which accounts for a bigger proportion. The results for ND corroborate with its network nature and distance-based conceptualization. On the other hand, as for CD, both high skewness and high variance can be spotted in its distribution. A vast majority of disparity values between disciplines are found to be close to 1, meaning significant dissimilarity. After comparison, our proposed ND delivered broader distribution and less variance than CD, which could potentially lead to higher discriminative power of interdisciplinarity.

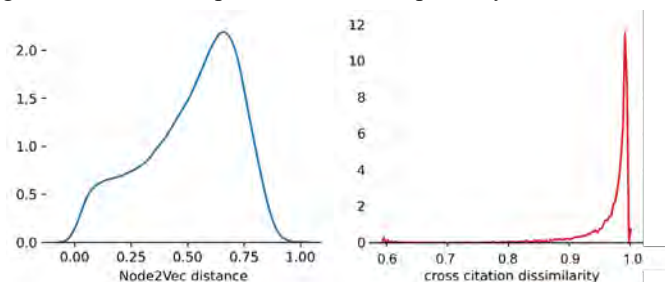


Figure 2. probability distribution of disparity for two methods

Discriminative power

To test the capability of distinguishing disparity between different disciplines and main fields, we conducted a case study for Linguistics and examined its disparity value with several other disciplines and 19 main fields.

The left table in Table 1 shows the average disparity value for linguistics with disciplines under different main fields for two methods. Similar to results in the previous section, the obtained disparity value for ND varies significantly among main fields while that of CD exhibits less variation. Both methods generated the lowest disparity for Linguistics with four main fields, namely art, philosophy, sociology, and psychology, and the highest disparity with environmental science, geology, chemistry, and materials science. Some discrepancies can be found, for instance, in Computer Science, which is ranked the 7th for ND and 5th for CD, and in Physics (15th for ND and 9th for CD).

Average disparity with main fields				Disparity with disciplines in Biology		
ND		CD			ND	CD
art	0.140	psychology	0.881	computational biology	0.439	0.998
philosophy	0.143	philosophy	0.967	evolutionary biology	0.467	0.996
sociology	0.198	sociology	0.973	ecology	0.586	0.998
psychology	0.213	art	0.978	virology	0.684	1.000
history	0.281	computer science	0.984	microbiology	0.774	1.000
political science	0.334	history	0.988			
computer science	0.377	political science	0.993			
business	0.500	mathematics	0.995			
mathematics	0.510	physics	0.997			
geography	0.520	business	0.998			
economics	0.590	geography	0.998			
engineering	0.597	medicine	0.999			
medicine	0.610	engineering	0.999			
biology	0.635	biology	0.999			
physics	0.680	economics	0.999			
environmental science	0.730	geology	1.000			
geology	0.735	environmental science	1.000			
chemistry	0.751	chemistry	1.000			
materials science	0.763	materials science	1.000			

Disparity with disciplines in Computer Science		
	ND	CD
natural language processing	0.086	0.821
speech recognition	0.204	0.933
information retrieval	0.264	0.979
computer vision	0.375	0.998
computer hardware	0.594	0.999

Table 1. A case study for disparity between Linguistics and other disciplines

We also looked into the disparity value for Linguistics with several disciplines in Biology and Computer Science (tables on the right). The strong connection between linguistics and natural language processing is captured by both methods as shown by the lowest disparity value among all. However, CD generated identical disparity values for the rest of the selected disciplines and failed to differentiate disciplines from different main fields. ND seems to be better able to capture variations of disparity for both among main fields and disciplines within them.

CONCLUSION

When quantifying interdisciplinarity, disparity remains to be one of the most challenging elements. Researchers employ dissimilarity and distance interchangeably to refer to disparity even though they are fundamentally different not only in concept but also but in measurements. Also, current methods for disparity delivers low discriminative power for fine-grained classification systems. In this paper, we proposed a distance-based method for disparity, in which we utilized a representation learning algorithm Node2vec to generate embedding vectors for disciplines and applied a similarity measurement to get pair-wise disparity. We compared the performance of our proposed method (ND) with cross-citation dissimilarity (CD) by examining the distribution and conducting a case study. ND appears to outperform CD with less skewness and more widespread distribution, which could eventually lead to greater discriminative power in quantifying interdisciplinarity. What's more, a case study for Linguistics is conducted and showed that ND is capable of detecting variations of disparity for both among main fields and disciplines within them.

LIMITATION AND FUTURE WORK

There are limitations to this paper. The chosen hyperparameters of the Node2vec model were set based on experience and limited experiment. The exploration or exploitation function of the biased random walk in Node2vec would significantly affect the network structure and the obtained disparity value. Parameters need to be tuned carefully and specifically to fulfill the aim of this study. Furthermore, the effect of our proposed disparity method on the measurement of interdisciplinarity is not tested empirically. Last but not least, the method is not tested on other networks such as co-citation and bibliographic couplings. As a next step, we will focus on devising evaluation functions to obtain optimal hyperparameters for the model and examine the effect of our model in quantifying interdisciplinarity. Detailed analysis on the differences between ND and CD will be conducted as well.

ACKNOWLEDGMENTS

This investigation has been made possible by the financial support of the Flemish Government to ECOOM, among others. The opinions in the paper are the authors' and not necessarily those of the government.

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Career Development in Knowledge Management

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ABSTRACT

This is a SIG-KM sponsored panel presented by members of the SIG-KM officer team. First, the panel will overview their experience in knowledge management (KM) as scholars and scholar-practitioners. They will briefly discuss their career development successes and hurdles as a roadmap for others to follow. Second, the panel will discuss career pathways for KM scholars and scholar-practitioners in a global knowledge economy. Finally, they will hold an open discussion with audience members to share their experiences, expectations and hopes for the KM and the broader field of information science. [90 minute session]

KEYWORDS

career development; networking; knowledge management; faculty mentoring; peer mentoring.

OVERVIEW

Knowledge is considered to be an important asset for any profit and non-profit organizations. Therefore, managing knowledge has been an important task for any organization. The fundamental concept of knowledge management (KM) lies with managing the types of knowledge, e.g., tacit and explicit, which was conceptualized by Polanyi (Polanyi, 1966). The concept of KM emerged from the business management community while they use different tools like dashboards; intranet and best practices databases make the community more connected to access and share information with the geographically dispersed community (Koenig, 2012). In 1987, McKinsey first used the term KM in the current context and then KM became public (McInerney and Koenig, 2011; Prusak 1999). After that as a multidisciplinary concept, KM is becoming popular in many disciplines.

KM has been defined by many researchers; there are presently more than a hundred definitions of KM. Nonaka & Takeuchi (1995) define KM as the capability of “a company or any other organization...to create new knowledge, disseminate it throughout the organization, and embody it in products, services and systems” (p. 3). Abell and Oxbrow (2001) refers to it as the management of an environment where knowledge is created, organized, shared and learned for the benefit of the organization and other stakeholders. Till now the best definition of KM is “Knowledge Management is the process of capturing, distributing, and effectively using knowledge” given by Davenport and probably no better or more succinct single-line definition has appeared since (Davenport, 1994). As a multidisciplinary concept, KM has been widely embraced by the organizational science, computer science, cognitive science, library and information science (LIS), education and business people (Dalkir, 2017). Considering the multidisciplinary nature, many researchers are interested in working on KM and literature shows that KM publications have increased rapidly since 2000.

As Francis Bacon said, ‘Knowledge is power’ and managing knowledge properly is a kind of weapon that leads to competitive advantages for organizations. To address challenges, increase efficiency and efficacy, and to achieve organizational goals, there has been an increasing call for application of KM in practice and research. The goal is to gain competitive advantages in business and provide better and innovative services or products to patrons. For creating value by offering innovative products and services, and offering new solutions for both organizations and individuals, KM is more needed for both profit and non-profit organizations in the 21st century.

CAREER PATHWAYS IN KM

As Knowledge Management has grown into a degree area in many universities, the question arises: what are possible career paths in KM? After all, given that “Knowledge Management is the process of capturing, distributing, and effectively using knowledge,” (Davenport, 1994) one can see the potential for KM roles in every kind of organization. We will discuss how KM specialization can benefit people in academe and in industry.

Perhaps the path most students will think of first is the professorship; after all, it is through their professors that many students are first introduced to KM. For those who are inclined towards academia, KM can be an excellent

area of specialization. KM encompasses a breadth of areas of research interest and approaches, from the humanistic to the hard sciences. After all, KM has over 100 specialties! While many KM professors take KM as their primary area of focus, others may complement their interest in KM with another area, ranging from information seeking behaviour to knowledge organization to archives and records management. Because KM takes so many concerns into its sweep, there are many opportunities for the aspiring KM scholar to find interesting (and useful) questions to pursue in their scholarship. Indeed, as information and communication technologies proliferate, and as the ways organizations work become ever more diverse, new KM questions emerge by the day.

Another available path is to go into government or industry jobs. Within a job, one many times will be the only person in the group or organization that is looking out for how, where, who will organize and/or maintain order within the groups records. An added concern is if one comes into a company or organization after it has been in existence for many years. There may not have been someone previously that was managing the historical knowledge for the company. Even though all of these concerns can cause one to be starting from a very difficult position, it is at the same time a wonderful opportunity.

Being a single person in a job can allow the freedom to organize the knowledge of the group for something that can have a lasting structure centered around the main focus of the organization. Within a larger company, such as a government job, one may need to work with a whole group of people and even across separate organizations. Working with managing knowledge will need even more structure so that as people cross and move around in organizations the important knowledge is maintained. This requires an agreement on Standard Operating Procedures (SOPs) within the members of the group so that knowledge can be both stored and retrieved later easily.

In short, knowledge management is one of the invisible infrastructures of the information economy; there are many roles which either center or benefit from KM that students could take on as they graduate.

MENTORING

Mentoring can provide a pathway for young KM practitioners or scholars to help their career success in industries or universities. It can take various forms, such as training, industry mentoring, internships and industry talks and projects. Mentoring junior practitioners or scholars can help senior peers systematically sort out their knowledge and skills and facilitate knowledge transfer, especially tacit knowledge. Senior peers may also receive novel knowledge or ideas during the mentoring process. The junior usually benefits a lot from being mentored. As new hands, they may have more or less difficulty in putting the theory into practice. To be mentored can help the junior grasp the correct direction and opportunities of career development and avoid the mistakes of their predecessors.

The formal mentoring system exists in some industries and universities. A typical example is the training of new employees. They are taught with the rules and regulations of the organization, job responsibilities, workflow and guidelines, specific working methods and techniques, domain knowledge, the use of information systems, and so forth. The mentors are often senior peers and domain experts. In some organizations, each new employee maybe assigned with one or more mentors. The latter are encouraged to share their working experience with the former and provide advice and assistance.

As the formal mentoring system does not necessarily apply in all the organizations, the junior needs to seek various opportunities to be mentored. For example, some universities and colleges provide internships in related industries for graduating students. The students can obtain work experience or participate in industry projects. The senior peers, department managers, project managers, the experts in the project team, and the consultants hired by the organization are all mentors. The students can learn domain knowledge and skills as well as obtain other knowledge, such as how to run a project and the techniques of communication.

Since we are in a learning society, members of different types of organizations can mentor each other. The triple helix model lays a sound foundation for ubiquitous mentoring. Industry partners work with the faculties and researchers in universities and mentor the latter in teaching by providing real cases or mentor in research by providing feedback on the effect of scientific research achievements in practice. The latter can also mentor the former by turning scientific research results into practice and guiding new product development. Nowadays industry experts are often invited to give professional talks to students and faculties. It is also a kind of mentoring and called the Second Classroom. The industry experts can share their experience and vivid cases with the students, which enable the students to know the requirements of industries and make preparations in advance.

CONCLUSIONS

Knowledge management provides foundational theoretical and practical approaches for information science professionals and scholars. Today's global workforce offers a rich array of career pathways to the ASIS&T participants. This panel of scholars and scholar-practitioners provide a wealth of career knowledge and offer an open dialog for sharing research, experiences, and peer-mentorship in the area of knowledge management.

GOALS OF PANEL

- Overview panelist experience in knowledge management (KM) as scholars and scholar-practitioners.
- Discussion of panelist career development successes and hurdles as a roadmap for others to follow.
- Discuss of career pathways for KM scholars and scholar-practitioners in a global knowledge economy.
- Open discussion with audience members to share their experiences, expectations and hopes for the KM and the broader field of information science.

STRUCTURE

The first half of the session will be facilitated with Panelist personal stories, strategies and suggestions. The second half will be facilitated by the Panel Chair to have a full discussion between panel members and the audience.

BIOGRAPHY OF PANELISTS

Jeff Allen is an internationally recognized scholar in the area of workforce innovation for the knowledge economy. He serves as a Regents Professor of Information Science at the University of North Texas. Together with his colleagues, he prepares students for jobs that are not yet created. He has served as Founding-Editor of *Learning and Performance Quarterly*, Editor-in-Chief of *Performance Improvement Quarterly*, Editor of *Career and Technical Education Research* and Founding Director of the Center for Knowledge Solutions.

Lu An is a professor and the deputy director of the Department of Information Management, Wuhan University. She serves as the executive board member of International Society for Knowledge Organization (ISKO), the Chair Elect of the ASIS&T SIG-KM, the deputy editor of Knowledge Organization, and the director of the Research Office of Data Management and Knowledge Service at the Center for Studies of Information Resources (CSIR) of Wuhan University. She has published more than 100 papers on the core LIS journals and conferences and two monographs. Her research interests are visual knowledge discovery and online data analysis.

Darra Hofman is an Assistant Professor in the School of Information at San José State University in San José, California. Hofman received her PhD in library, archival, and information science from The University of British Columbia in 2020. She completed her MSLS from the University of Kentucky and her JD and BA (honors) from Arizona State University. Her research examines the intersection of archives, technology, and law, with a special focus on privacy, blockchain technologies, and health records. She is the Publicity Officer for SIG-KM, because even archivists love KM.

Md. Anwarul Islam is an Associate Professor at the Department of Information Science and Library Management, University of Dhaka, Bangladesh. He received his PhD from the School of Knowledge Science, JAIST, Japan. His primary research areas are KM, information-seeking behavior, information literacy, and informetrics. He was a visiting fellow at iSchool, SLAIS@UBC, Canada; ACRC Fellow at NTU, Singapore and VLIR-UOS Scholar at the University of Antwerp, Belgium. He is a New Leaders Awardee of the ASIS&T, and serves as Chair of the SIG-KM, Co-Chair Elect of SIG-III, and Poster Co-Chair of 84th Annual Meeting of the ASIS&T.

Heather D. Pfeiffer is a part-time Assistant College Professor at Dona Ana Community College/New Mexico State University. She has served within SIG-KM since 2006, and held multiple offices including chair, chair-elect, past chair, secretary, treasurer, and webmaster. At the ASIS&T Annual Meetings, she has presented posters and workshops, participated in panels, and held open happy hours. Dr. Pfeiffer's full-time job is as a Civilian employee for the U.S. Army at The Research and Analysis Center (TRAC). She is the Knowledge Management Deputy Officer (KMDO) and runs the KM Working Group (KMWG) that does KM for TRAC at White Sands Missile Range.

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Foundations of Information Science

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ABSTRACT

The foundations of information science define our field and, thereby, our professional identity. It follows that if our professional identity is to be equitable, diverse, inclusive, and relevant, then the foundations of our field should also be. Three diverse contributions to the foundations of information science will illustrate diverse approaches to making information science more complete will be illustrated by experienced panelists with different backgrounds: Recuperating neglected work; exploring alternative methods; and drawing attention to undocumented work. Marcia Bates will revisit early work on information seeking. Michael Buckland and Wayne de Fremery will demonstrate an alternative approach to the problematic concept of “context.” Lin Wang will introduce aspects of the early history of information science in China.

KEYWORDS

China; context, foundations, information science, information seeking.

INTRODUCTION

Our professional identity, how we view ourselves, depends on how we understand our field. So attention to the history and foundations of Information Science matters. In particular, if we want a profession that is equitable, diverse, inclusive, just, and relevant, then we need equity, diversity, justice and relevance in our understanding of the foundations of information science. This panel session serves two purposes: First, four experts advance our understanding of information science with contributions in the areas of information seeking; with a novel interpretation of the central but perplexing concept of “context;” and with an initial incorporation of early Chinese information science into the mainstream of Anglophone information history. Second, the presentations were selected to illustrate three different ways to bring a more diverse and more complete understanding of the foundations of information science: Recuperating neglected work of pioneers; taking a different methodological approach; and incorporating voice from outside the dominant English-language canon.

STRUCTURE

This moderated panel session will have four parts: Three short presentations followed by a period for question and answer and for comments from participants.

The moderator will be **Asen O. Ivanov**, Postdoctoral Fellow in Digital Humanities, Guelph University, Canada. Dr. Ivanov is Vice Chair / Chair Elect of the Special Interest Group on the History and Foundations of Information Science.

PANELISTS

There will be four panelists in the following order:

Marcia J. Bates is Professor Emerita in the UCLA Department of Information Studies. A Fellow of the American Association for the Advancement of Science, she is a leading authority on information search, human-centered design of information systems, and information practices. She was Editor-in-Chief of the 7-volume *Encyclopedia of Library and Information Sciences*, 3rd ed., and has received awards for research and leadership. She has been active as a technical consultant to numerous organizations. She is a graduate of Pomona College (B.A.) and of the University of California Berkeley, School of Information (M.L.S., Ph.D.). She served in the Peace Corps in Thailand. More at pages.gseis.ucla.edu/faculty/bates/. Professor Bates has received the ASIS&T Award of Merit, the ASIST Research Award, and, twice, the best *JASIS&T* paper award.

Michael K. Buckland is Emeritus Professor, School of Information, University California, Berkeley. An English librarian who moved to the USA, Professor Buckland has had extensive experience as a librarian, as an administrator, and as an educator. He was written extensively on the history and foundations of information science.

He has received the ASIS&T Award of Merit, the Watson Davis award for service, and the Best Book award. A former ASIS&T President, he is currently Chair of the History Committee.

Wayne de Fremery is an associate professor in the School of Media, Arts, and Science at Sogang University in Seoul, Korea and Director of the Korea Text Initiative at the Cambridge Institute for the Study of Korea in Cambridge, Massachusetts ([/www.koreatext.org](http://www.koreatext.org)). He represents the Korean National Body at ISO as Convener of a working group on document description, processing languages, and semantic metadata (ISO/IEC JTC 1/SC 34 WG 9). Some of his recent research projects have concerned the integration of privately generated textual heritage information into the information management systems of the National Library of South Korea (*Library Hi Tech*, 2020) and the use of deep learning to improve Korean OCR, for which he received a national citation of merit. Prof de Fremery is expected to participate virtually.

Lin Wang is distinguished professor of information science, Hangzhou Dianzi University, China. He is also a guest research fellow in the National Information Resource Management Institute at Beijing. He received a Young Information Scientist award from the China Society for Science and Technology Information and his PhD in information science from Peking University. His research interests include the foundations of information science and information philosophy. He has published more than eighty academic papers in international LIS journals and leading peer-reviewed information science journals in China. Several papers received “best paper” awards by national academic organizations including the Chinese Society for Science and Technology Information and the Chinese Science and Technology Communication Society.

PANEL PROGRAM

Asen Ivanov, as moderator, will introduce the session and moderate its four components.

The Long Arc of Information Seeking Research by Marcia Bates. A brief overview of the 65-year history of research on information seeking will be followed by a description of critical early research of high quality in the field. Emphasis will be on work completed in the 1960's and 1970's. This presentation identifies and recuperates neglected, but significant early work.

Context, Relevance, and Labor, presented by Michael Buckland and Wayne de Fremery. Context matters because context affects the meaning of signs and documents. Advances in information technology (writing, printing, copying, telecommunications, new media), were designed to spread signs and documents across space and time and thereby into different contexts and potentially different meanings. Context has long been recognized as important, but has resisted satisfactory theorizing. Typically there has been an empirical approach: Instances of context have been identified, analyzed, and found to be complicated. A quite different approach based on linguistic and conceptual analysis establishes context in terms of relationships, lists, and boundaries. Combined with a sense-making (hermeneutic) view, context emerges in a relationship between a perceiver, an object, and a meaning. Context emerges as closely related to relevance, another central concept that has resisted satisfactory explanation. Relevance involves the relationship between a meaning and a purpose such that context and relevance are in means-end relationship. At a more practical level, contextualizing (adding metadata) radically reduces search labor in information retrieval. This is an example of how a different methodological approach can have substantial consequences.

Early Chinese contributions to Information Science by Lin Wang. Chinese information science (IS) research and practice began in 1956. It was the product of the Long-term Plan for Science and Technology Development in China (1956-1967). The development mode of Chinese IS academia and enterprise was state-led. During the first two decades, information science studies in China focused on scientific and technical information, which was also the name of the IS major in Chinese universities. The mainstream of Chinese information science consisted of science and technology information needs, organization, retrieval and service. A unified nationwide goal of information service was to provide “broad, speedy, precise and relevant” information access. Although the Chinese information science discipline and enterprise construction were greatly influenced by the Soviet Union in this period, they also formed their unique features. The most prominent features are the positioning of information enterprise and the functioning of information. IS practical work in China included both information resources management and intelligence studies. The Chinese translation of information is “Qingbao”, implying the combination of information and intelligence. “Qingbao” research and practice in China took the role of “eyes and ears, vanguard and consultant”. Since the Chinese opening and reform in 1978, information science in China gradually mingled with library and information science in western countries. A broad information outlook replaced the S&T information as the scope of IS in the late 1980s. Information needs, seeking, and use research in diversified contexts (business, economy, culture, social science) have prospered since then.

Question and answer. At least a quarter of the session will be reserved for an interactive period of moderated question and answer and for comments from the audience.

CONCLUSION

Both professional practice and our sense of identity as a profession depend on how we understand our field and our role in it. This panel session will combine two different approaches. First, the panelists will contribute insights that are expected to be new to all or most of the audience: pioneering early work on information seeking; a novel view of context; and an introduction to early information science in China. Second, the panel will illustrate three different ways in which understanding of information science can be changed: Recuperation of relevant work that has been largely forgotten; adopting a different methodological approach; and presenting historically important work from outside of the dominant anglophone tradition. Time reserved for question and answer will allow for clarification and additional commentary.

SPONSORS

This panel session is sponsored by SIG HFIS and co-sponsored by SIG ED and SIG STI.

Racial Attacks during the COVID-19 Pandemic: Politicizing an Epidemic Crisis on Longstanding Racism and Misinformation, Disinformation, and Misconception

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ABSTRACT

The COVID-19 pandemic crisis has affected everyone's life on a daily basis for more than a year. However, some racial groups have experienced a double pandemic, that of COVID-19 and racist attacks incorrectly tied to the pandemic. Harassment and physical intimidation were the source of many anti-Asian attacks. The number of unarmed black people assaulted and killed by police almost tripled during 2020 when compared 2019. In this panel, we will attempt to analyze recent racial attacks in terms of malinformation, such as misinformation, disinformation, or shallow, historical stereotypes of ethnic minorities as another layer of the pandemic originating with racism or inflamed grievances. The panelists will discuss the proposed topic drawing from each panelist's expertise and an interactive discussion with the audience will follow after each panelist's presentation. Members and attendees at ASIS&T who have an interest in the spread of dis- and misinformation via social media and politicizing the pandemic crisis will find our topics useful to their research.

KEYWORDS

misinformation; disinformation; COVID-19; racism; social media.

INTRODUCTION

The COVID-19 pandemic crisis has affected everyone's life on a daily basis for more than a year. However, some racial groups have experienced a double pandemic, that of COVID-19 and racist attacks incorrectly tied to the pandemic. Harassment and physical intimidation were the source of many anti-Asian attacks in the United States. In addition, many Asians were the victims from the mass shooting events occurred at the Asian business places in Atlanta on March 16, 2021 and at an Indianapolis FedEx facility on April 15, 2021. (Haynes, 2021, March 22; Hong & Bromwich, 2021, March 18). Many black people were killed or brutalized by police during the past several years. The number of unarmed black people killed by police in 2020, including the deaths of Breonna Taylor and George Floyd, was more than three times higher when compared to the number of unarmed black people killed by police force in 2019 (Ater, n.d.). The anti-Asian attacks and police brutality to black people have been on the rise since the beginning of the pandemic. Despite the widely supported #StopAsianHate and #BlackLiveMatter movements and public protests, a rising spate of attacks against Asian Americans and the growth of actual and observed deaths of black people by police violence has had little actual traction on such things as police reform and public sensitivity to racist language or stereotypes. Right and alt-right cable and print media and social media in the U.S. continue to be not only a hotbed for misinformation, disinformation, and fake news, but also the ground of public speech for racism and xenophobia, especially during a crisis (Depoux et al., 2020). In fact, the right and alt-right ecology use, in addition to economic and political fears, racist slurs to inflame and addict its disinformation adherents, so as to keep them in a closed propaganda feedback loop in order to retain power and privilege and a white, male supremacist ideology, willing to sacrifice American democracy for fascism. In this panel, we will attempt to analyze the recent racial attacks in terms of malinformation, such as misinformation, disinformation, or shallow, historical stereotypes of ethnic minorities. The panelists will discuss the proposed topic drawing from each panelist's expertise and an interactive discussion with the audience will follow each panelist's presentation.

PANELISTS AND THEIR CONTRIBUTIONS

Miyoung Chong, Deliberative Media Lab, University of Virginia

Topic: Politicizing an Epidemic and Racial Justice.

On March 13, 2020, Trump declared a statewide emergency due to the increasing number of infection cases from the new coronavirus in the U.S. that soon was to be declared as a pandemic by the World Health Organization.

Under the significant threat to public health and the national economy from the new epidemic disease, Trump and some prominent Republican politicians criticized Chinese and Asian Americans as part of a broader and classic political strategy of characterizing immigrants as malevolent and dangerous. For example, a government official in Kansas said that his community was overall protected because of a small number of Chinese residents. U.S. Senator John Cornyn (R-TX) overtly blamed Chinese propelling racist tropes about Chinese eating bats, snakes, and dogs (Shepherd, 2020, March 19). The political elites' racist framing to the new epidemic disease and stigmatized naming using #Chinesevirus on social media platforms stimulated pre-existing racist sentiment. However, the racial appeals by politicians to leverage the crisis to affect public opinions are rarely new in politics. Political elites have continuously made efforts to shape mass attitudes by setting agendas of certain public policies as connected to certain racial groups, such as welfare and black people or immigration and Latinos, which researchers call "othering" (Dionne & Turkmen, 2020; Kam, 2019). The racial impact from the new coronavirus pandemic has been strikingly different, and the nationwide mortality rate has been the highest to black people compared to other racial groups in the U.S. (Polyakova et al., 2021). Along with the Asian communities in the U.S., the black communities have undergone twofold crises from the pandemic and police brutality. During a botched raid in March 2020, Breonna Taylor, a black medical worker, was killed by local police officers in her apartment at Louisville, Kentucky. #JusticeForBreonnaTaylor emerged as one of the most prominent hashtags centered on a black woman in respect to the Black Lives Matter Movement. Ms. Taylor's death drew national media attention and became one of the major drivers of large-scale protests that erupted amid the COVID-19 pandemic. Twitter once again became a pivotal spot for social media activism on racial justice and police reform. In this panel, I present the findings of the recent studies about the #Chinesevirus and #JusticeforBreonnaTaylor Twitter networks and discuss racial discrimination against Asians and black people concerning disinformation and stereotyped misconceptions of those minority racial groups in the U.S. within historical and activism contexts.

Thomas J. Froehlich, School of Information, Kent State University

Topic: COVID-19 Disinformation and Racism as Strategies Used in the Culture Wars for Inflaming the Grievances of the Alt-right Closed Propaganda Feedback Loop.

There are two major kinds of dis/mis/information seekers in the Age of Disinformation: (1) Those that live in a closed propaganda feedback loop, filter bubble or disinformation ecology and (2) those that don't, those who are open to considering different perspectives on an issue and willing to learn, understand, evaluate, and argue for a position. There is a third group, the disengaged, who by default tend to acquiesce to the success of the first group. The first group maintains it followers by having them reject any information sources other than their own right or alt-right media (e.g., Fox News) and social media (e.g., Breitbart) and by stoking their biases, angers, resentments, grievances, etc., which is echoed and reaffirmed through all elements of its disinformation ecology, composed of disinformation-misinformation ecology composed of like-minded cognitive authorities (e.g., Newsmax, Infowars), peers, friends, associates, religious leaders, politicians, and pundits. In its "closed propaganda feedback loop," each part reinforces (and often inflames) the others, through multiple channels (Cable news, social media, religious leaders and organizations, group associations, party rallies, word-of-mouth, etc.) that echo and reinforce each other. Their problematic interpretation of conservatism tacitly or explicitly embraces white, male supremacy, bolstered by a distorted interpretation of history. As a consequence, in addition to economic and socialist fears, its memes, tropes and messages are fueled with culture wars against science (e.g., COVID-19 is a hoax, requiring masks in public spaces is an assault on the individual's right to freedom) and racist slurs (e.g., Chy-na virus, Mexican rapists) and racist attacks to keep their base addicted both to their ideology by stoking their racist prejudices, fears and resentments, no matter how baseless they are.

Kai Shu, Department of Computer Science, Illinois Institute of Technology

Topic: Some Challenges in Combating COVID-19 Infodemic – Data, Tools, and Ethics.

Social media has become an important means of user-centered information sharing and communications in a gamut of domains, including news consumption, entertainment, marketing, public relations, and many more. The low cost, easy access, and rapid dissemination of information of social media draws a large audience, but also exacerbates the wide propagation of disinformation and fake news. Disinformation on social media is growing fast in volume and can have detrimental societal effects, particularly so during the pandemic, COVID-19. When the whole world is scrambling to fight the COVID-19 pandemic, governments and WHO also have to combat an infodemic, which is defined as "an overabundance of information some accurate and some not that makes it hard for people to find trustworthy sources and reliable guidance when they need it" (Donovan, 2020). Recent advancements of computational approaches on detecting disinformation and fake news have shown some early promising results. Novel challenges are still abundant due to its complexity, diversity, dynamics, multi-modality, and costs of fact-checking or annotation. It is also important to understand whether disinformation is more biased toward certain social groups and how to measure and identify these biases. In this panel, I will present some lessons learned when

exploring effective and explainable detecting strategies of fake news and discuss some imperative challenges in combating disinformation and the need for interdisciplinary research.

PANEL STRUCTURE AND PARTICIPANT ENGAGEMENT

In the beginning of the session, the panel moderator will introduce the structure and the panel. In the first portion of the panel session, all panelists will give a 20-minute presentation about their research on dis and misinformation, social media, racial issues in relation to the COVID-19 pandemic. Thereafter, the moderator will ask the audience to join a 20-minute discussion facilitated by a set of questions based on the panelists' presentation. After the interactive discussion with the audience, the panelists will address their research findings in relation to the information science and technology and interdisciplinary disciplines and discuss how they would push their research in the future by giving two-minute reflections. Directly afterwards, the moderator will summarize the outcomes that resulted from the panel discussion.

RELEVANCE TO ASIS&T AND SIGNIFICANCE TO THE FIELD

Members and attendees at ASIS&T who have an interest in the spread of malinformation, such as misinformation, disinformation, conspiracy theories, and fake news, via social media by means of politicizing the pandemic crisis and its consequences on racism will find our topics applicable to their research. We anticipate that this panel will provide direction for those works and foster related interdisciplinary research.

Author Bios

Miyoung Chong

Miyoung Chong is a postdoctoral researcher in Deliberative Media Lab at University of Virginia. She earned her Ph.D. in Information Science with data science major in the College of Information at University of North Texas in August 2020. Her research centers on critical informatics with a particular focus on technological affordances and its socio-political implications for crisis management and social change. Her larger body of research is characterized by computational social science and data science to investigate digital media and online community engagement. She published her studies as a leading author in *Government Information Quarterly*, *Scientometrics*, *Open Information Science*, and *Quality & Quantity* and published in *Journal of Medical Internet Research* and *Journal of Business Anthropology* as a collaborator. Her presentation venues include ASIST Annual Meetings, iConferences, and the Association for Education in Journalism and Mass Communication (AEJMC) Annual Conference. She wrote a book chapter titled with "Social Media Analytics" and developed a course "Democratic Politics in the New Media Environment" at University of Virginia. Some of her current research projects include: A Longitudinal Topical and Geo-locational Analysis of a Racist Twitter Network, Assessing Transnational Crisis Communication of Public Health Agencies, and Political Elites' Framing on Critical Race Approach.

Thomas J. Froehlich

Thomas J. Froehlich, Ph.D., is Professor Emeritus, School of Information, Kent State University (27 years). The majority of his published work is concerned with ethical considerations in the information professions, evolving in part from his philosophy background (Ph.D., Duquesne University). Dr. Froehlich taught in the areas of information science, ethics, network and software resources, online searching, and user interface design, and created and managed a Masters program in Information Architecture and Knowledge Management (2001-2011). Since the rise of Trumpism and fascism in the United States, he has devoted his research to the irrational underpinnings of the acceptance of the varieties of false information. It has led to the creation of a graduate course on the Age of Disinformation, taught in the Springs of 2018 and 2019 and scheduled for Spring 2022. His latest publications are:

Philosophical Musings on the Underbelly of the Age of Information. (2021) *Informacio*, vol. 26, no. 1, available at: <https://informatio.fic.edu.uy/index.php/informatio/article/view/313>.

A disinformation-misinformation ecology: The case of Trump. In: *Fake News Is Bad News - Hoaxes, Half-truths and the Nature of Today's Journalism* (2020), available at: <https://cdn.intechopen.com/pdfs/74337.pdf>

The role of pseudo-cognitive authorities and self-deception in the dissemination of fake news," *Open Information Science*, 3: 115-136, 2019, available at: <https://doi.org/10.1515/opis-2019-0009>.

Most of his publications can be found at his web site: <http://personal.kent.edu/~tfroehli/>.

Kai Shu

Dr. Kai Shu is a Gladwin Development Chair Assistant Professor in the Department of Computer Science at Illinois Institute of Technology since Fall 2020. He obtained his Ph.D. in Computer Science at Arizona State University and was the recipient of the 2020 ASU Engineering Dean's Dissertation Award. His research and computational tool development address challenges varying from big data, to social media, and to AI on issues on fake news detection, explainable machine learning, trust social computing, and social media mining. He is the leading author of a monograph, *Detecting Fake News on Social Media* (2019), and the leading editor of a book, *Disinformation*,

Misinformation, and Fake News in Social Media (2020). He has published innovative works in highly ranked journals and top conference proceedings such as ACM KDD, SIGIR, WSDM, WWW, CIKM, IEEE ICDM, IJCAI, and AAAI. He was invited to talk and serve as a panelist at the first Global WHO Infodemiology Conference. He presented two tutorials at top data mining conferences, co-organized conference workshops, guest-edited a journal special issue, and served as a principal book editor, all related to his research on disinformation. More can be found at <http://www.cs.iit.edu/~kshu/>.

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Youth Information Interaction Research in the Pandemic: Adjustments, Innovations, Implications

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ABSTRACT

For over a year, the pandemic has forced youth to alter their routines and rely almost exclusively on technology to learn, play and connect with family and friends. Although some alterations in youth's routine seem to be temporary, some adaptations and appropriations resulting from interactions with technology will likely be forever altered. As this scenario develops, we must reflect on how these permanent changes will affect our approaches and inquiries on youth information interaction. This 90-minute panel will convene scholars and members of the ASIS&T community interested in discussing the present and the future of digital youth research. Panelists will mediate focused conversations with participants to generate a collective account of experiences and reflections based on challenges and research plans for after the pandemic. As the implications of a global pandemic are unfolding, youth information interaction research will be critical to inform policies and programs in education and reduce digital divides.

KEYWORDS

Digital youth; Information behavior; Digital divides; COVID-19.

INTRODUCTION

For many of us, the global COVID-19 pandemic has dramatically altered the way we work, learn and play. The same can be said for young people, who have been forced to adopt new information practices (online schooling, virtual visits with relatives, Zoom playdates and birthday parties with friends) or have intensified their use of established technologies (e-reading platforms, search interfaces, and social networks). Some of these adaptations and appropriations will be temporary, but there are indications that some of our information interactions may be forever altered (Bradford, 2021). These transformations also affect how we study youth information interaction – the phenomena we see as important, the questions we ask, the methods we use to engage with youth have and will be changed by this realignment of people, place, and technology. How are youth information interaction (YII) researchers navigating this changing space? What will youth research look like post-pandemic? Will we ever be “post-pandemic”? This 90-minute panel seeks to engage diverse scholars and the ASIS&T community to explore these questions and others to better understand the present and future of digital youth research.

Historically, youth information interaction (YII) studies have been conducted in face-to-face environments, with only a few of these studies adopting distanced data gathering, trace data or secondary data sets (Agosto, 2019). The main focus of YII studies lies in understanding the interactions between youth and information by engaging with young participants using qualitative methods, or using lab-based experiments. Researchers have altered their research frameworks and methodologies due to the current pandemic restrictions (Lealand, 2020). As social distancing measures have compromised face-to-face research, we have the opportunity to evaluate the challenges and opportunities in conducting distanced studies with youth. What possibilities exist to investigate YII data generated via digital platforms? What creative, insightful or alternative paradigms exist or were employed by fellow scholars? How can we conduct this work safely, ethically, and with minimal risk to youth participants who are already vastly increasing their screen time due to online schooling?

This panel will map out the collective account of experiences and reflections on how the pandemic has affected youth's research agenda and methodologies, and gather insights on how YII scholars have overcome challenges emerging in this scenario. YII studies often intersect with learning experiences in and outside of the classroom; thus, it encompasses educational practices and policies. At a time in which youth depend more on digital platforms to learn, connect with peers and entertain themselves, YII research will be fundamental to inform policies and

programs to engage with the challenges of digital literacies and skills as well as conceptual and technical divides among young people.

BACKGROUND

Distanced data collection

Methodologies to collect online data using digital tools have been around since the inception of the internet (Kozinets, 2015). Anthropology and media studies scholars have gathered transactional log data (e.g., online posts on social media) (Pink et al., 2016), and used video conferencing software and mobile applications to collect data (Archibald et al., 2019; Gibson, 2020). The studies conducted in those disciplines investigated online behaviors and “offline” social practices of diverse populations, including vulnerable and hard-to-access communities. As a result, most of these studies have provided methodological foundations for scholars interested in collecting online and distanced data.

To a smaller extent, YII research has explored online and distanced procedures to collect and analyze data. Some YII studies have gathered transactional log data to measure the frequencies and identify patterns in youth’s information-seeking and retrieval activities (Duarte Torres et al., 2014). Other studies analyzed YouTube videos to identify early childhood interactions with technology (Hourcade et al., 2015) or YouTube comments to ascertain learning traces (Meyers, 2014). More recently, researchers surveyed data from large-scale projects to provide evidence on how youth information behavior has changed through the years (Bowler et al., 2018). Nevertheless, these studies are the exception rather than the norm; they do not provide a roadmap for the adoption of digital tools (e.g., video conferencing software and mobile applications) to collect data with youth participants.

The current pandemic imposed changes in research plans and timelines. Many researchers were forced either to put off their studies or develop strategies to transition to distanced data collection. The researchers opting for deferring their research questioned the validity of the data collected using digital tools and, consequently, the cogency of study outcomes (Lealand, 2020). Other scholars decided to proceed with their plans, adapting methodologies and designing their studies for distanced data collection procedures (Lobe et al., 2020). Nevertheless, the restrictions imposed by the pandemic might create opportunities and challenges for researchers in several ways.

In the realm of opportunities, the current circumstances have fostered novel methodologies supported by digital technologies. Furthermore, these methodologies might help to explore the implications of the increased use of digital technologies during the pandemic for youth. At this time, it is unclear whether digital data collection through applications like Zoom might allow researchers to diversify their participant samples and reach new conclusions or simply reinforce the biases already present in research with youth. We can all agree that conducting distanced research with youth brings several challenges. First, access to digital platforms is limited to persons over the age of thirteen in most cases. Second, recruiting and accessing youth’s transactional logs involve more levels of privacy than those of adults. Finally, video conferencing and applications might work better with older populations than youth.

Youth’s Digital Experiences during the Pandemic

Most schools moved their teaching activities to digital platforms that were not initially designed for primary and secondary education learning experiences (Bradford, 2021; Chandra et al., 2020). Thus, the transition to online/hybrid learning has two immediate implications. First, technology access and literacy imbalances are likely to affect young people’s learning outcomes. Second, the increased use of digital platforms in learning might affect how educators and parents perceive the role of technology in the classroom and the home.

As teaching has shifted to online and hybrid formats, reports have surfaced that youth are struggling to access online platforms and achieve learning outcomes. Schools were not prepared to deliver their classes using online/hybrid formats due to technological challenges (e.g., lack of technical infrastructure, insufficient electronic devices for students) (Ascione, 2021; Donoso & Retzmann, 2021). Educators and parents were not prepared for online/hybrid formats, thus struggling to keep youth motivated and engaged (Reilly, 2020).

Educators, parents and policymakers are evaluating the implications of online/hybrid learning. In a joint initiative to work collaboratively to keep youth motivated, educators and policymakers have been discussing how to reduce the barriers to information and digital literacy (Bradford, 2021). One strategy is the implementation of programs focusing on the reduction of digital divides and digital and information literacy training (United Nations Educational, Scientific and Cultural Organization, 2021). As a result, educators, parents and policymakers might be gradually changing their mindsets about using digital tools to support learning. As youth scholars, we must be ready to explore the extent to which the pandemic has affected youth’s learning experiences and information behavior.

Despite enormous uncertainty, this much is clear: we who research and practice with young people in the information professions will be stronger through shared stories of our collective address of these changing

circumstances. While the approach to YII research and practice in the last 12 months may be ad hoc, the opportunities and innovations discussed in this forum may provide hope and inspiration for the years to come.

PANEL FORMAT (90 MINUTES)

Session Introduction (5 minutes)

The moderator will introduce the panelists and briefly discuss the panel topic.

Panel Discussion (20 minutes)

Each panelist will have 5 minutes to discuss their experiences and reflections as YII scholars during the pandemic. The discussions will cover the following topics: youth methodologies and research frameworks emerging from the pandemic; implications of the increased use of digital technology by youth, information literacy and digital divides; challenges and opportunities for YII studies after the pandemic.

Group Activity (60 minutes)

Attendees will be assigned to four groups and participate in focused conversations with one panelist for 30 minutes. Each panelist will facilitate discussions gravitating around the following themes: adjustments to the existing research procedures; innovations in youth's methodologies; and implications to YII's research agenda. Each group will map out the insights and identify themes/patterns concerning challenges and potential approaches for YII research in a post-pandemic world.

Each group will be invited to share their findings with the larger group during a 30-minute discussion. The four maps containing the themes/patterns covering challenges and potential approaches for YII research post-pandemic will be made available for future consultations via an online cloud storage service (e.g., Google Drive).

Wrap-up (5 minutes)

The moderator will thank panelists and attendees and close the session.

PANEL MEMBERS

Dr. Dania Bilal, University of Tennessee, Knoxville (Panelist)

Dania's research focuses on youth information behavior and interaction and sits at the intersection of human-computer interaction and information retrieval. She has researched different aspects of youth information interaction, paying attention to their cognitive and emotional developments, information needs, and experiential learning. Her research has made implications for theory and practice, advocating for system design informed by youth's mental models and learning. Her current projects focus on theory and theorizing in youth information behavior research and interaction, human-centered AI, and AI literacy. During the Pandemic, she postponed projects involving youth. She will share stories documenting youth information interaction during the Pandemic.

Dr. Eric M. Meyers, University of British Columbia (Panelist)

Eric's research sits at the intersection of information science and the learning sciences. His recent work has focused on how crafting and prototyping activities in informal learning settings, specifically Maker Camps and library-based coding and crafting programs, support the development of design literacies and computational thinking, the skills and attitudes that facilitate understanding of today's complex information and communication technologies. During the pandemic, Eric has turned his focus to the textual ecosystems that describe, influence and condition youth information interaction, including youth literature, film and immersive media. If one cannot study children coding, how is code and coding represented in children's media? What does this say about how we frame children's participation in computationally rich learning activities?

Dr. Sophie Rutter, University of Sheffield (Panelist)

Sophie's research explores how environments affect the way children interact with, and use, information: for instance, how the school environment influences the way children and teachers use search technologies and search for information. She has also worked with school children to co-design handwashing communication. Since the pandemic Sophie has become interested in how the online/hybrid environment may have affected children's information-seeking for their school work: how such research can be conducted online, as well as methodologies for doing research with (and not just about) children in an online environment.

Dr. Rachel M. Magee, University of Illinois Urbana-Champaign (Panelist)

Rachel M. Magee is a youth advocate and assistant professor at the University of Illinois Urbana-Champaign. Her work in the School of Information Sciences is informed by her background as a librarian, and her current research collaborates with teens and public libraries as co-researchers focused on youth cultures, literacies, and technology experiences. In the panel, Magee will reflect on how these research interactions have shifted online as well as the affective impacts of the pandemic on the abilities and interests of teens, library staff, and researchers to engage in this complex, collaborative work.

Vanessa Figueiredo, Ph.D. Candidate University of British Columbia (Organizer & Moderator)

Vanessa's research explores how young people shape their interactions with information and information systems in the school context. Due to the current pandemic, she adapted her research plan to conduct distanced data collection using Zoom. The methodological changes motivated her to organize a panel to collect experiences of doing YII research during the pandemic and reflect on how the current restrictions will affect YII experiences. She will moderate the discussions and activities proposed for the panel.

CONCLUSIONS AND NEXT STEPS

This panel will encourage scholars to share their experiences during the pandemic and propose reflections on the future of youth scholarship in the face of unrivalled changes. The outcomes of this panel will support researchers to identify critical areas in youth studies and devise flexible research plans. We hope to co-develop an agenda with the attendees of this session that will push YII research forward. By promoting robust conversation and minimizing the "talking head" segments common in panels, we seek to develop a rich and engaging experience for all attendees. We also anticipate this panel and the ensuing conversation will act as a springboard for future publications, or perhaps a special journal issue focused on methods and frameworks for studying youth information interaction under complex circumstances or focused on distance-technology-enabled techniques with children.

ACKNOWLEDGMENTS

The authors and contributors to this panel wish to extend their gratitude to the young people, their parents, educators, and caretakers who enrich their lives and make our work possible.

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Expanding Our Conceptions of Embodied and Affective Information Interactions with Queer Theory

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ABSTRACT

Embodiment and affect are understudied in information science work to date. Literature that engages with embodied information interactions typically focuses on physical bodies, while work on affect largely centers people's emotional experiences in formal knowledge institutions like libraries. Room therefore exists to grow in our understanding of embodiment and affect, particularly in terms of theorizing how bodies and feelings factor into a wide range of information experiences from non-dominant standpoints. This panel centers queer experiences and queer theory in order to expand conceptions of and connections between embodied and affective dimensions of information interactions. Panelists will present a range of research that examines queer people's practices and experiences with information in historical, archival, creative, and health-related domains. Bodies and emotions are essential components of critical queer theoretical perspectives, meaning that scholarship which centers queerness and its intersections with constructs like race has great potential to expand many branches of information science further beyond their normative bents. In concert, topics discussed should spark conversation among attendees about the theoretical and practical benefits of deeply studying embodiment and affect and further utilizing critical theory in multiple domains within the information science discipline.

KEYWORDS

Embodiment; affect; queer; information interactions; theory.

INTRODUCTION

Embodiment and affect are generally understudied in information science literature, and this limits our ability to understand people's information interactions (Floegel & Costello, 2021; Ocepek, 2018; Olsson & Lloyd, 2017). We use "information interactions" here as an umbrella term that encompasses information behaviors, practices, creation, and other human-information phenomena (see Fidel, 2012). Neglect of embodiment and affect are indicative of core limitations that have been pointed out across our discipline, including its long-standing cognitive focus (Savolainen, 2007) and tendency to binarize people and information systems or technologies (Floegel & Costello, 2021; Lloyd & Olsson, 2019). Moreover, embodiment and affect tend to be rendered most clear in non-normative contexts (Ahmed, 2004; 2006; 2013), meaning that trends in information science including marginalizing work from scholars of color (Cooke & Kitzie, 2021), white-ism (Mehra & Grey, 2020), and cis/heteronormativity (Floegel & Costello, 2019; Wagner & Crowley, 2020) all feed into under-theorization of embodiment and affect. This panel argues that information science would do well to consider how bodies and feelings—and in particular, marginalized bodies and feelings—factor into information interactions if the discipline is serious about embracing epistemics and scholarship beyond white, Western, and cis/heteronormative standpoints.

"Embodiment" broadly refers to practices, interactions, and experiences that are somehow corporeal (Olsson & Lloyd, 2017), and many argue that all practices, interactions, and experiences are fundamentally embodied (Varela, Thompson, & Rosch, 2016). However, in literature to date, embodiment often translates into practices that involve the physical body, like touching food in a grocery store (Ocepek, 2018), using tools to restore cars (Lloyd & Olsson, 2019), writing lists (McKenzie, 2020), and providing care to patients as a nurse (Bonner & Lloyd, 2011). "Affect" broadly refers to emotions or feelings (here, we consider affect to be synonymous with emotions and feelings rather than a separate construct; see Ahmed, 2013). Emotions are perhaps less commonly—or at least less specifically—

discussed in literature beyond that which examines people's feelings within formal knowledge institutions like libraries and schools (Julien & Fourie, 2015; Krakowska, 2020; Kuhlthau, 1988; Nahl & Bilal, 2007) or beyond psychological takes on information seeking (see Savolainen, 2015). Affect may be less explicitly discussed than embodiment because emotions are stereotypically feminized and therefore not often considered "significant" elements of people's experiences (Ahmed, 2004, 2013; Doty, 2016).

However, outside of information science, both embodiment and affect are used within critical theoretical spaces to understand how marginalization operates within our everyday lives and institutions. Queer theory, in tandem with critical disability studies and critical race theory, provides compelling theoretical and empirical takes on embodiment, affect, and their ties to power (Mitchell & Snyder, 2015; Puar, 2012, 2017). Generally, queer theory seeks to destabilize or reorient what seems to be normal or status quo with the goal of shifting power relations away from institutionalized whiteness and cis/heteronormativity (Ahmed, 2006; Puar, 2017). In terms of embodiment and affect, queer theory specifically points to ways that queer bodies and emotions have been inequitably regulated over time, particularly along racialized, gendered, classed, and national lines (Puar, 2017; Schuller, 2018). Queer theory further highlights how members of queer communities use embodied and affective practices to counter regulation and related oppression (Halberstam, 2011; McKinney, 2020). Moreover, queer theory draws underarticulated connections between embodiment and affect, and argues that we cannot separate the two constructs (as we tend to do in information science work). Ahmed (2013), for example, calls affects "embodied cognition" and argues that feelings are binarized from bodies only because of institutionalized misogyny wherein masculinized physicality is prioritized over feminized emotions. This further calls into question the divide between embodiment as purely physical and affect as purely mental; queerness's anti-binary stance lends credence to the argument that we cannot separate bodies from feelings (see Jagose, 1997).

Queer theory's relationship to embodiment and affect therefore raises questions about how information interaction literature handles these topics, and points to ways that research may be better attuned to embodied and affective power dynamics going forward. In particular, we believe that queer theory may help us a) understand how queer bodies and feelings have historically been sites of both regulation and resistance in information institutions and within information interactions; b) consider embodiment and affect outside of purely physical practices; and c) draw connections between bodies and feelings that necessarily factor into any information interaction. As early career scholars who are both personally and professionally entrenched in queer spaces, and who have queer bodies and feelings ourselves, we will present four ongoing research projects that engage with questions around queer embodiment and affect in information interactions. Findings and questions raised by our research should spark necessary and productive conversation around embodiment, affect, and how information science can further engage with historically marginalized standpoints, peoples, and practices.

PANEL FORMAT

This 90-minute panel session will proceed as follows:

- Introduction (5 minutes)
- Panelist Presentations: 4 panelists (15 minutes per presentation, 60 minutes total)
- Questions and Discussion (15 minutes)
- Summary and Brainstorm Research Agenda: Panelists will conclude the session by asking attendees to offer suggestions for a research agenda on embodiment and affect, which may lead to further collaborations among panelists and attendees (10 minutes)

We present our credentials and presentation topics below.

Travis Wagner

Travis Wagner is a PhD. candidate in the School of Information Science at the University of South Carolina. Wagner is also an instructor in UofSC's Women's and Gender Studies Department. Their primary research interests include critical information studies, queer archives, and embodied information practices. Their dissertation explores the phenomenological role of gender as a descriptive practice as it relates to catalogers working with visual information. Their recent publications include articles in the *Journal of Documentation*, *Open Information Science*, *Reference Services Review*. They are also the co-creator of the Queer Cola Oral history and Digital Archive.

In their presentation, Wagner will discuss the co-constitutive nature of queer embodiment as it informs the work of information organization within cultural heritage institutions. Specifically, they will understand how the complex visibility of queerness offers sites to explore how information professionals make sense of gender as a normative phenomenon and how this normative ideology can be disoriented (Ahmed, 2006). Specifically, their work expands on critical information studies focused on regulating queer bodies through informational surveillance (Adler, 2017) or discursive limitations (Drabinski, 2013) to explore how practitioners' own lived experiences and phenomenological orientations play into the cataloging of gender diverse embodiment. Further, their work explores

how both queerness as an identity and queerness as a thing encountered operate to destabilize fixed orientations between historical understandings of cataloger and object (Šauperl, 2002) as well as notions of domain and document frames of subject description (Mai, 2005). Their work then theorizes towards what it would mean to make the work of cataloging body-oriented and how this informs not only discussions of a cataloger's positionality (Diao, 2018), but practitioner positionality within LIS more broadly. Wagner's presentation will engage with the following questions: a) How does queer embodiment inform the interpretation of gender within cataloging practices? b) What implications does queerness as an embodied information encounter have for LIS professionals more broadly? and c) Does queer embodiment exist in a practitioner/object binary, or might this binary require its own queer encounter?

Diana Floegel

Dr. Diana Floegel earned their Ph.D. from the Rutgers School of Communication and Information in May 2021. Their interdisciplinary areas of teaching and research include people's information creation practices, sociotechnical assemblages, and social justice in information institutions such as libraries. Their dissertation work used participatory fandom as a context through which to examine how power dynamics are expressed by and enacted within queer people's technologically mediated information creation practices. They have published widely across top information science journals including *JASIS&T*, *Journal of Documentation*, and *Library and Information Science Research*.

In their presentation, Floegel will argue that when queer people write transformative fanfiction ("fic")—or texts that remix canonically cis/heteronormative media so that it contains queer characters, relationships, and/or themes (Fiesler & Dym, 2018)—they are engaging in both embodied and affective information practices despite the so-called "virtual" nature of writing fic online. Drawing on interview data with 25 queer participants in seven different countries as well as content analysis of fanfiction texts and five social media platforms used by fans, Floegel will discuss overlapping liberatory and oppressive dimensions of embodied and affective elements of information creation. In particular, they will demonstrate how intersectionality (Crenshaw, 1988; Collins, 2000) functions within queer creative practices and the online spaces in which they occur so that white, Western, and cisgender fans experience self-discovery and catharsis through fanfiction while fans of color, non-Western, and transgender fans experience oppression and marginalization (Floegel, 2020; Pande, 2018). Further, Floegel will discuss how elements of social media platforms like their taxonomic systems and content warnings serve to enforce inequitable experiences for queer fans along racialized, gendered, and nationalized lines. Floegel's presentation will raise the following questions: a) How can embodiment and affect be virtual? b) How are embodiment and affect reciprocal forces within information creation, and can we separate them? c) Can embodiment and affect be universalized experiences, and why or why not?

Daniel Delmonaco

Daniel Delmonaco is a PhD student at the University of Michigan School of Information. They are also part of the Graduate Certificate program in Science, Technology, and Society (STS). Delmonaco researches LGBTQ+ health and online information seeking. Their current research focuses on the online sexual health information seeking practices of LGBTQ+ young people and the development of comprehensive and inclusive online sex education resources. They also research the content moderation experiences of marginalized people on social media platforms.

In their presentation, Delmonaco will discuss the embodied and affective nature of LGBTQ+ young people (ages 15 to 25) and their sexual health information seeking practices. This presentation discusses findings from 17 interviews and 3 focus groups with LGBTQ+ young people in which participants discussed their experiences searching for sexual health information and their online sexual health search strategies. Participants expressed a preference for receiving sexual health information in online communities instead of via healthcare providers or LGBTQ non-profits (Delmonaco et al, 2020). This preference often came with feelings of disappointment over needing to turn to online and peer-based resources out of necessity, desires for privacy, and/or safety concerns. Previous research on LGBTQ+ sexual health information seeking does not directly consider the embodied and affective nature of this specific information interaction (Bui et al., 2009; Mitchell et al., 2014; Steinke et al., 2017; Veinot et al., 2013). Delmonaco's presentation will discuss participants' reflections on their own sexual health information experiences and online search strategies for related information. Findings suggest that both affective and embodied elements of sexual health information seeking impacted participants' search strategies and satisfaction with information they encountered. Delmonaco's presentation will pose the following questions: a) How do affect and embodiment present themselves in the sexual health information seeking of LGBTQ+ young people? b) How might we consider affect and embodiment in the development of sexual health resources for LGBTQ+ young people?

Bri Watson

Bri Watson (@brimwats) is a PhD. student at the University of British Columbia's iSchool focusing on queer nomenclature, histories of information, and equitable cataloging in GLAMS (galleries, archives, libraries, museums, and special collections). They are the Director of HistSex.com, a free and open access resource for the history of

sexuality and serve on the editorial board of Homosaurus, an international linked data vocabulary for queer terminology. Additionally, Watson serves as the Archivist-Historian of the Consensual Non-Monogamies Committee of the American Psychological Association.

Watson will conclude the panel by placing previous presentations into the history of cataloging and classification. As Wagner (above) and others (Adler, 2012; Poole, 2020) have demonstrated, queerness and queer bodies destabilized the rules and historical understandings between catalogers and the catalogued. In the decades following, information professionals, activists and researchers have struggled with controlled vocabularies, such as the Library of Congress Subject Headings (LCSH), which have been (rightly) criticized as inappropriate, misleading, or outrightly offensive. Folksonomies and social tagging, once seen as possible remedies by researchers, have been matched by a near-equal amount of research (Floegel, above; Keilty, 2012) that points to how uncontrolled tagging oppresses along sexual, racialized, gendered, and nationalized lines. However, as Floegel and Delmonaco demonstrate, queer people have continued to innovate by engaging in "both embodied and affective information practices," likely out of necessity, as access to information on risk and protection (from HIV/AIDS, for example) can be literally lifesaving. Building on these discussions, Watson's presentation will argue that community developed and supported vocabularies like the Homosaurus (<http://homosaurus.org>) offer futures which create a place and space of justice for nonnormative, "weird," "queer" and "perverse" bodies. By engaging in "information activism" (McKinney, 2020)—including literally overwriting LCSH—catalogers can create an affective and embodied language in which subjects "can discover themselves existing" (Watson, 2020).

CONCLUSION

Questions that each presentation raises should inspire robust discussion among attendees that could lead to the development of a research agenda that centers explorations of power, inequity, and liberation in the context of embodied and affective information interactions. Further study of embodiment and affect is necessary in information science, particularly if the discipline is to continue to strive for equity, inclusion, and justice in its scholarship.

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Community Resilience Through Diversity

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ABSTRACT

The COVID-19 pandemic has brought about a pivot in people's practice of their daily life and work, in particular a pivot towards virtual living and working. Sponsored by the ASIS&T European Chapter, this panel discusses the diverse ways in which this has affected different communities within Europe, bearing in mind the varying languages, economic and political situations, and library and information structures within different European countries. Following on from presentations giving diverse perspectives from five European countries, we will ask session participants to reflect on the impact of the pivot on living and working in their own context, their coping mechanisms, and likely impact on the future.

KEYWORDS

Community; Diversity; Europe; Pivot; Resilience.

INTRODUCTION

Eric Ries (2011, 2012), who coined the term “pivot,” observed that highly successful businesses experienced dramatic, abrupt change or a pivot before they boomed, citing for example, Twitter, YouTube, and Groupon. During the past year, the COVID-19 pandemic has dramatically disrupted our everyday lives, affecting our families and colleagues, our social participation, and our workplaces, bringing about “pivot” in how we approach our everyday lives and work. In short, the worlds we knew were turned upside down. While some were furloughed, others of us were able to continue working, “pivoting” to teaching online, meeting online, and conducting research online – to enable short-term survival for long term continuance, growth, and resilience. The possibility of vaccination has changed our view for the future, though vaccination roll out has been mixed in different regions and has created divisions among people.

Throughout this tumultuous period, our library and information science community has persevered. The European community is a diverse association of nations, cultures, languages, and people, and the geographical entity of Europe extends still further. It is this diversity, between the many cultures and languages of Europe that we will leverage in this panel to highlight the challenges and approaches in different European countries. Ongoing findings from the European Social Survey (European Research Infrastructure Consortium (ERIC), 2021) identify differences between countries in attitudes to justice, health and values, for example. Information is emerging on how a variety of factors affect the response of libraries and information centres. Rundqvist (2021), reviewing the response of Swedish public libraries, notes the contextual nature of the response, affected by the epidemiology of the disease in Sweden, Sweden's political strategy as regards lockdown, and learning acquired as the pandemic proceeded.

Mercurio (2021) identifies the importance of existing organisational cultures and priorities, contrasting the greater readiness of Italian municipal libraries to cope with remote working and service, compared with Italian state libraries with their “fixed 19th-century vision of the function of the public library”. Tammaro (2020) has also identified organisational and cultural issues impacting Italian libraries' response to the pandemic. Social and economic factors within countries also affected users of libraries, for example in Jaeger & Blaabaek's (2020) study of inequalities in library use during COVID-19. The pivot has also obviously affected Library and Information Science educators, providing both challenges and opportunities (e.g., Ocholla, 2021), and more generally brought issues of open access, electronic delivery and workforce skills into sharp focus (e.g., Research Libraries UK, 2020).

What are the strengths of communities that have supported resilience among our teaching and research activities? How has diversity facilitated resilience? As vaccination progresses, how will we realign our work together for a stronger future? What do we need to do in the short term and in the long term to sustain these goals?

PANEL STRUCTURE AND PARTICIPANT ENGAGEMENT

This panel offers a space to pause and consider the past year and how diversity has supported our community resilience. The first part of the session will consist of presentations from speakers from five countries (covering both Northern and Southern Europe), addressing different aspects of our theme (approximately 50 minutes). The remainder of the session will involve online interaction with participants, to surface their own experience and views.

This panel session will challenge participants to consider:

- a) What helps them not only survive, but potentially flourish in their academic and professional activities, despite the extreme changes in our life circumstances brought about by COVID-19; and
- b) What realignment will mean for our European community.

Collection of membership stories of resilience

In advance of the panel session at ASIS&T's Annual Meeting, we will invite ASIS&T members in Europe, including academics and professionals, to post their experiences of coping with the pandemic in their libraries, universities, research, and teaching, noting in particular, creative community solutions and resilience in the face of this worldwide calamity. A Google Jamboard will capture this content for discussion at the panel session, available at: https://jamboard.google.com/d/1RCQgS4_PCbWi1ByJ2BaPJMkYmvTXUMLelKh48kf_g1k/edit?usp=sharing

Key questions for participant discussion will be:

- a) What has been your experience of the pivot as we reframed how we do things?
- b) What have been your coping mechanisms as we repositioned ourselves to manage through the pandemic?
- c) What do you believe the future will look like, as we realign our lives post pandemic?

PANEL SPEAKERS

The panel discussion will include 4 speakers representing diverse areas, including professional work and academia, different linguistic-cultural backgrounds, and different European countries.

Isto Huvila, Department of ALM, Uppsala University, Sweden

Communities, diversity, and resilience in Nordic library, archive and museum context

Huvila's presentation provides a glimpse to developments and debates in Nordic libraries, museums, and archives (LAMs) relating to community support, diversity and resilience during the COVID-19 pandemic. Examples provide evidence of how the pandemic unfolds as a challenge but also as an imperative, opportunity, and impetus for pursuing new means for supporting communities, their diversity and resilience. Comparisons between the Nordic countries and their strategies and policies relating to LAMs provide further interesting insights into their societal role in a crisis situation.

Olivia Manuela Marques Pestana, University of Porto, Portugal

One step back, two steps forward: How the Portuguese IS academic environment coped with the pandemic

This presentation will focus on the strategies followed by Portuguese Information Science programmes to face the challenges that arose due to the pandemic. Built on the conclusions of the interviews conducted with the programmes' directors, several aspects are highlighted: the new online environment is the present and not the future; blended learning is the best choice; flipped classes, mainly the theoretical, are welcomed by students.

Anna Maria Tammaro, University of Parma, Italy

What the new normal looks like in Italian libraries

Anna Maria investigates leaders and librarians, how they are preparing the new normal, different visions, new and old issues. Tammaro (2020) described an investigation into the impact of COVID-19 on libraries in Italy.

Ying-Hsang Liu, Department of Archivistics, Library and Information Science, Oslo Metropolitan University, Norway

Stay safe and stay relevant: Danish library initiatives during the COVID-19 lockdown

Ying-Hsang will discuss how Danish libraries have responded to the crisis using a coordinated approach. Specifically, following the government guidelines for lockdown and reopening, libraries have stayed relevant to the community with virtual and intermediary information services. within the constraints of the lockdown.

Sümeyye Akça, Department of Information and Records Management, Marmara University, Göztepe/Ankaraİstanbul, Turkey

University libraries in Turkey: During and after quarantine

Sümeyye will discuss the impact of COVID-19 on academic libraries in Turkey, and how this community has transformed services to support its members. The conclusion of the interviews with managers of libraries about the impact of this new situation will be presented in detail.

University libraries can meet most of their users' information needs in electronic environment, but they should increase their efforts, in order to adapt for different unusual scenarios.

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What's Next for Information World Mapping?: International and Multidisciplinary Uses of the Method

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ABSTRACT

As use of arts-involved and data visualization methods increases in information science, it is important to reflect on strengths and weaknesses of various methods. In this 90-minute panel, an international lineup of information researchers will share their experiences using the participatory, visual elicitation technique information world mapping (IWM) in their work. Panelists will discuss ways to adapt the technique to different contexts, share their thoughts on what is next for IWM, and raise questions regarding challenges and new uses of IWM in information research. Presentations will be followed by an interactive discussion among panelists and Q&A period with the audience.

KEYWORDS

Research methods, Visual methods, Arts-involved methods, Qualitative methods, Information behavior.

INTRODUCTION

Information world mapping (IWM) is an arts-based elicitation method designed for use within qualitative interviews (Greyson et al., 2017). The method combines attributes of information horizons (Sonnenwald, 2005), Photovoice (Julien et al., 2013; Wang & Burris, 1997), and relational mapping (Radford & Neke, 2000), to generate participant-created visual maps of the people, places, and things in individuals' information worlds (Jaeger & Burnett, 2010; Yu, 2012), as well as participant-centered depictions of information practices (Savolainen, 2008) therein.

Since its inception for use in a study of health information practices, IWM has been adapted, translated, and used in studies on a variety of topics from refugee settlement (Martzoukou & Burnett, 2018; Shankar et al., 2016) to caregiving for people with dementia (Dalmer, 2017). IWM has been used with several populations, including iSchool students (Tsai et al., 2019), LGBTQIA community members (Kitzie et al., 2021), African immigrants (Mabi, 2020), and vaccine hesitant mothers (Greyson & Bettinger, 2017). IWM has spread from North America to Europe and Asia, been translated, and used not only in information science, but in other disciplines that may study information behaviours and practice, such as public health and ageing studies. Different materials have been used in various settings, and due to the COVID-19 pandemic, researchers have begun to explore online adaptations of the IWM activity. Although the method was originally conceived as an aid to verbal elicitation, researchers have been exploring analytic methods for use on the maps themselves as research data (Greyson et al., 2020).

This panel will showcase a variety of uses of IWM, describe the ways the method has been adapted and translated for use in different contexts (locations, cultures, disciplines, technology access environments), discuss analytic approaches to use with IWM, and raise questions for the future of the method. A variety of researchers who have used IWM in their work will describe the projects within which the method was used, highlighting the benefits and challenges of IWM in their experiences, and providing their perspectives on what are the next challenges or innovations for use or adaptation of IWM. Following these brief presentations, we will engage in an interactive question and answer session among panelists and with the audience.

PANEL PRESENTATIONS

Following a brief introduction to the method by the moderator (Greyson), each of four panelists will describe their use of IWM, including how it was situated within their research projects, how it worked for their study populations, approaches to analysis of data when using IWM, and questions their experience raises for future use of IWM.

Kitzie: Using IWM to Describe the Health Information Practices of SC LGBTQIA+ Communities

Kitzie has used IWM in ongoing research exploring the health information practices of LGBTQIA+ communities in South Carolina. Over 60 participants have engaged in IWM as part of this research during in-person semi-structured interviews and virtual focus groups. Participation is divided between community leaders and members, who mapped health information practices at both individual and community levels of observation. Data analysis is twofold, with content analysis of participant's map descriptions and situational analysis of the maps.

Kitzie will overview findings from IWM data collection and analysis, focusing on the following topics:

- Kitzie will identify strengths (e.g., comparison of individual and community as units of analysis) and challenges (e.g., participants' difficulty in generalizing practices at the community level) in adapting IWM to describe community-level, rather than individual, information practices.
- Kitzie will discuss unique opportunities of situational analysis for IWM, including opportunities to elicit and identify discursive power, resilience, and resistance among participants.
- Kitzie adapted IWM to a virtual focus group context and will address several lessons learned, including translating IWM to digital media and making IWM interactive within a focus group context.
- Finally, Kitzie will overview methodological strengths and challenges unique to her research, including pairing critical incident technique questions with IWM and cultural availability of IWM methods to participants.

Questions for discussion among panelists based on these topics may include: How faithful does IWM need to be to its original context in order to attain its underlying methodological insights? What are the unique insights IWM can contribute to describing the lived experiences of marginalized people and communities?

Mabi: Mapping the Employment Information Practices of African Immigrants

Dr. Millicent Mabi completed her doctoral studies in August, 2020, and is currently an adjunct faculty at the School of Information, University of British Columbia. Her research interests sit at the intersection of information and migration, including information behaviour of underrepresented groups, information poverty, Africans at home and in diaspora, immigration and settlement, and information services for marginalized populations. Dr. Mabi used IWM in a research that explored the role of information and identity for African immigrants seeking employment in Metro Vancouver, Canada.

Twenty-five African immigrants were invited to participate in the information world mapping. Nine of them opted not to participate. Participants who agreed to participate were given flip chart sheets and coloured markers and invited to represent their employment information worlds in response to a prompt. The maps served to deepen understanding of the interviews, provided prompts to engage participants further, and provided insights on other data collected as part of the study. There were benefits from the use of IWM with this population, as well as insights about the possible influence of culture, gender role and personality traits on IWM. Thus, I ponder over the following questions: Why might people engage in or opt not to participate in information world mapping?; What aspects of people's culture could influence information world mapping?; Is there a possible impact of multitasking on the quality of IWMs?; How can immigrant mothers be better supported to engage in information world mapping?

Martzoukou: Syrian New Scots' Mapping Across Language Barriers

Dr Konstantina Martzoukou (SFHEA, Ph.D, MSc, MA, ILM 5) is Teaching Excellence Fellow and Course Leader (MSc Information and Library Studies) at the School of Creative and Cultural Business of Robert Gordon University in Scotland. Her research interests encompass information seeking behaviour, information and digital literacy and online learning. Dr. Martzoukou used IWM in the "Syrian new Scots' Information Literacy Way-finding practices" research project, which she co-led with Prof. Simon Burnett. In this study, participants in focus groups were led through the IWM drawing exercise in translation, with prompts drawn from Dervin's (1976) taxonomy of exploring information needs based on describing specific problems as a way of articulating needs.

IWM was found to be a visual participatory, interactive drawing-based interview technique that enabled a richer exploration of information behaviour in context and was particularly useful with participants who did not speak English. IWM in this context acted as both a research tool, an ice-breaker activity, and a way to express predominant feelings and emotional states. IWM was found to be an effective visual communication method to express what could not be easily articulated, acting as a prompt to stimulate participant engagement and interaction and as a device to contextualise and enrich the stories shared by the participants. Participants' drawings acted as stimuli for discussion around everyday life problems/ information needs, information sources & enablers/barriers, communication and sharing of information, cultural integration. They also provided a direct and unobtrusive means of communication between the researcher and the interviewees. While this study did not involve analysis of the visual information from the drawings, it nonetheless raised questions regarding analysis of maps. During the drawing exercise, researchers were unable to steer participants back to the specific direction of the study if they got

sidetracked. As a result, the drawings expressed more than just information related domains, but also participants' affective situations. This caused us to wonder whether this 'lack of control' may be a challenge or an opportunity.

Tsai: Applying IWM in Academic, Health, and Everyday-life Contexts

Dr. Tsai is an Associate Professor of Library and Information Science at National Taiwan University. She obtained her Ph.D. in Library and Information Studies from the University of Wisconsin—Madison. Her research focuses on information behavior, especially how individuals with diverse backgrounds seek information and how individuals collaboratively seek, use, and exchange information to fulfill their learning objectives. Dr. Tsai has been acquainted herself with visual elicitation methods since 2010 and has been using IWM on various projects with different emphases in academic, health, and everyday-life contexts since early 2018. Nearly 60 students participated in IWM research when Tsai traced master's students' thesis writing processes, examined the everyday-life information behavior of Taiwanese international students in Japan, and explored the collaborative information practices of domestic and international students. An additional 197 students in the information behavior course during the last four years also worked on an IWM exercise. Despite several ongoing IWM projects, other IWM participants in her recent works include 17 first-time homebuyers and 17 caregivers of Autism Spectrum Disorder (ASD) children.

In this panel, Dr. Tsai will discuss issues encountered when implementing IWM based on her observations. Almost all participants chose not to do think aloud and preferred a quiet time to draw their IWMs. While many participants had an initial reaction saying that they don't know how to draw, after a few minutes they typically did it well. Prompting with earlier conversation in the interview and breaking down instructions in detail using a storyboard may help facilitate the process. Even when using the same 12-color pens and a blank A4 paper as the research tool, participants may exhibit different characteristics and preferences drawing their IWMs. The time needed and the use of colors and metaphor vary largely among participants. Some contemplated at least 10-15 minutes before drawing while others finished within 10-15 minutes; some preferred single color while others utilized almost all 12 colors provided; some depicted their IWMs using metaphor while others included specific items to present information sources. Quite a few participants relied on using texts and links in their IWMs. Nevertheless, IWM no doubt helps solicit and capture a thorough picture of information practices. Potential ways to accommodate participants and to facilitate the implementation of IWM will be discussed.

CONCLUSION

This panel will raise and discuss tricky questions regarding use of IWM, many of which are transferrable to other arts-involved, participatory, or community-engagement research methods. These questions include: What cultural influences have we observed to date that suggest modifications to implementation of IWM? How does IWM work in group settings, and online? Has the idea that IWM would give participants additional control over their narratives, and potentially reduce linguistic and literacy barriers between researchers and participants borne out in practice? Is the method also useful in data collection with privileged populations? When participants do take control of their IWMs, how do researchers manage the exercise or analysis of maps that took an unexpected direction? Is the unpredictability of the method and time required to include IWM in a study "worth it" in terms of enrichment of data, rapport with participants, or other factors? We expect there will not be one simple answer to any of these questions, given the diversity of researchers, participant populations, topics of study, and settings in which IWM is used; however, we will identify key questions and areas for exploration for the next phase of IWM in information research.

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Social Media, Vaccines, and Partisan Division of Health Information

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ABSTRACT

Vaccine confidence and uptake is essential to achieving herd immunity levels sufficient to end the COVID-19 pandemic; however, polarized and partisan discussion on vaccines have increased the difficulty of achieving sufficient vaccine coverage in the population. As individual's health information seeking behaviors diversify, studies suggest that social media is a major "battle ground" for shaping attitudes toward vaccines. Interdisciplinary experts on vaccine discourse will discuss the information context of the vaccine debate, political influence, and attitudes towards science and vaccines against the backdrop of social media. This panel is expected to contribute to the field of information science by invoking a conversation on social media, an important information communication technology, as a field of study that inter-connects the most current vaccine conversation with theories of partisan behavior of health information and affordance of technology. This panel is sponsored by SIG SM.

KEYWORDS

Social Media; Vaccine; Health Information Behavior; Politics.

INTRODUCTION

Polarized and partisan discussion on vaccines have increased the difficulty of achieving sufficient vaccine uptake to achieve herd immunity against COVID-19 (also called community immunity). Studies suggest that social media is a major "battle ground" for vaccine messaging. Previous studies show that vaccine hesitant parents have complex information-seeking behaviors partially due to their tendency of distrust against traditional information sources of scientific authority (Glanz et al., 2017; Greyson & Bettinger, 2017). More recent studies revealed that social media discourse may have an impact on vaccine attitudes. A recent study suggests that frequent exposure to Twitter topics such as safety concerns and conspiracies of vaccines is associated with lower vaccine uptake (Dunn et al., 2017). And another study found that anti-vaccine groups have been highly active in social media, more so than pro-vaccine actors (Blankenship et al., 2018). Anti-vaccine groups on Facebook are also used as information exchange hubs that allow for easy access to both seek and share vaccine opposed content (Koltai, 2020).

Studies on COVID-19 vaccine acceptance provide evidence of partisanship and vaccine attitudes in several settings. In France, for example, an online survey conducted between March 2020 revealed that political far-right and far-left intended to refuse vaccination against COVID-19 (Peretti-Watel et al., 2020), and another survey result also shows significant difference on vaccine acceptance depending on party affiliation (Talev, 2020). A survey study conducted on April of 2020 on French population by Ward et al., (2020) found that people without clear party affiliation and who did not vote at the last presidential campaign were more likely to plan to refuse the COVID-19 vaccine.

Social media, as a communication platform, is vulnerable to misinformation, information manipulation, and political influence (Smith et al., 2020). Scholars argue that, in social media, the information void created by lack of scientific information is often filled by unreliable information sources such as alternative news outlets (Hagen et al., 2020; Marwick & Lewis, 2017; Persily, 2017; Smith et al., 2020). Furthermore, times of crisis often creates many opportunities for misinformation to develop and spread (Sunstein & Vermeule, 2009; Starbird et al., 2019), which has been especially true during the extended public health crisis of the COVID-19 pandemic.

However, it is not clear *how* and *to what extent* social media plays a role for vaccine attitude considering the complex information-seeking behaviors of the public. Some new studies suggest that politics and political ideology is the rising factors involved with the discussions on COVID-19 vaccine uptake (Broniatowski et al., 2020; Ward et al., 2020).

This panel is an attempt to discuss social media's role on vaccine conversation in the context of complex information behavior of the public during the COVID-19 pandemic. Panelists, therefore, are combination of expertise in social media, vaccine discourse, health information behavior, and political science.

This 90-minute panel session will be used the following way. Each of the four panelists will give a presentation (10 to 15 minutes each) of their research on the selected topic (for about 60 minutes).

Loni Hagen will present her recent research findings on partisan communication patterns, narratives, the most influential actors using COVID-19 vaccine conversation on Twitter. Anti-vaccine sentiment was high among the political right communities. Science and health experts communicated closely with the political left communities and had a great distance from the anti-vaccine and political right communities.

Devon Greyson will provide an introduction to vaccine attitudes and decision-making, including the role of social media as one information source among many in people's lives, and the shift of anti-vaccine social media content over the past decade from libertarian circles on both the left and right to clustering increasingly on the political right and intertwining with right-associated conspiracy networks.

Ashley Fox will present results from a survey experiment and open-ended questionnaire that shows that while accessing news through social media is associated with greater COVID-19 vaccine hesitancy, few hesitant respondents cite mis/dis-information or conspiracy theories as reasons for not intending to vaccinate. Rather, partisan, gender and racial identities are the strongest predictors of vaccine hesitancy even as more hesitant groups vary little in the reasons they provide for not wanting to vaccinate.

Kolina Koltai will present on anti-vaccination narratives promoted in anti-vaccination communities and accounts across multiple social media platforms, including the role of politics as its tie to vaccine policy and mandates. She will also cover the shift in political leaning among the anti-vaccination community from a rather non-partisan community to an increasingly right-leaning one.

For the second half, we will have an interactive discussion session with the audience. The following discussion questions and other follow-up questions will be discussed (for about 30 minutes).

- What, if anything, can be done on a public policy level to limit the sharing of medical mis- and disinformation on social media, and the influence of corporate social media platforms?
- How can we measure the influence of social media as compared with other vaccine information sources in an individual or population's information world?
- If vaccination preferences are fairly fixed and resistant to specific message framing, is coercion through vaccine mandates/passports more effective/justifiable?
- Considering how we have seen how scientific topics like climate change and vaccines become politicized, what can information researchers hope to understand about this phenomenon?

We will use *#asist_sm* to advertise the session throughout the ASIST community and social media prior to the conference and to continue the conversation beyond the session.

DURATION

90 min event.

ATTENDANCE

We expect to draw between 15 and 25 participants. Maximum 30.

PANELISTS

Loni Hagen is an Assistant Professor at the School of Information at the University of South Florida. She received degrees in Law, Information Studies (specialized in Information Law), and earned her PhD in Information Science from University at Albany, SUNY. Her current research interests are in finding novel ways of collecting, extracting useful information from social media data and using them for policy decision-making.

Devon Greyson is Assistant Professor of Health Communication at the University of Massachusetts Amherst. With a research focus on health information practices and population health information interventions, Greyson currently studies vaccine information systems and communication, cannabis decision-making during pregnancy and lactation, and health-related online disinformation efforts.

Ashley Fox is an Associate Professor of Health Policy at Rockefeller College of Public Policy, University at Albany, SUNY. Her research focusses on health politics and policy including understanding the causes of the politicization of disease responses, and the effects of policies and political communication on health outcomes.

Kolina Koltai is a Postdoctoral Fellow at the Center for an Informed Public at the University of Washington in Seattle, Washington. She earned her Ph.D. in Information Studies from the University of Texas at Austin. Her research focus is on studying how sociotechnical systems affect the decision making of social groups when they dissent from the scientific mainstream. She primarily studies this within the context of social media platforms and vaccine dissent.

MODERATOR

Catherine Dumas is an Assistant Professor in the School of Information Science & Technology at Simmons University. She earned her PhD in Information Science from the University at Albany, SUNY. Her research is motivated by data generated by platforms potentially used for online collective action or digital activism. Her most recent project is using artificial intelligence to study user behavior and interactions on next-gen social VR platforms to improve communications.

CONCLUSION

SIG Social Media is planning to host a series of panels to be held at the ASIS&T annual meetings to establish social media as an independent field of information science research. In this inaugural panel session, we will discuss current issues of partisan vaccine discourse with the backdrop of social media informed by interdisciplinary theories and methodologies. The practical implication of the session includes enhancing public communication strategies during health crisis as well as by science communities.

ACKNOWLEDGMENTS

Author 1 gratefully acknowledge the grant from the National Research Foundation of Korea Grant funded by the Korean Government (NRF-2017S1A3A2066084). Author 4 acknowledges funding from the Population Health Initiative at The University of Washington and the Knight Foundation.

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History and Heritage Update

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ABSTRACT

Major new developments in the history and heritage of ASIS&T and of information science generally are presented. First, the progress of the ASIS&T Curator's Working Group's strategic plan for ASIST's knowledge management and for stewardship of its heritage resources will be presented by Deanna Hall, the ASIS&T Curator. Second, the ambitious program of the ASIS&T History Committee to encourage attention to historical work by promoting open access to past publications and the creation of guides to resources will be reported by the Committee chair, Michael Buckland. Third, the emergence of extensive humanities research on information history, newly summarized in new encyclopedic collection *Information: A historical companion* (2021), will be introduced and characterized by Paul Duguid, a contributor and co-editor.

KEYWORDS

Heritage, Humanities, Information history, Information Science, Curator's Working Group.

INTRODUCTION

The conference themes of equity, diversity, inclusion, justice, and relevance will not be reflected in our understanding of our association and of its field without conscientious, systematic, and factual attention to its history and heritage. Three major new developments in the history and heritage of ASIS&T and of information science generally will be presented for members interested in opportunities and methods in access to and the preservation of historical resources.

Substantial collections of materials related to the history and heritage of ASIS&T currently exist in at least two external archives, at the Smithsonian and at the University of Michigan. The ASIS&T office also contains an extensive collection of physical materials including books, reports, records, photographs, and audio and video recordings. Our digital heritage includes resources, often in obsolete formats, that were accessible through legacy websites. Much needs to be done to preserve and create stable access to all of these materials. The panel session will introduce and explain three major new developments.

The ASIS&T Curator acts as a resource for the ASIS&T Board, management, staff, committees, chapters, SIGs, and members to encourage the discovery, preservation, and accessibility of resources relating to our history and heritage. The work of the Curator's Working Group developing a strategic plan for knowledge management and for the stewardship of heritage resources will be presented.

In the recent reorganization the History Committee was made a standing committee with a carefully written charge. The Committee has begun an ambitious long-term initiative to encourage and facilitate both interest and research into the history of ASIS&T and information science generally. This program will be described and also the relationships between the Curator, the History Committee, and SIG HFIS.

Meanwhile, outside of ASIS&T there has been an explosion of research on information history in the humanities which has been summarized in a new encyclopedic collection. An overview of this work will be provided.

STRUCTURE

This moderated panel session will have four parts: Three short presentations followed by a period for question and answer and for comments from participants. This panel session follows the similar, well-received session at the 2020 annual meeting.

The Moderator will be **Robert D. Montoya**, M.F.A., M.L.I.S., Ph.D, Assistant Professor, Department of Information Studies, School of Education & Information Studies, University of California, Los Angeles. He is also Director, California Rare Book School, and also of the Libraries, Justice, & Ethics Lab at UCLA. Prof. Montoya is the current Chair of SIG HFIS.

PANELISTS

Three panelists will speak in the following order:

Deanna Morrow Hall is President, Corporate Information Resources, Inc., Stone Mountain, GA. She is a Canadian chemistry major who immigrated to the USA to accept a position as Associate Editor with Chemical Abstracts Service. There, she discovered the emerging discipline of documentation/information science, and subsequently obtained the MLS from Case Western Reserve University's School of Library Science. The remainder of her career involved managing corporate libraries and departmental records. As ASIS&T Curator she is responsible for:

- monitoring the discovery, preservation, and accessibility of resources relating to the history of ASIS&T, both in the Association's possession and elsewhere, and for making recommendations as appropriate;
- defining integrated information management policies and practices for all of ASIS&T's business units.

Michael K. Buckland is Emeritus Professor, School of Information, University of California, Berkeley. An English librarian who moved to the USA, he has published extensively on the history of documentation and information science, including the early search engine designer Emanuel Goldberg (1881-1970) and other neglected pioneers. Prof. Buckland was a co-founder of SIG HFIS, has served as ASIS President, and received the Watson Davis award for service to ASIS&T. He is currently Chair of the ASIST History Committee.

Paul Duguid, Adjunct Professor, School of Information, University of California, Berkeley, is a co-editor and a contributor to the newly-published collection *Information: A historical companion* (Princeton UP), a 900 page synthesis of humanities research on information history. A specialist in the history of trademarks, he is known as co-author with John Seeley Brown, of *The social life of information* (Harvard Business School, 3rd ed, 2017). Prof. Duguid has for many years taught courses on concepts of information and on information history. Prof Duguid is expected to participate virtually.

PANEL PROGRAM

Robert Montoya, as moderator, will introduce the session and moderate its four components.

Curator's Report. Deanna Morrow Hall, ASIS&T Curator, will describe the ASIS&T Board's charge to the Curator's Working Group, the composition of the Group, its initial response to the charge, and its current status.

History Committee Initiatives, by Michael Buckland, Chair of the History Committee. The History Committee, is now a recognized standing committee with a detailed charge focused on encouraging interest in history. The History Committee's recent significant achievements includes promoting open access as an official value in the new ASIS&T Strategic Plan. Also, most ASIS&T past publications, including volumes of the *Annual review of information science and technology*, have been made openly accessible on the HathiTrust platform www.hathitrust.org. A worldwide register of oral history recordings relevant to the history of information science is in preparation. A variety of resource guides to encourage and to facilitate historical work are planned. Software has been identified for the future presentation of heritage resources and a short history of ASIS&T is in preparation for our 85th anniversary in 2022.

Humanities Research in Information History, by Paul Duguid (Univ of California, Berkeley). There has been an explosion of research in the humanities on the history of information in recent years which has remained little known in the information science community. Professor Duguid will introduce and characterize aspects of this large, important, and growing body of work, much of which has been summarized in a new 900 page encyclopedic handbook of which he was co-editor: *Information: a historical companion* (Princeton University Press, 2021). Prof. Duguid is expected to participate virtually.

Question and answer. At least a quarter of the session will be reserved for an interactive period of moderated question and answer and for comments from the audience.

CONCLUSION

Three important new developments will have been introduced and explained, along with a clarification of the respective roles of the Curator, the History Committee, and SIG HFIS. The panel session is related to the following designated conference topic: Archives, data curation and preservation; Information Theory; and Library and Information Science. This panel session supports ASIS&T Strategic Plan Objective 3.5: Document and share the history of ASIS&T and reports on Tactic 3.5.3: Establish a task force, composed of individuals with experience in archives and records management, to create records management and archival policies for the Association by 2021.

SPONSORS

Sponsored by SIG HFIS. Co-sponsored by SIG STL.

Welcome to Information Science

Sponsored by SIG-HFIS

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ABSTRACT

This panel engages conference attendees in the history and foundations of information science and provides an opportunity to reflect upon our field's current and future identity(s). It enacts the following scenario: At an orientation event for an information science program a spokesperson gives incoming students a brief address on the theme, "Welcome to information science." Six imaginative but authentic versions of that talk are offered here. To showcase the variety of approaches to information science across the past century, each disquisition is inspired by the work of one luminary, namely: Paul Otlet, S. R. Ranganathan, Jesse H. Shera, Elfreda Chatman, and Marcia J. Bates. In an effort to encourage a more spacious information science, an indigenous perspective on ways of knowing is also included. Attendees to this session will time-travel across almost 100 years of information science history and ultimately rest in the reality of a multi-perspective discipline.

KEYWORDS

Information science, intellectual history, disciplinary identity(s), indigenous ways of knowing.

INTRODUCTION

Information science programs are growing by leaps and bounds (ALISE, 2020). Each year we indoctrinate hundreds of new students during the application process, at orientation events, and when courses begin. At the Faculty of Information, University of Toronto, our first contact with initiates is at an open house called "Information Day." There, the Dean provides a sweeping statement on "information" that changes year-to-year and is often linked to current events. Next, individual Faculty members deliver two-minute profiles of eight narrower specialties, such as library and information science, knowledge and information management, or information systems and design, among others.

Most of us attending the ASIS&T Annual Meeting have at some point served in the capacity of our field's ambassadors and welcomed a next generation into the fold. To do so, we draw upon a combination of personal predilections, metatheoretical commitments, and institutional traditions. This practice, which socially constructs and reconstructs our discipline over the years, has gone mostly unconsidered. As an exception, a paper in the *Journal of Education for Library and Information Science* (and the companion website at <https://welcometolis.weebly.com/>) entitled "Welcome to Library and Information Science" (Hartel, 2012) imagines three welcome statements inspired by landmark works of Jesse H. Shera, Howard D. White, and Marcia J. Bates. The opening words of these addresses appear in Figure 1.

The collaboration at hand revisits and extends the premise of that paper, adjusts the focus to *information science*, and features "Welcome to information science" expositions drawn from the work of six scholars, who view information science from multiple perspectives. Overall, the panel asks attendees of the 2021 ASIS&T Annual Meeting to consider: *How do we welcome newcomers to the field? And what are the implications of these mostly ad hoc pronouncements on our research, teaching, and collective identity?*



Figure 1. “Welcome to library and information science...” statements as imagined in Hartel (2012)

WELCOME!

To *welcome* means to greet someone who is arriving in a polite or friendly way. From the perspective of interactionist studies of microsociology, it is an “introductory greeting behavior” (Astrom, 1994) and includes elements of verbal as well as nonverbal communication. Putting aside what is said, greetings are situated, embodied, and involve kinesics (body movements), proxemics (position in space), haptics (touches), vocalics (paralinguistic expressions) and turn-taking (Baesler & Burgoon, 1987). However, the welcome that is given to incoming graduate students is not so intimate. It more closely resembles what organizational science calls “on-boarding,” a step of “human capital management” for newly hired employees, which is implemented with an eye to their rapid productivity. While on-boarding does not map perfectly to the academic situation, the literature offers a helpful three-level welcoming framework (Cesario & Chambel, 2019). The first level (which is the only one of interest here) is a “corporate welcome” that conveys the *history, structure, mission, vision, core values* and *ethics code* of an enterprise. These six elements encapsulate important and defining tenets of a discipline and will be touchstones for the “Welcome to information science” statements on this panel.

THE PROCESS OF DESIGNING THE PANEL

This panel was designed through a two-step process. First, we chose the *source information scientist* whose landmark contribution marks a particular sensibility and moment in information science history. Second, we enlisted a *presenter* and *expert* who will draw from the source to synthesize and then voice a “Welcome to information science” statement at the Annual Meeting.

Selecting source information scientists

For the first step, SIG-HFIS leadership considered sources from across the past century, and favored “foundational” information scientists with substantial publication records and high citation counts. It was desirable, though not necessary, for a source scholar to have written and published about information science *as a field*. In keeping with our values and the theme of the Annual Meeting—Equity, Diversity, Inclusion, Justice, and Relevance—we sought sources from multiple perspectives within the information science literature. Ultimately, as the source information scientists, we selected:

- **Paul Otlet** (1968 – 1944), Belgian bibliographer, lawyer, and peace activist considered a founder of the European documentation movement, which evolved into information science. His Mundaneum project sought to create a universal repository of all the world’s recorded knowledge and his related writings on information science anticipated today’s networked and hyperlinked information environment.
- **S. R. Ranganathan** (1892 – 1972), Indian librarian and educator who is seen as the father of library science in India and whose contributions had worldwide influence. His *Five Laws of Library Science* was the first textbook of its kind and contains fundamentals that remain relevant today.
- **Jesse H. Shera** (1903 – 1982), American librarian and information scientist, who pioneered the use of information technology in libraries. With his collaborator, Margaret Egan, he sought to articulate a cogent theoretical foundation for library and information science, called social epistemology.
- **Elfreda Chatman** (1942 – 2002), American scholar of library and information science, known for pioneering ethnographic research into information seeking behaviors among understudied or minority groups. Her work resulted in widely cited, middle-range theories of information poverty, life in round, normative behavior and small worlds, among others.
- **Marcia J. Bates** (b. 1942—), American information scientist and leading authority on information search, human-centered design of information systems, and information practices. She edited the 2010 *Encyclopedia of Library and Information Sciences*, 3rd edition and is one of the most highly cited authors in information science.

Upon finalizing the roster, above, we mitigated an inescapable feeling that important voices were missing by committing to future iterations of this panel, which would include more and varied perspectives over time. Furthermore, at the 2021 event we intend to ask the audience to recognize and contribute missing views.

Selecting presenter/experts

A second step was to enlist scholars within the ASIS&T community to present at the session. This required an individual with expertise in the work of a source information scientist, an interest in composing the welcome address, and a willingness to deliver it at the Annual Meeting. For this contribution, we sought diversity, in particular, members of QTBIPOC communities. In one instance, the source scholar, Marcia J. Bates, remains active in the field and so we happily collapsed the two roles. At the time of publishing the proceedings, the panel seat for Paul Otlet remains unfilled; other panelists (*and their source scholars*) are listed below.

- **Vishma Bhattarai** (*S. R. Ranganathan*) is librarian at Enoch Pratt Free Library, in Baltimore, Maryland. He has library degrees from Tribhuvan University, Kathmandu and Catholic University, USA, as well as a Master’s degree in Religion and Society from Liverpool Hope University, England. Mr. Bhattarai has been engaged in a comparative analysis, at the institutional level, of various international libraries to counterparts in Nepal, thereby building bridges between these communities. Mr. Bhattarai has spent years studying the work of S. R. Ranganathan and was the first to translate Ranganathan’s biography into Nepali.
- **Patrick Keilty** (*Jesse Shera*) is Associate Professor in the Faculty of Information and Centre for Sexual Diversity Studies at the University of Toronto. He is the editor of *Queer Data and Feminist and Queer Information Studies Reader*. His writing has appeared in *Feminist Media Studies*, *Porn Studies*, *Catalyst: Feminism, Theory, Technoscience*, *The Information Society*, *Journal of Documentation*, *Scholar & Feminist Online*, *Library Trends*, *Knowledge Organization*, and elsewhere. He has written about the politics of the sex industries, embodiment and technology, data science, the history of information retrieval, design and experience, graphic design, temporality, and sexual taxonomies.
- **LaVerne Gray** (*Elfreda Chatman*) is Assistant Professor at Syracuse University’s School of Information Studies. Her award-winning dissertation, “In a Collective Voice: Uncovering the Black Feminist Information Community of Activist-Mothers in Chicago Public Housing, 1955-1970,” was inspired by her grandmother and the community of women working for betterment in Chicago Public Housing. Her theoretical development and qualitative analysis approaches extends Elfreda Chatman’s informational inquiry into marginal community spaces. Her Black Feminist Information Community (BFIC) model blends the historical, cultural, and gendered complexities of informational environments. Her work has appeared in *Library Quarterly* and has numerous forthcoming articles in *JELIS*, *International Journal of Information*,

Diversity and Inclusion, and *Journal of Critical Library and Information Studies*. Dr. Gray's research is at the intersection of Black feminism, information justice, and memory work.

- **Marcia J. Bates** (*Marcia J. Bates*), as already profiled above, will deliver her own “Welcome to information science” statement.

Indigenous ways of knowing

If our source scholars were drawn *only* from what is conventionally seen as falling within the information science literature and field, we would create a backward rather than forward-looking conversation. For this reason, we embraced other relevant and timely ideas. To be specific, information science shares some purposes with indigenous epistemologies. A complex term that defies simple definition, *indigenous knowledge* or *indigenous ways of knowing* refer to, “...a network of knowledges, beliefs, and traditions intended to preserve, communicate, and contextualize Indigenous relationships with culture and landscape over time” (Bruchac, 2014). The field of information science is right now learning how to recognize and integrate indigenous epistemologies (Nataka, Byrne, Nataka, & Gardiner, 2005). By including a scholar versed in indigenous ways of knowing onto the panel, we give all ASIS&T delegates an opportunity to imagine a more spacious information science that takes stock of its past with a gaze firmly set onto its future. The panelist versed in indigenous ways of knowing will be confirmed nearer to the date of this panel.

MODERATOR

The panel's moderator will be **Jenna Hartel**, who is versed in the intellectual history of information science. She will provide introductions to the source scholars and their representatives on the panel and host the discussion period. Dr. Hartel is an Associate Professor at the Faculty of Information, University of Toronto. She is a long-time ASIS&T/SIG-HFIS member; a winner of the 2016 ALISE Excellence in Teaching Award; and the author of the paper “Welcome to Library and Information Science” that motivated this panel.

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Documenting Information Processes and Practices: Paradata, Provenance Metadata, Life-Cycles and Pipelines

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ABSTRACT

Processes and practices—and in general, informational doings and their diverse constellations—are pertinent elements of the information landscape. This panel presents research on documentation and description of processes and practices in the information field addressing: 1) how different conceptualisations of processes and practices influence how they emerge as describable entities; 2) what different approaches to document and describe processes and practices exist and have been proposed in information science and technology research; 3) what aspects of processes and practices different documentation approaches capture, make visible and invisible; and 4) what novel insights from the current state-of-the-art research can be drawn to support practitioners in different areas of the information field, including knowledge organisation, information management, information literacy instruction, and development of information systems and services.

KEYWORDS

pipelines; processes; practices; paradata; provenance metadata.

INTRODUCTION

Processes and practices are pertinent elements of the information landscape and thus of interest across the broad information science and technology field. Besides functioning as sites where information interactions occur, information work takes place and the information itself—understood as broadly and diversely as it is conventionally approached in the information field—happens, they are undertakings that need to be documented in order to understand the nature of their related information and how information unfolds in practice. Besides, a comprehensive understanding of information and processes is a key to enhancing their equity, diversity, inclusion and relevance. Descriptions of such informational doings have been conceptualised, for instance, in terms of workflows, process and life-cycle models, provenance and process metadata, and recently, also as paradata in different areas of the information science and technology field. Even if there is obvious overlap between process- and practice-oriented perspectives and approaches and a comprehensive understanding of informational undertakings has been acknowledged as a key premise of useful and manageable information, so far there has been surprisingly little exchange between the research traditions.

Panel members will present research conceptualizing, documenting, and describing processes and practices in the information field specifically addressing: 1) how different conceptualisations of processes and practices influence how they emerge as describable entities; 2) what different approaches to document and describe processes and practices exist and have been proposed in information science and technology research; 3) what aspects of processes and practices different documentation approaches capture, make visible and invisible; and 4) what novel insights from the current state-of-the-art research can be drawn to support practitioners in different areas of the information field, including knowledge organisation, information management, information literacy instruction, and development of information systems and services. The panelists are information science researchers who have conducted empirical research and concept development relating to different aspects of documenting processes and practices in diverse contexts ranging from archival research and game studies to archaeological and scientific information.

DOCUMENTING PROCESSES AND PRACTICES: ON OVERVIEW

A glance at the literature shows that the issue of documenting and describing processes and practices has been discussed in different parts of the information science and technology field from diverse perspectives and covering such a variety of contexts from scientific (Leipzig et al., 2020; Thomer et al., 2018) and scholarly information (Huvila, 2020; Trace & Karadkar, 2017) to workplace studies (Trace, 2011), game heritage (Prax et al., 2019), digital preservation (e.g. Mayer et al., 2013a) and curation (Chao, 2014), and archives and records management (Trace, 2020). In spite of the varied contexts and perspectives, it is possible to identify certain trends. A part of the literature emphasises an explanatory and often prescriptive, structured modelling-oriented approach whereas others stress descriptions and documentation as means to provide a contextualised understanding of processes and practices. The explanatory work appears to be to a certain extent more inclined to focus on processes whereas the latter is perhaps more inclined to use practices and related concepts to refer to the undertakings they describe. The different strands of work do also seem to demonstrate somewhat different disciplinary influences. Explanatory research is more often stemming from knowledge organisation and information-modelling (e.g., Greenberg et al., 2021; Leipzig et al., 2020; Mayer et al., 2013b) background whereas in descriptive research it is possible to trace influences of heritage studies, anthropology and science and technology studies (e.g. Huvila, 2020; Sköld, 2015; Trace & Karadkar, 2017). In practice, however, the division between the two principled approaches and conceptual spheres is not watertight. Modelling can be done for descriptive purposes and schemes for retroactive documentation often have normative and prescriptive ambitions to steer information work. In parallel, it is possible to see that different parts of the information science and technology field conceptualise the documentation and description of processes and practices in somewhat diverging, although at the same time, often overlapping terms. The same applies to what is being documented i.e. whether processes and practices are considered as, for instance, professional or scholarly practices or processes.

A key concept pertaining to the documentation of processes and practices alike is the archival studies notion of provenance that lacks a consistent definition but in broad terms, is used to refer to the creator, records, and custodial history of archival records (Tognoli & Guimarães, 2019). Preserving the integrity of archival records and an understanding of their history requires that provenance, their original order and the *fonds*, or the original body, of records are respected and maintained intact throughout their chain of custody (Douglas, 2010). In practice, however, the complexity of the processes pertaining to archival information means that the order and contexts in which records are created and used change and it is often close to impossible to determine and maintain them in an 'original' order that would cover their custodial history as a whole. Therefore, it is often necessary to produce explicit descriptions to complement what information and its organisation tell about its custodial, or in broader terms, processual history.

Descriptions of the processual history of information and generally, information processes and practices, have many names and come in different forms. Data preservation literature refers often to the umbrella term provenance metadata to refer to structured and unstructured documentation of (data) provenance. Provenance metadata is an element in several metadata standards even if different standards tend to conceptualise the notion of provenance in somewhat diverging terms and focus on, for instance, custodial activities or provenance history of information (Bountouri, 2017). In addition, there are also specific schemes for provenance metadata including PROV Ontology (Moreau & Groth, 2013) and Open Provenance Model (Moreau et al., 2008). A related concept of paradata (roughly, data on data-related processes and practices, see e.g. Couper, 2000 versus metadata that describes data; Pomerantz, 2015) has gained prominence especially in survey research (Goodwin et al., 2017) and cultural heritage visualisation communities (Bentkowska-Kafel & Denard, 2012), and more recently, for instance, in archaeology (e.g. Huvila et al., 2021). A key aspect of both provenance metadata and paradata, underlined in the recent literature (e.g. Huvila et al., 2021; Michetti, 2017; Sköld, 2017), is that they can take many different forms and be embedded in the data itself—especially when the perspective to information-related processes and practices is extended beyond interactions pertaining to specific technical information objects to their broader stakeholder contexts.

Besides provenance metadata and paradata that are often oriented towards providing curatorial descriptions for conveying understanding of information processes, artefacts, and their contexts, there are parallel approaches to documentation and description of information work and practices that are explicitly geared towards reproducibility of processes. Systems engineering and management literature refers to lifecycle documentation to describe documentation of information, events, and activities in the course of the lifecycle of a system or service. In critical operational settings such as the energy and aviation industries, keeping a meticulously structured logbook is a crucial safety measure (Schmidt & van Hoof, 2012). Significant progress has also been made in computational semantic labeling of data (e.g., Greenberg et al., 2021; Zhao et al., 2020). In the context of data-intensive scientific work, calls for reproducibility of research and the reusability of research data have contributed to a comparable interest in formalising the documentation of work procedures. Digital preservation research has emphasised the need

to preserve complete computer systems through meticulous documentation of the technical system and its use (Mayer et al., 2013a) together with its social, including for instance, legal context (Mayer, et al., 2013b). Several different conceptualisations of procedures and their representations exist. A part of the literature refers to process curation (Rauber, 2012) or preservation of processes (Mayer, et al., 2013a) understood as consisting of the collection, pre-processing and use of data. Pipelines refer to a series of computational transformations performed on data. The largely synonymous term (scientific) workflows are used sometimes in a somewhat broader sense to also cover non-automated aspects of processes (Leipzig et al., 2020). In contrast to sciences, non-computational scholarly research generally lacks an equivalent to scientific workflows and pipelines. Proposed models for scholarly workflows exist (e.g. Antonijevic & Cahoy, 2018; Chiquet, 2020) but due to the practical and epistemological conditions of research in scholarly disciplines, it is possible that for instance argumentation (Stead & Doerr, 2015; Vatanen, 2004), process-modeling (Thomer et al., 2018) or events-based (D'Andrea & Fernie, 2013) approaches may end up being more applicable to milieus with high epistemic variety such as scholarly work but also in other comparably heterogeneous contexts such as everyday-life information processes and practices. It is conspicuous that descriptions differ not only in how they describe doings but also in how specific descriptions are useful in different contexts and what aspects of doings they document.

Independent of the contexts and means of documenting and describing processes and practices, the different approaches share common challenges. Many of them are well-documented, for instance, in earlier knowledge organisation and information behaviour research (e.g. Greenberg et al., 2021; Huvila, 2020; Sköld, 2017; Thomer et al., 2018; Trace, 2020), others in the work stemming from science and technology studies (STS) and in the growing body of information science research that combines information and STS perspectives (e.g. Borgman et al., 2015; Borgman et al., 2019; Gregory et al., 2020; Huvila, 2016; Huvila et al., 2021). As a whole, it is, however, apparent that there is room for a higher degree of cross-fertilisation. Processes and practices are complex and often difficult to distinguish and demarcate from the settings in which they are carried out—and sometimes from each other. Consequently, a description is in practice always a simplification and it either may or may not represent the original process or set of practices in adequate detail. Similarly, it is difficult to determine what type and amount of information would be enough for different purposes, especially ones that are not known in advance. Understanding different types of descriptions requires different competences and literacies. Further, while simple flat descriptions can be relatively easy to assemble, a comprehensive understanding of processes and practices often requires rich documentation that can be arduous and expensive to produce.

LAYOUT OF THE PANEL

The panel starts with a presentation by the moderator (IH) that introduces documentation and description of information processes and practices as a topic of research and practice and briefly introduces central concepts of the field. After the 10 min introduction, all panellists give a 5-minute lightning talk of their work relating to documentation and description of information processes and practices with a specific focus on its theoretical and empirical insights and implications to their area of information science and technology research and practice. After the lightning talks, each of the panellists presents a short commentary on their colleagues' presentations with a focus on pointing out commonalities and differences in the approaches and the relationship of their different takes on documentation of processes and practices. After the commentaries, the panellists give short, one-minute reflections of how they would push the state-of-the-art of research on documentation of processes and practices on the basis of their experience. During the final 30 minutes of the panel, the audience is asked to join the discussion with panellists. The discussion is led by the moderator and facilitated by a set of questions based on the panellists' presentations. The panel closes with an invitation from the moderator to contribute to the discussion started at the panel and a round of proposals and ideas for future work in the field from the panellists and the audience.

The presentations combine two parallel approaches to engage with the research on documenting and describing processes and practices. All presentations explicate how processes and practices are conceptualised in five different contexts across the information field, how these different understandings coincide and diverge, and what implications it has on their describability and documentability. At the same time, all presentations engage with the question of different means of documenting and describing practices and what they imply for their usefulness in different contexts and for different purposes. By bringing these two parallel perspectives together, the panel explicates the disciplinary nexus of documenting information processes and practices and its implications to related different areas of the information field, including archival studies, knowledge organisation, game studies, research data and information management. Further, the panel delves into the practical and theoretical implications of different approaches to documenting information processes and practices.

PANELISTS AND THEIR CONTRIBUTIONS

Isto Huvila, Uppsala University

Isto Huvila presents empirical findings of his research on how archaeologists document their information making in archaeological field reports. The presentation draws on an ongoing empirical research project on archaeological

paradata and documentation of information making and manipulation practices in archaeology. Huvila shows the diversity of ways and means of how information making becomes explicitly and implicitly documented in report-writing and how the functionality of specific types of paradata can be explained in terms of their epistemic distance to the situations where they are taken into use. The findings call into question simplistic ideas of paradata as straightforward acontextual descriptors and suggest ways forward for resource description research and practice.

Professor Isto Huvila holds the chair in information studies at the Department of ALM (Archival Studies, Library and Information Science and Museums and Cultural Heritage Studies) at Uppsala University in Sweden. His primary areas of research include information and knowledge management, information work, knowledge organization, documentation, and social and participatory information practices.

Xintong Zhao and Jane Greenberg, Metadata Research Center, Drexel University

Xintong Zhao and Jane Greenberg will present collaborative work on how materials science literature documents key processing methods. This embedded knowledge, along with the names and properties of materials, capture the process of materials discovery. Knowledge extraction work, analyzing these processes and associated properties of materials provide data for the development of ontological knowledge systems. The presentation will report on empirical results, and how this work can assist with further computational research. Current efforts have implications for the development of neural networks and automatic processes sharing knowledge and workflows.

Xintong Zhao (Doctoral candidate) and Jane Greenberg (Alice B. Kroeger Professor and Director of the Metadata Research Center) are both at the College of Computing & Informatics, Drexel University. Zhao's research interests focus on knowledge discovery, information extraction and natural language processing, and Greenberg's on metadata, big metadata, knowledge organization and extraction, ontologies, linked data, and data science.

Olle Sköld, Uppsala University

Olle Sköld's contribution consists of delving into the social micro-processes of information creation in the serious-leisure setting of videogame play. Videogames and videogame play comprise a presently very impactful domain of cultural production that is only fractionally understood, explored, and theorized from the viewpoints of information and archival science. Sköld reports on empirical research of information creation in two online videogame communities active in distinct videogame and social-media software environments. The findings offer insights into how online videogame communities create and document information and how these processes are interlinked with videogame lifecycles, community self-management practices, and software affordances. Sköld's presentation also discusses proven (practices) and promising (paradata) conceptualizations of information-creation processes in the videogame domain and outlines their implications for and varying usabilities in SSH scholarship and ALM institutions invested in the curation and dissemination of videogames and videogame documentation.

Olle Sköld is an assistant professor at the Department of ALM at Uppsala University in Sweden and a researcher in the CAPTURE (ERC 818210) and Labour's Memory projects (RJ IN20-0040). Sköld's research is characterized by an extensive focus exploring matters of documentation and preservation in the videogame domain and by a broad interest in the GLAM field, digital humanities, and knowledge production.

Andrea Thomer, University of Michigan

Andrea Thomer reflects on work studying data practices in the natural sciences, and the many ways that provenance is captured (and sometimes, is not captured) at these sites. While traditional modes of documenting the broader context of data collection like field notes are still important, there's a growing need for more computationally-friendly modes of capturing and sharing these chains of provenance. Thomer will particularly discuss a) the challenges of translating qualitative field notes into semantic data, and b) the need to infer provenance in long-lived natural science databases.

Andrea Thomer is an assistant professor at the University of Michigan School of Information. She conducts research in the areas of long-term data curation and knowledge infrastructure sustainability; database curation; integrative data reuse; and the collaborative use and curation of natural science data.

Ciaran B. Trace, The University of Texas at Austin

Ciaran B. Trace presents findings of her research on how cultural heritage professionals document their work to stabilize and inscribe context for the documentary evidence under their care. The presentation draws on current and extant research projects on provenance metadata and documentation of the information processing that lies at the heart of archival practice. Trace shows the way information contextualization is documented in physical and intellectual manifestations of processed collections and how diverse types of provenance metadata demonstrates shifting understandings of what it means to anchor collections to contexts both originary and emerging. The findings seek to create connections among disciplines for whom mapping and documenting information lineage is a central concern.

Ciaran B. Trace is an associate professor at the School of Information at The University of Texas at Austin where she serves as co-editor of the journal *Information & Culture*. Her primary areas of study include knowledge and research infrastructures, theories of information and information work, personal and disciplinary information practices, and materiality in the digital age.

ACKNOWLEDGEMENTS

This work has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme grant agreement No 818210 as a part of the project CApturing Paradata for documenting data creation and Use for the REsearch of the future (CAPTURE).

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Data Discovery and Reuse in Data Service Practices: A Global Perspective

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ABSTRACT

The proposed panel will address the issues of the discovery and reuse of publicly available data on the web in the context of data service practices from a global perspective. Thousands of data discovery services have appeared around the world since the promotion of ‘open science’, reproducible research, and the FAIR (Findable, Accessible, Interoperable and Reusable) data principles in the research sector. However, there is also increasing demand for transparency of search algorithms, and in the design, development, evaluation, and deployment of current data search services; this requires a better understanding of how users approach data discovery and interact with data in search settings. From a global perspective, we will identify and discuss the specific system design issues in data discovery and reuse, drawing on our organization of the NTCIR (NII Testbeds and Community for Information access Research) project of Data Search track, the design and evaluation of the data discovery service of the Australian Research Data Commons (ARDC), and studies examining researchers’ practices of data discovery and reuse.

Keywords: Data discovery; Research data management; Data repositories; User interfaces.

INTRODUCTION

In the context of increasing demand for transparency and accountability of research practices, the open data agenda and their associated issues of data discovery and reuse have received much attention in recent years. Research funding agencies have encouraged researchers to deposit their data in publicly accessible repositories whenever possible (ARC, 2017; ERC, 2017; NIH, 2020; OECD, 2020). One of the FAIR (Findable, Accessible, Interoperable, and Reusable) data principles suggests that (meta)data be registered or indexed in a searchable resource (Wilkinson et al., 2016). However, from the perspectives of information science, with particular references to the organization of information and information retrieval, there remain important research issues concerning the design, development, evaluation, and deployment of current data search services via metadata repositories.

For example, a recent survey of data service practices has revealed some important system design issues, such as the metadata elements indexed, search results ranking models, and system evaluation methods (Khalsa et al., 2018). The importance of metadata and portal functionalities has been identified in user requirements and recommendations for data repositories (Wu et al., 2019). Borgman et al. (2021) reflect on research data management practices from a long-term research project across domains. Löffler et al. (2021) indicate the inadequacy of domain-independent metadata in a dataset retrieval system for domain experts in biodiversity research.

From user perspectives, research has revealed the similarities and differences between dataset search and document retrieval (Kern & Mathiak, 2015; Megler & Maier, 2015), and recognized that locating data for reuse in research is challenging for many (Gregory et al., 2020). Specifically, data discovery and reuse are purpose-driven activities, characterized by a variety of data needs and discovery strategies (Gregory et al., 2020b) that are interwoven with processes of sensemaking (Koesten et al., 2020). From a system design perspective, data search systems have been designed to retrieve relevant datasets or find answers from datasets to a search question (Kato et al., 2020). Research has focused on the adoption of AI (Artificial Intelligence) approaches to find datasets in publications (Lane, Mulvany, & Nathan, 2020) and the availability of benchmarks for system evaluation (Chapman et al., 2020). Yet the

intended users of data search services have not been well-supported for complex search tasks, and their needs often remain under-studied.

This panel brings together information science researchers and practitioners internationally to flesh out the research issues concerning the design of data search systems. Panelists have established their research programs in user- and system-oriented information/data retrieval, organization of information, as well as practical experiences in academic libraries and national data services. Specifically, this panel aims to address the following questions:

- 1) What is the role of metadata schemas and elements in current data search repositories?
- 2) How do we capture the contexts of data search for designing user interfaces?
- 3) How can we understand and support the complex and diverse needs of data user communities?
- 4) How can we build robust data search systems through benchmarking?
- 5) What are the barriers to data discovery and reuse from institutional perspectives?

The 90-minute panel is composed of an overview of the research issues associated with open research data (10 minutes), followed by a 15-minute presentation by four panelists addressing the proposed questions. Participants will have the opportunity to contribute to the discussions at the Q&A session.

Panelists and their Contributions

Ying-Hsang Liu, Ph.D. is a senior researcher at the Department of Archivistics, Library and Information Science, Oslo Metropolitan University in Norway. His research program lies at the intersections of information retrieval, knowledge organization, and human information behavior. It has focused on the design of interactive information technologies, with a particular emphasis on user perceptions and individual differences and the relationship between visual search and user search behavior. He will provide an overview of the research issues concerning data discovery and reuse and moderate the panel.

Hsin-Liang (Oliver) Chen, Ph.D. is Dean of the Library, Missouri University of Science and Technology. His research interests focus on the application of information and communication technologies (ICTs) to assist users in accessing and using the information in different environments. Dr. Chen will discuss barriers in terms of discovery functions and metadata elements adopted by the members of Dataverse, a global research data management project. The available search functions have a direct impact on users' search behaviors when the metadata elements and descriptions may influence the discoverability of the datasets.

Makoto P. Kato, Ph.D. is an associate professor at the Faculty of Library, Information and Media Science, the University of Tsukuba in Japan. His research interests include information retrieval, web mining, and machine learning, and is concerned with information retrieval system design by eliciting information needs from users, using sensors, brain signals, and mouse clicks for personalization. He is the organizer of the NTCIR Data Search track (<https://ntcir.datasearch.jp>), a shared task on ad-hoc retrieval for governmental statistical data. He will discuss the findings from the NTCIR initiative and plans for the next round of evaluation.

Mingfang Wu, Ph.D. is a senior research data specialist at the Australian Research Data Commons (ARDC). She has researched the areas of question-answering, interactive information retrieval, interfaces supporting exploratory search, and enterprise search. Her recent research focuses on the data discovery paradigms as part of the Research Data Alliance (RDA) initiative and for improving the data discovery service of the Australian national research data catalog. As an experienced information retrieval researcher and practitioner of data management, she will share the findings from a user study of capturing search contexts in data repositories and her reflections on the barriers to effective data search from institutional perspectives.

Kathleen Gregory, Ph.D. is a postdoctoral research fellow at the Scholarly Communications Lab at the University of Ottawa in Canada and a guest research fellow at Data Archiving and Networked Services (DANS) in the Netherlands. Her research program is concerned with how research data are communicated, understood, and used in academic and public spheres. Her current project focuses on data citation practices, which builds on her doctoral work which investigated data discovery and reuse in the context of informing the development of data search systems. She will draw on findings from four years of research to reflect on the use and users of both data and data discovery services and to consider applications for systems design.

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Search a Great Leveler? Ensuring More Equitable Information Acquisition

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ABSTRACT

The ubiquitous search box promised to democratize knowledge access by making information universally accessible. But while many search engines cater well for certain user groups, information tasks and content types, they cater poorly for others. Poorly-served users include those with certain types of impairment (e.g. dyslexia), and weakly-supported tasks include highly exploratory goals, where it can be difficult to express information needed as a query. Furthermore, the overdominance of search functionality in many information environments has restricted support for other important forms of information acquisition, such as serendipitous information encountering and creative ‘inspiration hunting.’ Search results and recommendations can also promote certain types of content due to algorithmic bias. Rather than act as a great leveler by making information acquisition effective, efficient and enjoyable for all, search engines often unfairly favor some types of user, task or content over others. In short, search is not always equitable. This panel discussion will elucidate the inequity of search as an information acquisition paradigm from multiple perspectives and propose design principles to ensure more equitable information acquisition.

KEYWORDS

Information equity, information acquisition, search, design

PANEL MOTIVATION

The ubiquitous search box promised to democratize knowledge access by making information universally accessible. While early research focused on the ability of certain groups to gain access to information on the Web; the ‘digital divide’ (DiMaggio & Hargittai, 2001), researchers promptly identified the issue of information inequity. For example, it has been argued digital technologies “*have helped to exacerbate existing differences in information access and use, and may even have fostered new types of barriers*” (Lievrouw & Farb, 2003, p.499). This applies especially to search technologies; although mainstream search engines cater well for certain user groups, information tasks and content types, they cater poorly for others. For example, users with cognitive or communication impairments (Kerkmann & Lewandowski, 2012; MacFarlane et al., 2012), or lower education levels obtain inferior results (Hargittai, 2006). Similarly, highly exploratory tasks (where it can be difficult to express information needed in the form of a query) are not as well-supported as targeted forms of search, e.g. known-item search or fact-checking (Rose & Levinson, 2004).

This argument extends to search more generally, as a paradigm for information acquisition: search works better in and is therefore better suited to some situations than others (Martin & Quan-Haase, 2017). Most notably, search is better suited to information tasks where the expected format of the information is known (e.g. weather forecasts, a particular scholarly paper, news on a certain topic). The challenge of finding ‘unknown unknowns’—where a person does not know what they hope to find was highlighted by Borgman (1996): Information retrieval is difficult to facilitate because it requires describing information you do not yet have. It is also known that requiring users to search for information disadvantages those with less knowledge of a field (Marchionini, 1997) and that marginalized groups prefer people to internet as information sources for reasons of convenience and access (Agosto & Hughes-Hassell, 2005).

Despite search being better suited to certain situations, there has been much research focus on search as compared with other important forms of information acquisition (Baeza-Yates & Ribeiro-Neto, 2011). Also the overdominance of search functionality in many information environments has restricted support for other important forms of information acquisition, such as serendipitous information encountering (Erdelez & Makri, 2020) and creative ‘inspiration hunting.’ (McKay et al., 2020). Furthermore, search results and recommendations has also been found to unfairly favor some types of content due to algorithmic bias (Lewandowski, 2017; Ferraro et al., 2021).

Rather than acting as a great leveler by making information acquisition effective, efficient and enjoyable for all, search is not always equitable (Lewandowski, 2017). We frame this issue as *inequity* rather than inequality as it extends beyond unequal information distribution; it involves *unfairly favoring some types of user, task or content over others*. We consider this favoring not only unequal, but also *unfair* and therefore *inequitable*. It has also been argued that equity is more attainable than ‘equal’ information distribution, making it a suitable framing (Lievrouw & Farb, 2003).

This panel will elucidate the inequity of search as an information acquisition paradigm from multiple user group, task and content perspectives. The nine diverse panelists will bring a range of viewpoints on the limitations of contemporary search technologies. Some will focus on specific user groups, others on specific information task types and others on biases for and against specific types of content. All will present arguments, based on their own research, centered on how and why search unfairly favors some types of users, tasks or content types. As well as highlighting inequity, the discussion will also take steps towards ensuring more equitable information acquisition by proposing design principles aimed at reducing information inequity in search and digital information environments more broadly.

We now outline the positions of each panelist. Each position aims to elucidate the inequity of search as an information acquisition paradigm by explaining how and why search is inequitable for particular types of user, task or content:

THE USER PERSPECTIVE: SEARCH UNFAIRLY FAVORS SOME TYPES OF USERS

Search favors users who do not have certain impairments

Dr. Andrew MacFarlane: Search engines focus on the needs of the general population rather than those of users with impairments. The widespread use of machine learning algorithms only enhances this focus. However, users with impairments often have very different needs that are not well-served by search interfaces or ranking mechanisms (Berget & MacFarlane, 2019). Search may disadvantage those with a variety of impairments, including cognitive (e.g. users with specific learning difficulties such as dyslexia, ADHD or autism), sensory (visual or hearing) and motor (physical impairments). For example, there is evidence visually impaired searchers formulate more expressive queries to reduce the overhead of inspecting results, as this can be time-consuming and effortful due to the linear nature of screen readers (Sahib et al., 2012). It is not yet known how best to support searchers with different impairments, but different design interventions and accessible technologies are likely needed for different impairments (and perhaps even for different difficulties faced by searchers with the same impairment). We are currently investigating how best to support searchers with aphasia—a communication impairment often the result of a stroke that can lead to difficulties in formulating or comprehending language—by understanding search difficulties they face and workarounds they use.

Lynne Cole: As an example of a specific learning impairment, search disadvantages people with dyslexia due to differences in how they process information (Reid, 2016). It relies heavily on cognitive skills people with dyslexia may find problematic, such as reading and spelling (Morris et al., 2018). Some features such as voice search (Morris et al., 2018) and visual icons (Berget et al., 2016) help alleviate these difficulties. However, there are additional (and less researched) cognitive aspects of dyslexia that can further exacerbate the inequity of search; people with dyslexia can find vocabulary recall from long term memory difficult (Snowling, 2000), hence, communicating information needs through query formulation an editing can present barriers. Dyslexia can also create issues with working memory (Cole, et al., 2020); during search working memory capacity may be fully engaged with reading, interpreting and evaluating information to the extent the information need or search queries used are forgotten. This suggests the need for dyslexia-specific search support to aid query formulation and reformulation and memory aids, such as the option to create placeholders or provide reminders of previous queries entered and results or documents examined.

Search favors users who submit English-language queries

Prof. Shanton Chang: Global search engines do not usually cater to non-English searches (Bar-Ilan & Gutman, 2005), resulting in the creation of language-specialist engines such as Qwant (French), Baidu (Chinese) and Yandex (Russian). Mainstream search engines unfairly favoring English over other language queries presents an important challenge; many countries are multicultural and multilingual, so people may use different search engines within the same geo-socio-political region. For example, COVID-19 highlighted that migrants who live in English dominant

countries do not always access English resources; international students in Australia, for example, continued to use own-language search engines, precluding them from receiving crucial pandemic-related information while in their host country (Chang et al., 2020), resulting in language-based inequity. This inequity is being further entrenched by English-dominant machine learning techniques such as natural language processing (Névéol et al., 2018). It is essential global search engines cater better for non-English queries to curb the widening of the information access gap.

THE TASK PERSPECTIVE: SEARCH UNFAIRLY FAVORS SOME TYPES OF TASKS

Search favors known-item and fact-checking information tasks over exploratory tasks

Dr. Dana McKay: A fundamental driver of search engines has been to provide a single (or restricted set of) ‘correct answers’ to searchers’ queries, resulting in precision—providing *only* relevant documents—as a longstanding measure of quality (Baeza-Yates & Ribeiro-Neto, 2011). Search has moved on from focusing solely on precision and recall though, incorporating features such as knowledge-graph-based semantic linking that may better support exploratory search—searching to learn, without looking for anything specific (White & Roth, 2009). There are also new success measures, including novelty and diversity (Clarke et al., 2008). Despite these developments, search still favors highly directed tasks. This is not the case for browsing, which has two fundamental advantages over search; the ability to explore without having to know anything about a collection and the ability to readily broaden possible selection options simply by moving around (McKay et al., 2018). While improvements to search may eventually support effective result exploration, the limitation of needing to formulate queries to produce results remains. The predominant focus on search to the exclusion of other forms of information acquisition has disadvantaged new entrants to a field, explorers, and those who are simply stumped (Marchionini 1997; McKay et al., 2020). It is past time we stop privileging those who know what they are looking for and better support those less sure, or who just want to explore.

Search favors active information seeking over passive information encountering

Dr. Stephann Makri: Search also favors active information seeking over passive information encountering. Unlike expressly seeking information, encountering involves information seeking *you*; serendipitous information encounters can happen when looking for information on a different topic, when not looking for any particular information, or not looking for information at all (Erdelez & Makri, 2020). Passive encountering has traditionally been under-researched as compared to active forms of acquisition, particularly search, but is increasingly being recognised as an important means of finding information and of creating new knowledge (Makri et al., 2019). While this form of serendipitous information acquisition often occurs during active search, this is as an unintended byproduct (Makri et al., 2014). Search environments typically support passive information encountering indirectly and incidentally; as an unexpected but often welcome distraction to the search at hand (Makri & Buckley, 2020), but a distraction nonetheless. Although recommender systems, including those that drive personalized search, now value search result novelty and diversity as well as relevance (Castelis et al., 2015), search is still better suited to active seeking than passive encountering. Perhaps search favors active seeking due to its intrinsic nature; searchers must express what they hope to find when formulating queries and therefore must have some idea of what they expect to find. On the other hand, encounterers do not have this expectation and if they hope at all, it is only to somehow be pleasantly surprised.

Search favors tasks that involve finding existing knowledge over creating new knowledge

Dr. George Buchanan: Search supports finding existing knowledge well, but creating new knowledge less well. A key type of knowledge creation occurs as an outcome of creative problem-solving. This involves generating novel solutions to which no existing ‘off-the-shelf’ solution exists, or where established methods cannot be used. Information acquisition can play a key role in this type of knowledge creation (Maiden et al, 2018), for example by facilitating ‘inspiration hunting’ (McKay et al., 2020). However, this is difficult to achieve in search environments. For example, architectural students had to click on image search thumbnails of inspirational building designs and view the image in the context of the surrounding Webpage text to gain sufficient context to decide whether and how to incorporate aspects of the designs into their own novel design projects (Makri & Warwick, 2010). As search engines rarely provide direct creativity support (Maiden et al, 2018), search favors information tasks that involve finding existing knowledge over creating new knowledge. Search has a bias towards presenting topically similar results (Baeza-Yates & Raghavan, 2010). This reduces the chances of passively encountering a novel idea that can provide the kernel of a creative solution (Maiden et al., 2018). In contrast, browsing better facilitates rapidly seeding more ideas. This is often more fruitful than deeply investigating a few. The pursuit of ever higher levels of relevance has further exacerbated the inequity of search when it comes to providing the diversity needed to fuel creative inspiration.

THE CONTENT PERSPECTIVE: SEARCH UNFAIRLY FAVORS SOME TYPES OF CONTENT

Search results and recommendations can be biased

Prof. Dirk Lewandowski: Search engine bias involves a predominant representation of certain aspects in the (top) search results, resulting in some types of content being unfairly favored over others. Types of empirically identified search engine bias include gender (Otterbacher, et al., 2017), race (Noble, 2018) and commercial intent (Lewandowski & Sünkler, 2019). To address this bias, it is paramount to better understand how results pages are generated and how (plus to what extent) key stakeholder groups influence these results. There are five such groups (Schultheiß & Lewandowski, 2021); *search engine providers* determine ranking through algorithms, but may unfairly promote their own offerings (European Commission, 2017); *content providers* influence search results not only through what they produce, but also potentially by promoting their own content using *search engine optimization (SEO)* and *paid search marketing (PSM)*. These, as professions in their own right, form separate groups. Also, *users* influence result rankings through interaction with results, which can potentially be gamed. Understanding and quantifying stakeholder influences on search results is paramount for shaping search engines to be as fair as possible.

Andrés Ferraro: Recommender systems are intended to provide a helping hand in identifying interesting or useful information, but can be inequitable by unfairly favoring some types of content. As noted earlier, there are many possible types of search bias. These affect recommender systems too. In the music domain, a particularly concerning bias type is *gender bias*; music recommenders are more likely to promote music by male than female artists, putting (on average) male artists in the first recommendation position and the first female artist in the seventh or eighth position (Ferraro et al., 2021). This introduces an exposure bias, as recommendations lower in the list are less likely to be viewed. This, in turn, exacerbates existing music industry inequalities; women represent < 20% of registered composers and songwriters, while 98% of works performed by major orchestras are by male composers (Smith et al., 2018). To address this inequity, Ferraro et al. (2021) proposed a simple approach to provide more exposure to female artists by re-ranking recommendations and moving male artists a specified number of positions downwards.

Sanne Vrijenhoek: In an online news context, recommender bias can influence how users see the world and can therefore potentially undermine democratic values (Helberger, 2019). Current news recommenders often focus on measuring increases in user engagement, such as through click-rates (Beel et al., 2013), rather than measuring the user's longer-term interest in a diverse news diet. This may unduly promote sensationalist content, the viewpoint of the 'majority,' or content already in line with the user's own opinions; a 'filter bubble' effect (Pariser, 2011). When developing equitable news recommenders, these should not only be evaluated based on traditional metrics such as accuracy and diversity, but also based on the normative notion of diversity (Vrijenhoek et al., 2021). Doing this requires translation of abstract notions such as 'tolerance' into something computational: a likely painful process that will require strong inter-disciplinary collaboration, but necessary for news recommenders to become more equitable.

DESIGN PRINCIPLES FOR ENSURING MORE EQUITABLE INFORMATION ACQUISITION

As well as raising awareness of issues around the inequity of search as an information acquisition paradigm, this discussion will take steps towards ensuring more equitable information acquisition. All panelists and attendees will be asked to reflect on broad design principles and more specific design guidelines for reducing inequity in search and digital information environments more broadly, such as more closely integrating search and browse functionality and providing explicit support for meaning-making, knowledge scaffolding and information (re)organization.

PANEL FORMAT AND DIVERSITY

This 90-minute panel will follow a highly interactive format. We will begin by spending 5 mins. introducing the panelists and the overarching argument that search is an inequitable information acquisition paradigm. Then each panelist will spend 3 mins. presenting their specific position on how and why search is inequitable for a particular type of user, task or content. After each panelist position statement, 4 additional mins. will be dedicated to questions or comments from attendees. Attendees will be particularly encouraged to present counter arguments on search equitability to facilitate lively discussion and debate. The remaining 20 mins. (approx.) will be dedicated to synthesis, remaining questions and discussion on how to design more equitable information environments. This discussion will follow a 'fishbowl' format, where attendees will be encouraged to 'jump in' to the discussion one at a time, encouraging broader participation and interactivity. Backchannel debate via chat will also be encouraged and issues raised and questions asked fed into the live discussion. We will also provide an *asynchronous* chat channel to facilitate discussion with people who watch the recording. The panel includes representation from a diverse range of academics and reflects the following types of diversity: gender, ethnic, cultural, linguistic, sexuality, disability, geographical, and career stage. The panel also represents a diversity of perspectives on ensuring more equitable information acquisition.

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Examining Concepts of the Public: Who is Served by Information Services?

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ABSTRACT

The goal of this panel is to define foundational social and epistemic “boundaries” within the “public sphere” that libraries and information institutions typically consider when defining their constituents of interest. Defining what we mean by the “public” or “communities” in “public libraries,” for example, is important, not only because the concept of a “public” is plural and contextually situated, but also because the boundaries of said public are often artificially outlined depending on social and cultural aims. To what degree do information services act like politics, strategically defining “community” to exclude as much as include? In politics, the “public” and its representative rights vary from state-to-state and county to county. Is this variation the same as regional differences in reading, described, for example, in *The Geography of Reading* (Wilson, 1938). Is it more overtly racial (e.g. Lipsitz 2011) or political (e.g. Bishop 2009)? What is a “citizen” in this space, and how does that differ from our construction of the public? Which publics are being denied their needs through the boundaries erected by these institutions and systems?

KEYWORDS

Social diversity; library communities; public libraries; vulnerable populations; community archives.

INTRODUCTION

Who do librarians, archivists and information specialists serve? In the last decade we have witnessed a general pivot in nomenclature, from the “user” to “community.” What is behind the evolution in this terminology? Is this a simple change in the words we use, or does this reflect a new conceptualization of clientele or “the public?”

This panel centers the broad-level question of whom is served by information institutions. What implications of mission accrue when asking how libraries serve broad categories: the public, the community, the child, or the citizen. By posing the question of service at this level of generality, the panel examines the unique position that information plays in advanced information-based societies. Not only does this position allow institutions and systems to respond to the informational needs of these groups of people, but potentially it allows them to help shape the groups themselves through their service. Accordingly, the panel further examines what responsibilities attend that potential: do information services address justice, pluralistic democracy, liberation? Through this frame, the panel explores the consequences of these institutions conceiving of their missions as broad “service to all” models. Is it instead fruitful to think of narrower, more targeted constituencies?

Further, adding nuance to these definitional problems, there are many groups of the public that are of particular interest to information scholars given their minoritized, underrepresented, or vulnerable status. Thus, we must answer a subsidiary question, such as, What does it mean to be underrepresented, minoritized, or vulnerable, and how does this meaning impact how we create information structures for epistemic uses to the social members in particular? The point here is that, as information professionals, we are charged with—one would hope—creating a society that is more just and ethical, and we do so by designing, collecting, disseminating, and curating technologies and spaces. This panel hopes to problematize what we mean when we say that a structure or institution benefits “the public,” and from this, we can better attend to the diverse and plural needs of multi-cultural and multi-contextual individuals.

PANELIST ABSTRACTS

Jeremy Abbott, PhD Student, UCLA Department of Information Studies: “In Name Only? The “Public” in Public Libraries.”

The notion of “publicness” is necessarily embedded in the project of the public library. This presentation will investigate the manner in which public libraries are charged with serving the concept of the public, and how the execution of that mission conversely serves to define that concept. It will pursue this question by examining the discourse of publicness that public libraries assert drives their service mission through declarations of service to all, as well as the very title of “public” library. It will also compare that discourse to the methods libraries employ to control library space – ostensibly public space – arguing that control of inclusion and exclusion within library spaces also serves to control inclusion in that discourse of publicness. What responsibilities do public libraries have in the construction of “the public”? What public is served by a gap between service to all and service to some?

Michelle Caswell, Associate Professor, UCLA Department of Information Studies: “Where’s the Power Analysis in Community Archives?”

Notions of “community” in formulations of “community archives” are often so vague they are rendered meaningless. On the one hand, dominant Western archival institutions can invoke “community” as a euphemism for unnamed BIPOC and LGBTQ+ communities and “community engagement” in that context can reproduce dominant extractive archival practices. Yet on the other hand, when centered on the liberation of oppressed people, archival practices invoking “community” can represent significant shifts in power. This presentation will critically interrogate formulations of community in literature on community archives and disentangle the relationship between community archives, power, and liberatory memory work.

Gregory H. Leazer, Associate Professor, UCLA Department of Information Studies: “Death of the Community.”

Taking inspiration from Ron Day’s 2011 article “Death of the User”, this article seeks to understand and critique notions of “community” and “the public”, drawing on concepts of social pluralism and feminist epistemology. Recent work, especially in librarianship, has emphasized the role of community in treatments of the library as a “third place” or its role in “social infrastructure.” However, a simple substitution of “communities” for “community” does little to resolve our problem. How is “community” to be defined? What distinguishes one community from another? How do information services relate or support any one particular community? How do such definitions enshrine or critique concepts of justice or power?

Robert D. Montoya, Assistant Professor, UCLA Department of Information Studies: “Reformulating Vulnerable Populations in the Library Environment.”

Libraries are often thought to be core institutions that support the distribution of information resources and the production of programming catered to what are often termed vulnerable or at-risk communities or populations. This paper will examine what information professionals and librarians mean when we call communities “vulnerable,” and examine the role and potential of the library to facilitate collective resistance against such oppressive social powers. Invoking critical feminist and critical development theories, I will posit that libraries should support a collective, relational, and resistance-based understanding of vulnerability that can help expose the systemic mechanisms that create the conditions for such vulnerability. Building on Erinn Gilson’s definition of vulnerability, vulnerability in this context can be defined as the inability to predict, identify, control, or contextualize our epistemic position, vis-à-vis access to information, and how it affects our role, position, and participation in society (Gilson, p. 127). In essence, individuals who do not have access to adequate informational resources are at a social disadvantage and are less able to advance their positions in society and participate in civic activities (such as voting and other political activities) that can potentially improve their social standing or contribute to a general national culture. In this category, for example, we might include the LGBTQ+ populations, children and young adults, the disabled, as well as the elderly—all of whom are, by virtue of their own social positions and identities, may be underrepresented in library collections, services, and discourses—and thus limited in terms of their actual and potential knowledge capacities.

In general, library services generally aim to provide information services in ways that bolster individual positions within society, such as the provisioning of information to access healthcare, to vote, to sources of knowledge, etc. And while these services are certainly necessary and should continue to be offered, I will posit that an equally pressing responsibility of the library (and especially public library spaces) is to also support radical and collective notions of vulnerability that support systemic resistance. By understanding vulnerability as a form of possible empowerment and resistance, as advocated by Judith Butler, Zeynep Gambetti, and Leticia Sabasay (2016), the library becomes an active participant in reformulating and dismantling the networks of power that facilitate and maintain the conditions for such control and oppression. In particular, with a special focus on international library

development work in Kosovo, I will examine how power and politics problematize such radical and activist work, but also how supporting collective resistance is vital for the long-term health of functional authentic democratic institutions and societies.

Safiya Noble, Associate Professor, UCLA Department of Information Studies: “An Information Studies Curriculum for Social Diversity.”

What does it take to train and intellectually develop information professionals who are capable of having mastery of complex ideas that allow them to discuss, understand, and critique the value systems and power structures embedded in information work in diverse societies? What elements of intellectual development allows for an exploration of the importance of thinking locally, from the grassroots, in the design, evaluation and engagement with information institutions and technologies – ranging from archives, and libraries to the Internet itself? This paper discusses the development of courses that address the need for interrogating and embracing aspects of the information society that shape and are shaped by cultural, societal, professional, community, and individual values, including an exploration of the impact of such values on professional practice, decision- making, and public policy.

PANEL STRUCTURE

The session will open with a five minute introduction, then each panelist will speak for 12 minutes. Panelists will speak in alphabetical order as indicated above. There will be twenty minutes for audience questions and answers, and the session will conclude with a five minute wrap-up.

The Moderator will be **Carlin Soos**, PhD Candidate, Department of Information Studies, School of Education & Information Studies, University of California, Los Angeles.

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SPONSORS

Panel coordinated by History and Foundations of Information Science (HFIS). Also supported by the Classification Research SIG.

Updates to Information Standards and Standardization Efforts

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ABSTRACT

This panel, sponsored by the ASIS&T Standards Committee, has two purposes. First, the panel reports the most recent activities of the national and international standards in the field of information science and technologies in which the ASIS&T Standards Committee and members have been involved. Second, the panel will focus on a number of significant standardization efforts, their important roles, and the challenges in dealing with semantic conflicts while addressing inclusion and relevance to ensure non-bias in information representation and the FAIRness of data. Those efforts have led to the globally adopted standard systems, vocabularies, and schemas, which will be introduced by this panel.

KEYWORDS

data standards, information standards, open data, knowledge organization systems.

INTRODUCTION

Standard development activities and outcomes led by NISO, ISO, W3C, WHO, etc., have greatly impacted the entire field of information science and technology. This panel will update the ASIS&T members and information professionals on selected standards, specifications, and best practice guidelines that have been recently developed or initiated by our international standards institutions. Another important goal of the panel is to increase the awareness and adoption of information standards by information professionals.

The vital importance of professional standards has been evident to all during the global pandemic. The amount of information (and misinformation) available through the web has confused consumers and researchers alike. The need for information that is easily accessible, reliable, and vetted (often peer-reviewed) has never been more imperative. Research results, clinical study results, best practices, clinical protocols—all reported quickly, consistently, and well-tagged for fast retrieval, with cross walks to different encoding systems used across the globe, are more necessary than ever before. International standards will greatly help eliminate semantic conflict and information overload issues while facilitating inclusion, justice, and relevance through thoughtful implementation.

Consider one simple but prominent example: for an outbreak of a new viral disease, three very important names have to be decided: (1) the name of the disease, (2) the name of the virus, and (3) the name of the species (International Committee on Taxonomy of Viruses, 2020). Establishing a name for a new disease provides a shared understanding so that researchers and developers can discuss disease spread, transmissibility, severity, prevention, and treatment. Viruses are named based on their genetic structure to facilitate the development of diagnostic tests, vaccines, and medicines (WHO, 2020a). Yet conflicting and sometimes problematic names can be observed in use in major pandemics of the past as well as in the most recent ones, such as the 2009 outbreak of H1N1 influenza in humans and the 2020 COVID-19 outbreak. Guidelines developed by the World Health Organization (WHO) ensure that the name does not refer to a geographical location, an animal, an individual, or a group of people (so as to ensure non-bias), while still being pronounceable and related to the disease (WHO, 2015), and have been applied to the naming of the COVID-10 (WHO 2020b) and the key variants of SARS-CoV-2 (WHO 2021). In response to the naming of the disease COVID-19 announced by the WHO on February 11, 2020 (WHO, 2020b, 2020c), the *International Classification of Diseases* (ICD-10) and other standardized health knowledge organization systems (KOS) immediately developed their new codes and coding guidance. As will be demonstrated through the presentations of this panel, these KOS standardization efforts enabled the world to tag using coding systems, and to compare and share data in a consistent and standard way—between institutions, across regions and countries, and over time. These systems facilitate the collection and storage of data for analysis and evidence-based decision-

making; together, they help to eliminate semantic conflicts, political interference, and to minimize information overload in real-world healthcare systems.

To take a broader view, for any data the widely-implemented FAIR principles ensure that published digital resources are Findable, Accessible, Interoperable, and Reusable (FAIR) (Wilkinson, 2016). To ensure the FAIRness of data, W3C's *Data Catalog Vocabulary* (DCAT) version 2, released in 2020, will be introduced by this panel. Beyond bringing attention to the new version of this standard, the presentation will emphasize this major revision's effort in responding to new use cases, requirements, and community experiences since its first version's release in 2014. According to its statements, this revision extends the original DCAT standard in line with community practice while supporting diverse approaches to data description and dataset exchange (W3C, 2020).

The development of a new standard that can significantly address inclusion and relevance also faces challenges in today's environment. The panelists will discuss the experience of developing the new standard-specific ontology within NISO, a process which involved representatives across the world (NISO, 2021). The procedural steps include the definition of the lifecycle of standards, definitions for each of the phases, and the challenges of integrating multiple vocabularies so as to provide effective service and to enable both modern and classic terms for a variety of users. This Standards-Specific Ontology Standard is to be used and deployed for diverse use cases and stakeholders. In addition to introducing the standards, their application, and best practices, the panelists will also bring insight into adopting and implementing new methodologies and protocols. We plan to generate a Q&A section to discuss the effective developments and implementations of standards.

THE PANELISTS

Short biographies are listed below, arranged in order of presentation. The presenters have played important roles in the area of standards for data and information for many years. They are serving on various standards committees at community, national, and international institutions.

Mark Needleman is the co-chair of the ASIST standards committee. He has worked for the University of California's MELVYL project, library automation vendors Data Research Associates (DRA) and Sirsi Corporation, and the Florida Center for Library Automation. He has been involved in several standards organizations such as NISO (National Information Standards Organization), ANSI (American National Standards Institute), ISO (International Standards Organization), the W3C (Worldwide Web Consortium), the Unicode Consortium, and the IETF (Internet Engineering Taskforce). Among other things, he has been involved with developing the Z39.50 protocol, the ISO ILL protocol, NCIP (NISO Circulation Interchange Protocol), the NISO OpenURL Standard, and the W3C XML Query Language.

Marcia L. Zeng is a Professor of Library and Information Science at Kent State University. Her major research interests include knowledge organization structures and systems (KOS), Linked Data, metadata and markup languages, database quality control, multilingual and multicultural information processing, and digital humanities. She has chaired and served on standards committees and working groups for IFLA, SLA, ASIST, NISO, and ISO. She has been a Working Group member of the ISO 25964 Thesauri and Interoperability with Other Vocabularies and co-chair of the DCMI-NKOS Task Group to develop a Dublin Core Application Profile for KOS resources. She was an invited expert of the W3C Linked Library Data Incubator Group and the Asset Description Metadata Schema (ADMS) of the European Union.

Marjorie M. K. Hlava is President, Chairman, and founder of Access Innovations, Inc. She is past president of NFAIS and past president of the ASIS&T, and the recipient of the ASIST 1996 Watson Davis Award and the ASIST 2014 Award of Merit. She has published more than two hundred articles and several books on information science topics. She also holds two patents. Her research areas include furthering the productivity of content creation and the governance layer for information access through automated indexing, thesaurus development, taxonomy creation, natural language processing, machine translations, and machine-aided indexing. A frequent speaker on standards, she served on the NISO board for 7 years. She was a member of the standards development committee for many standards including the Dublin Core, Thesaurus / Controlled Vocabulary, CrEdit, SSOS, Indexing, and more.

Timothy J. Dickey is co-chair of the ASIS&T Standards Committee, and recently served on the ASIS&T Board as Chapter Assembly Director. He is a library science educator with Kent State University and San José State University, with research in reference, diverse communities, emerging technologies, and music and humanities librarianship, and a practicing librarian with the Columbus Metropolitan Library. He served a three-year post-doctoral position with Lynn Silipigni Connaway at the OCLC Office of Research, with work in data mining, user studies, and an IMLS grant project evaluating virtual reference services. His Ph.D. is from Duke University, and the M.L.I.S. from Kent State University. Dr. Dickey's most recent book, *Library Dementia Services: How to Meet the Needs of the Alzheimer Community*, was published by Emerald in 2020, and he is a frequent speaker on a variety of LIS technologies and topics.

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Information Injustice and Intellectual Freedom: Polarizing Concepts for a Polarizing Time

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ABSTRACT

Historically, information professionals have advocated for intellectual freedom, specifically the rights to free speech and expression. The unrestricted flow of information has been foundational to library and information science practice. Yet, free speech at times is protected to the detriment of vulnerable communities. In this panel discussion, four library and information science researchers discuss the scholarly and pragmatic tensions surrounding LIS ethics and anti-hegemony. Using Chatman's (1996) concept of information poverty and Gibson and Martin's (2019) theory of information marginalization as discursive guides, the panelists will describe how they negotiate ethical principles, information justice, LIS professionalization, and social inclusion.

KEYWORDS

justice; intellectual freedom; information poverty; information marginalization; social inclusion.

INTRODUCTION

Access to information—facilitating access through organization, management, storage, retrieval, and dissemination—is the foundation of library and information science (Oltmann, Knox, & Peterson, 2021; Jaeger, 2007). The rhetoric of library and information science (LIS) has focused on unfettered information access (also known as intellectual freedom) and resistance to censorship for several decades. Yet, counter-arguments suggest that access without limits leads to harmful outcomes for the communities that are most vulnerable to injustice.

Two brief examples demonstrate the complexity of these issues. In 2019, Seattle Public Library allowed a transphobic speaker to reserve a room and give a talk; numerous protests erupted, and the library director was vilified, though she followed the library's written policy and the American Library Association's ethical guidelines (Paul, 2019; ALA, 2006). When the library won Library of the Year in 2020, critics were even more angry. Was it more just to give the speaker a platform or to deny her one? In a completely different vein, Twitter has blocked thousands of accounts tied to the QAnon conspiracy theory, for platform manipulation, spreading disinformation, and harassment (Collins & Zadrozny, 2020). Were the operators of those accounts utilizing freedom of speech that should be protected, or was Twitter justified in permanently suspending their accounts? In either of these cases, how do we balance prioritizing access to information and justice for marginalized communities?

The United States has an incredibly expansive conception of freedom of speech, legally protecting categories that are banned in other nations (including hate speech, for example). Federal limitations on speech must meet strict "time, place, and manner" guidelines as established by the Supreme Court (*Cox v. New Hampshire*, 1941). Thus, from a legal perspective, the Seattle Public Library, as a quasi-government agency, was probably obligated to not censor the transphobic speaker. As a private company, however, Twitter is able to ban whoever it chooses. There is strong historical support for a very broad intellectual freedom stance in the U.S (as upheld in cases such as *R.A.V. v. St. Paul*, 1992).

Yet, in the contemporary age, we are bound to ask whether this expansive view of freedom of speech is just: does this American perspective on freedom of speech and intellectual freedom serve all Americans? Consider the call from Seiter (2019), who advocates for "a justice-based understanding of [intellectual freedom] which facilitates the information-seeking and expressive behavior of those who have historically faced systemic oppression" (p. 109).

In her seminal work on information poverty, Chatman (1996) described four aspects of information poverty: lack of sources, association with social class, use of self-protective behaviors (secrecy and deception), and benefits outweighed by negative consequences. Gibson and Martin (2019) argue that these information poverty behaviors are "red flags" signaling the presence of systemic inequalities and structural marginalization (p. 485; see also Oltmann, Knox, & Peterson, 2021). Furthermore, these authors suggest that we use a critical approach to uncover "the

development of systemic, contextual barriers to information access” (p. 477). An information marginalization approach posits information access—or the lack thereof—as an issue of justice. A systemic lack of access to information is, simply, unjust. It is important to understand this sort of injustice as a social justice problem; as Mathiesen (2015) says, “social justice requires us to ask big questions about the existence of injustices in the economic, political, and cultural spheres” (p. 201).

This panel discussion seeks to probe these “big questions” about structural marginalization, access to and barriers to information, and the nature and role of information justice. When is information access detrimental to informational justice, and when does access facilitate justice? How can censorship enable or constrain information justice? How can we break down systemic information access barriers to empower individuals to seize and create justice?

Following a brief 5-minute introduction by the panel convenor (Oltmann), each panelist will take 10-15 minutes to describe their views on these prominent lines of thought within LIS, noting some of the key dilemmas and tensions that arise. In the remaining 30+ minutes, questions will be invited from the audience. We encourage the audience to ask questions of two or more panelists specifically to spur discussion. We ask that participants listen carefully to understand opposing viewpoints and be courteous in their responses, comments, or questions.

KEY TENSIONS AND ISSUES

(Panelists listed alphabetically)

John T.F. Burgess

My background is in virtue ethics, a form of character ethics which provides guidance on living in accordance with one’s purpose in life. The goal of living in virtue ethics is eudaimonia, or happiness from long-term flourishing. I apply virtue ethics to questions of professional praxis for library and information science professionals, focusing on issues of sustainability and intergenerational justice. Sustainability is a form of ecological justice emphasizing value decisions based on the triple bottom line of the environment, equity, and the economy. My conception of ecological justice is influenced by the mutualistic anarchism of Peter Kropotkin and the social ecology of Murray Bookchin, particularly from works such as *The Conquest of Bread* (Kropotkin, 2015) and *The Ecology of Freedom* (Bookchin, 1982). This form of anarchism emphasizes direct action, interdependence and mutual responsibility while working to overcome scarcity and deprivation. Intergenerational justice is a question within ecological justice which establishes what obligations the present owes past and future generations. If people living over the horizon deserve the same rights as one does, then principles of intergenerational justice extend that same dignity to those born beyond the horizon of one’s lifespan. I believe people the same obligations to dismantle systems that support social injustice, exist for systems that propagate generational injustice, most notably the unfettered exploitation of, and dispossession from, the biosphere. Systems which use power to exploit the environment will do the same to people. Ideas at the intersection between sustainability and virtue are explored in environmental virtue ethics (Hannis, 2015; Hursthouse, 2007; Jordan & Kristjánsson, 2017; White, 2015).

Interleaving virtue ethics and ecological justice has moved me to consider issues of information justice. As a concept, information justice usefully gathers a number of primarily individual-focused ideals such as intellectual freedom, privacy, and access to information under an umbrella, but also includes collective notions of justice such as epistemic, hermeneutic, and testimonial justice, (de Sousa Santos, 2014; Fricker, 2013; Keet, 2014) as well as cognitive justice, the right to implement social institutions in line with historically and culturally guided ways of knowing over and against colonial and hegemonic legacy institutions. (de Sousa Santos, 2007; Hall & Tandon, 2017; Visvanathan, 2006) So what does an ecologically informed idea of flourishing look like in the information justice space? What can we infer from scientific ecology about information ecology (Nardi & O’Day, 1999) even if by analogy? Luciano Floridi has written extensively on the idea of an infosphere, or an ecological web of information and communication systems akin to the biosphere, focusing expanding the territory of where moral responsibility lies in the implementation of information systems (Floridi, 2002, 2013, 2014). Capurro counters that human agency and intercultural communication should be the standard for making these determinations (Capurro, 2008). My own thinking straddles these two positions and seeks collaborative, direct action to work raise awareness of the moral harm done implementing information systems, how once established those systems become active participants in an information niche and have the potential to propagate information injustice into the future.

Emily J.M. Knox

Recently, my work has focused on the political and social foundations of the perceived tension between intellectual freedom and censorship. I describe this research as meta-axiological as I am analyzing fundamental values in library and information science. I use John N. Findlay’s definition of value as a “philosophical equivalent of the goodness, the excellence, the desirability, and what not which we attribute to contain sorts of objects, states, and situations” (1973, p. 6). That is, values signify what matters to a person or group of people, in this case to librarians and other information professionals.

What is most intriguing about this perceived tension between values is that both intellectual freedom and social justice are liberal political values as opposed to, for example, anarchist or conservative values. Freedman's (2015) introductory text on liberalism introduces this clearly. Freedman uses the metaphor of sheets of paper lying on top of each other to illustrate the five primary values of liberalism. These values are (from bottom to top): 1. Human rights and liberty 2. Economic freedom 3. Individual progress and development 4. Social space 5. Group identity. Freedman argues that various liberal positions may emphasize a particular value (that is, one sheet of paper shines through a hole in a sheet on top of it) but they all consist of some mix of these values. In essence, intellectual freedom emphasizes individual progress and development while social justice emphasizes social space and group identity.

Throughout my work, I also argue that intellectual freedom leads to social justice. A quick review of the 2020 American Library Association's Office for Intellectual Freedom's (2021) Most Challenged Books list demonstrates that the majority of the books on the list are focused on diverse topics including race and gender expression. Without support for intellectual freedom, the voices of people who are marginalized would not be heard. However, the discourse continues to focus on how support for intellectual freedom leads to the proliferation of hate speech and other harmful expression.

I believe this is because the field of library and information science has not sufficiently integrated Kimberle Crenshaw's (1989) concept of intersectionality into our core philosophical foundations. Crenshaw's theory of intersectionality argues that individual progress and development, social space, and group identity are all equally important for human flourishing.

Ana Ndumu

Immigration policy relies on ethical reasoning, and I am interested in understanding how ideologies around American national identity become vehicles for controlling both immigration and information flows. Debates on national sovereignty versus global human rights have been at the forefront of U.S. public consciousness for more than two centuries. There has seldom been a time in U.S. history when speech acts were not systematically employed in attempts to curtail the in-migration of specific people groups (Portes & Rambaut, 2006). Consider the "Yellow Peril" and the quotidian caricaturing of Chinese immigrants in the 19th century, the Anglicizing imperatives that drove discrimination toward southern and eastern Europeans in the early 20th century, and the current narratives of moral abhorrence and "culture of poverty" placed upon immigrants from the Global South. Resultantly, two tightly held U.S. constitutional philosophies - the rights to free speech and life, liberty and the pursuit of happiness - are diametrically employed to either curtail or advance migration. The immigration debate both reifies and relies on ethical constructions of race, ethnicity, nationality, and principles of 'Americanness'.

My research is motivated by ethical questions around the relationship between American nativism, information signaling, and public opinion on immigration. Immigrant communities face discrimination in many vectors of information access—from the continued, contentious use of the "illegal aliens" Library of Congress subject heading, to the former presidential administration's messaging on birthright citizenship and so-called "anchor babies". Information systems play significant roles in marginalizing vulnerable groups, as witnessed by the Department of Homeland Security's dependence on biased software such as Palantir (used in deportation decision-making) and Venntel (used to surveil immigrants' geolocation). Similarly, the legal information juggernauts LexisNexis and WestLaw sell surveillance data and the public records of undocumented immigrants to the U.S. Immigration and Customs Enforcement (Lamdan, 2019; Harwell, 2021).

Indeed, LIS has conformed to the philosophical ethics of welfarism or "culture of poverty" narratives that frame immigrants as an underclass in need of information remediation (Ndumu, 2021). In *The information poor in America*, for instance, Childers and Post argued that immigrants belong to a class of the disadvantaged who "are not predisposed as the general population to alter the undesirable conditions of their lives, or to see information as an instrument in their salvation." Much like current hard-line immigration rhetoric, they contended that Mexicans, in particular, are not only "isolated from information that sustains the dominant society," but "a number of characteristics magnify their isolation. They are proud of their culture, and especially tenacious in their language...they distrust or dislike Anglo institutions, such as schools, medical clinics, public housing..." (Childers and Post, 1975, p. 80). Childers and Post influenced a long line of LIS theorists, including Elfreda Chatman.

The notion of American cultural pureness coincides with the Bethamian tradition of Anglo-American legal utilitarianism (Burgess & Knox, 2019) and residual ideas on public welfare, disciplinary surveillance, and panopticonism. These moral codes contribute to hardline immigration policies such as the weaponization of a century's old public charge rule and the broader criminalization of immigration that increasingly drives detention and deportation. As the LIS field continues to confront barriers to access, inclusion, and empowerment, it will be vital to comprehend how information systems, ethical reasoning, and social symbolism are intertwined.

Shannon M. Oltmann

I typically describe myself as a “free speech maximalist,” meaning that I believe the best answer to offensive, hateful, or problematic speech is more, better, counter-balancing speech. This is often called the “marketplace of ideas” and can be traced to Justice Holmes (*Abrams v. U.S.*, 1919). According to this perspective, healthy competition between various ideas should result in the best ideas rising to the top. However, it’s important to recognize that a maximalist position results in discomfort, as awkward, painful, and hurtful things get said, written, and heard—and that this extends beyond discomfort, as it can perpetuate systemic racism, sexism, heteronormativity, ableism, and so on. This is a serious shortcoming of free speech maximalism and raises questions about the justice of a maximalist position. If maximalism aids in perpetuating inequity and oppression, then it seems it would be an unjust position.

However, I find the most common alternative to maximalism—some form of banning or restricting hate/offensive speech—equally problematic, for two reasons. First, laws and policies about hate speech, designed to protect marginalized or oppressed communities, are often used against those very same communities. Greenwald (2017) describes several such incidents across Europe. For example, in France, activists in the Boycott, Divest, and Sanction (BDS) movement for Palestine were found guilty of inciting hate or discrimination (JTA, 2015). Although not (yet) tried in a court of law, Black Lives Matter (BLM) activists have been accused of promulgating hate speech, including by former President Trump (Sprunt & Snell, 2020). Thus, creating laws or policies to restrict hate speech can, and often do, end up being used to restrict activists fighting against that very speech.

Another, subtler reason to hesitate in restricting offensive speech has to do with context. Many words or phrases that constitute “hate speech” can, in other contexts, have entirely different connotations. As a lesbian, I think about the word “queer,” which has been shouted at me as a slur and part of a threatening phrase, but has also been a self-identifier, a shorthand for affinity with a larger community, and a word reclaimed in pride. My concern about context, here, can and should be extrapolated to other words and phrases which have been reclaimed and “taken back” by the very communities targeted by them. The power of reclamation is immense (see, e.g., Jeshion, 2020) and should not be denied to marginalized individuals and communities. To do so, particularly in the spirit of protecting these communities, would seem unjust. This, then, leaves me in a quandary. Free speech maximalism can be unjust but restricting speech can also be unjust.

CONCLUSION

In this panel, we explore questions around information justice and intellectual freedom from several perspectives. These questions do not have straightforward or simple answers but are essential to consider in our contemporary age. It may be worth revisiting our foundational principles and codes of ethics to reconsider their value today. We must also consider the costs and benefits of imposing U.S. free speech maximalism globally through social media platforms.

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At the Margins of Epistemology: Amplifying Alternative Ways of Knowing in Library and Information Science

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ABSTRACT

This panel argues a paradigm shift is needed in library and information science (LIS) to move the field toward information equity, inclusion, relevance, diversity, and justice. LIS has undermined knowledge systems falling outside of Western traditions. While the foundations of LIS are based on epistemological concerns, the field has neglected to treat people as epistemic agents who are embedded in cultures, social relations and identities, and knowledge systems that inform and shape their interactions with data, information, and knowledge *as well as* our perceptions of each other as knowers. To achieve this shift we examine epistemicide—the killing, silencing, annihilation, or devaluing of a knowledge system, epistemic injustice and a critique of the user-centered paradigm. We present alternative epistemologies for LIS: critical consciousness, Black feminism, and design epistemology and discuss these in practice: community generated knowledges as sites of resistance and Indigenous data sovereignty and the “right to know”.

KEYWORDS

Epistemology, epistemicide, and epistemic injustice; equity, diversity, inclusion and justice; data, information, and knowledge; library and information science; paradigm shift.

INTRODUCTION

This panel begins from an information science perspective that takes into account a broader and historically situated social context that centers epistemology, ways of knowing, knowledge systems, and people as epistemic subjects and agents. This panel invites participants and panelists to consider together the ways in which the field of library and information science (LIS) can move towards information equity, diversity, relevance, inclusion, and justice by providing two interventions related to epistemology, ways of knowing, epistemicide, and epistemic injustice. The first intervention is to critically examine our field’s history, premises, foundational knowledge, institutions, and practices through an epistemic lens and by placing people as epistemic subjects and agents at the heart of LIS inquiry. The second intervention is reframing and reconsidering our practices as researchers, educators, and LIS professionals in order to consider alternative ways of knowing, what’s ours to know, and to work within and alongside communities and people in ways that are in service of their liberatory aims. Only by critically examining the assumptions underpinning our field, institutions, and practices can we prepare for the future and work toward epistemic justice.

PANEL FORMAT

This panel will engage participants and panelists to consider and reflect upon the assumptions about epistemology, data, information, and knowledge that underpin the field of LIS. We begin by presenting “epistemicide as a conceptual approach for understanding and analyzing ways knowledge systems are silenced or devalued within Information Science.” (Patin et al, 2021). The panel will be broadly divided into four parts. In Part I, we discuss the epistemological foundations of the field, define epistemicide (Patin et al. 2020), epistemic injustice, and critique the user-centered paradigm (Oliphant, 2021). In Part II, the panelists provide alternative frameworks from which LIS can critique epistemological assumptions including Black feminism, critical race theory, critical data studies and critical consciousness (Friere, 1970), and design epistemology (Clarke, 2018). In Part III, alternative epistemologies in practice and research are discussed using the examples of Indigenous data sovereignty and the Sex Worker

Database and community archiving. Part IV poses a series of questions that will invite participants to think about, and engage with, the two interventions provided by the panelists: an examination of the field's history, foundational knowledge, and practices from an epistemic perspective, and the ways in which LIS practitioners and researchers can work with and alongside communities, better understand what knowledge we as a field have a right to know, and the ways in which we can support people's epistemic aims.

Part I: Setting the Stage-Concepts and Considering the Epistemic in LIS

Epistemicide (Santos, 2014) is the killing, silencing, annihilation, or devaluing of a knowledge system. Epistemicide happens "when epistemic injustices are persistent and systematic and collectively work as a structured and systemic oppression of particular ways of knowing (Patin et al., 2020). We present epistemicide as a conceptual approach for understanding how we as a field harm epistemic development. This issue is especially relevant for information professionals because we handle knowledge from every field and are often in positions to determine what knowledge is worthy of collecting, archiving, and sharing.

The field has moved from a systems-centered to a user-centered paradigm. However, LIS continues to privilege information and information systems over people and their social and cultural contexts. In any information interaction, people can act, or are treated as, informants—epistemic agents who convey information and share knowledge—or as sources of information—where the inquirer may "glean" information from that person (Fricker, 2007). Attuning to who people are, their (perceived) status as knowers, and their treatment as epistemic agents and subjects may offer possibilities for new insights into the relationships among structures, people, data, information, knowledge and knowing, and social action. Simultaneously, treating people as epistemic agents and subjects rather than "users" requires us to examine our personal responsibilities and practices to be ethical and responsible listeners and for updating our beliefs in light of new information and evidence. A shift in the field that acknowledges and accounts for people's social identities, identity power, and social experiences in their interactions with data, information, and knowledge will enrich LIS's theoretical contributions to social transformation and social justice and thereby work in service of people's epistemic interests in both theory and practice.

Part II: Expanding our Epistemological Frameworks: Black Feminism, Critical Coconsciousness, Design

A Black feminist epistemic lens (Collins, 1991) requires a re-centering of information studies to a gendered and racial perspective. The premise of such removes a so-called marginalized status to incorporate a vision in articulating the value of both experience and standpoint. With a keen understanding of marginality as a place of resistance (hooks, 1990), and articulation of the permanence of racism (Bell, 1992; Delgado & Stephancic, 2001) information theories are poised to reconcile white-washing of the informational theoretical landscape. It represents a diversion of neutrality and values ways of engaging with the world that emphasize a communal justice orientation in the face of oppression. The utilization of such perspectives invites a reorganization of perspective to nullify Eurocentric values by creating an inquiry and knowledge from a space of empowerment. In recognition of the largeness of both theoretical frames, LIS research and practice benefits from knowledge that encourages a view that racialized-gendered perspectives that 1) Recognizes white hegemonic systems that perpetuate libraries as neutral spaces (Homna, 2005; Mehra & Gray, 2020), 2) Acknowledges African American gendered collective information practices (Gray, 2019), 3) Dismantle the valuation of Black community spaces as deficit (Gibson & Martin, 2019; Gray, forthcoming) 4) Reimagine cultural traditions of information, literacy, and collections that exists outside of the dominant institutional lens (Mehra & Gray, 2020, Patin et. al., 2020). The urgency of both inclusion and recognition of such knowledge liberates the totality of the LIS field by inviting orientations that challenge and resist the white normative structures in understanding libraries and the communities they serve.

Rooted in critical pedagogy (Freire, 1970) and Black and transnational feminism (hooks, 1994; Mohanty, 2003), the concept of "coming to consciousness" with respect to questions of oppression, domination, and injustice is important for LIS both as an area of study and an epistemic orientation for at least three reasons. First, it decenters traditional models of information which stress the disembodied production, distribution, and consumption of information and knowledge as a mechanistic and individualistic process. An LIS praxis informed by critical consciousness calls attention to the intersubjectivity, responsiveness, and responsibility at the core of our interactions with information. Second, such praxis emphasizes the role of information not simply as a collection of passively consumed facts, beliefs, or opinions but rather as a form of knowing which can actively transform its recipient. Finally, epistemic frameworks which embrace critical consciousness development not just as a research lens but also as a mode of being in the world, can help identify ways LIS researchers can respond more justly (both epistemically & practically) to the social effects of information.

Design is a common concept in information studies, especially regarding the development and creation of information systems, tools, and technologies. However, despite its predominance, it has historically been understood and applied in terms of scientific paradigms. Although this perspective is understandable based on the roots of

design's epistemological perspectives (e.g. Simon 1969), the discipline of design and understandings of its foundational epistemological paradigm have evolved since its original positing as a "science of the artificial." Design is a unique epistemological paradigm based on the creation of things that solve problems. Such an inherently different purpose calls for different methodologies and techniques of practice, and therefore requires a fundamentally different way of viewing and evaluating knowledge creation: what Cross calls a "designerly way of knowing" (Cross, 2011). As design processes and methods are increasingly harnessed in LIS research, education, and practice (e.g. Carroll et al. 2008; Clarke 2018; Clarke, Amonkar & Rosenblad 2019; Heckman & Snyder 2008; Jones et al. 2010; Snyder et al. 2010; Twidale et al. 2013) often for their potential to address concerns around equity, diversity, relevance, inclusion--it is critical that foundational epistemological frameworks from design are used to underlie and support this work. Or, we risk evaluating and assessing tools and services created in one paradigm according to the criteria of another—an inevitably unsuccessful prospect that can lead to epistemic injustices.

Part III: Alternative Epistemologies in Indigenous Data Sovereignty and Community-based Organizing

Indigenous data sovereignty is the concept that Indigenous peoples have the right to access, control, and govern data about their community and ancestors no matter where the data is being held or who holds the data. Additionally Indigenous data sovereignty allows for critical Indigenous nation rebuilding efforts through the self-governance of information. Indigenous data sovereignty also provides a framework in which Indigenous communities are able to assert their own community specific data protocols that align with community Ways of Knowing and governance structures. Within LIS there is a lot of unlearning in regards to ownership, stewardship, and access, that needs to be done when working with Indigenous communities and adhering to Indigenous data sovereignty principles.

Drawing upon decades of community-based organizing in Canada to decriminalize sex work, the Sex Work Database is a digital activist archives that uses a participatory archiving approach to preserve the community records of sex work activist groups. More broadly, the research project examines how community histories, records, and community archives can amplify community-created narratives about sex work and sex workers that humanize them, make them less vulnerable to gender-based violence, and are themselves sites of decriminalization activism. We consider how digital systems can be used to create anti-violence community archives that generate and preserve community derived arrangement and descriptive practices that challenge the violent, colonizing, and stigmatizing media representations of sex workers, prioritizing community knowledges and epistemological frameworks as critical sites from where appropriate community-led strategies and interventions might be generated.

Part IV: Interactive Dialogue

Drawing on the concepts, ideas, and examples presented, for Part IV, panelists will dialogue with each other and the audience about how various epistemologies, research methods, and practices can be centered in LIS research, practice, and extended to LIS education as well.

- How do our field's conceptions of data, information, and knowledge change when we consider them in a cultural context?
- What are some of the ways in which LIS can center people as epistemic subjects and agents in theory, research, and practice?
- How does your own work incorporate "alternative ways of knowing"? How might it?
- How do specific dominant LIS epistemological frameworks harm communities?
- What possibilities do the concepts of epistemicide, epistemic injustice, and engaging with alternative ways of knowing offer for LIS education?
- How does consideration of epistemic injustice, epistemicide, and alternative ways of knowing move the field towards information equity, diversity, inclusion and justice?

CONCLUSION

Understanding equity, diversity, inclusion, justice, and relevance issues is often siloed and hidden, especially from within the academy. The ways that Western ways of knowing and its evaluation and metrics often work to uphold hegemonic norms and existing power structures. This can mean that "new" or otherwise unfamiliar forms of knowledge sharing and knowing may not be viewed as credible as Western forms of knowledge sharing. Our field has much work to do in terms of identifying critical discourses that need to be had and research agendas that need to be undertaken. This panel discusses diverse epistemologies relevant to LIS Information Science and posits the use of these critical practices can help us address our issues so we may push towards justice.

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Conducting and Publishing Research in Developing Countries: Challenges and Solutions

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ABSTRACT

Most of the knowledge in the library and information science (LIS) discipline is created and published by researchers in developed countries. Two roundtable sessions of ASIS&T SIG-III with the ASIS&T Africa Chapter and ASIS&T South Asia Chapter, in early 2021, confirmed “the lack of a conducive research environment” as the primary reason for this inequality in the discipline and called for systematic efforts, like this panel, to (a) create awareness about this inequality and (b) start building a global support system for LIS researchers in developing countries. In the first 30 minutes of this panel, six LIS scholars with cultural roots, academic training, and research experience in developing countries will illustrate common challenges to conducting and publishing research in developing countries. In the next 30 minutes, attendees will be divided into groups, with each group facilitated by a panelist, to brainstorm solutions for addressing the challenges related to academic training for conducting and publishing research, accessing resources, institutional support, opportunities for research collaboration and funding, fieldwork, analyzing data, composing manuscripts, and finding mentors, among others. In the last 30 minutes, each group will present its findings.

KEYWORDS

Conducting LIS research; Publishing LIS research; Developing countries; Diverse LIS researchers; Inclusive LIS research.

INTRODUCTION

“When a flower does not bloom you fix the environment in which it grows, not the flower.”

—Alexander den Heijer

Problem Statement

The epistemological research approach relies on the “researcher as a lens” for knowing and making sense of social reality (Goldman & McGrath, 2014). Hence, every researcher’s interpretive knowledge creations such as research publications can be a function of their personality and professional backgrounds, academic training, and life experiences rooted in contextual factors (Nagel, 2014). The personal and professional context of researchers can influence their worldviews, the types of research topics they consider worthy of investigation, framing of research, the study population, the methods used for data collection, and data interpretation to construct new knowledge.

Most of the knowledge in the library and information science (LIS) discipline is created and published by researchers in developed countries. As a result, the knowledge and research in the LIS discipline are heavily influenced by Western values, philosophies, attitudes, norms, and lifestyles, among other contextual factors, which show inequality in our discipline. Importantly, this knowledge does not necessarily represent or has relevance within the non-Western worldview and may not be useful in understanding populations in developing countries. For instance, for over 45 years, Western researchers defined and developed “information literacy,” a major research area in the LIS discipline, around a set of individual-level, prescriptive skills for seeking, processing, and using information, mostly in academic settings (Hicks & Loyd, 2015). In recent years, Lloyd and Talja (2010) and other LIS scholars have challenged this reductionist view by redefining information literacy in terms of the social construction of knowledge beyond academic settings. This new conceptualization of information literacy is more appropriate and useful in studying the information literacy of individuals from developing countries (Lloyd &

Wilkinson, 2017). Upon examining Scopus and Web of Science databases, several bibliometric studies find that the LIS publications authored by researchers in developed countries disproportionately outnumber the ones authored by researchers in developing countries (Ahmad et al., 2019; Islam & Roy, 2021; Siddique et al., 2020).

It is time to make LIS research more inclusive, the theme of the 84th Annual Meeting of ASIS&T, where new knowledge created and published by LIS researchers in developing countries reflects their local or indigenous values, philosophies, attitudes, norms, and lifestyles, among other contextual factors that are for the most part distinct from those in developed countries. If a growing number of diverse LIS researchers from developing countries conduct and publish their research in top-tier LIS journals and conferences with high impact factors, low acceptance rates, and high visibility, they are likely to be the role models and mentors for LIS students, practitioners, and researchers who aspire to conduct and publish research in the similar contexts.

BACKGROUND OF THE PANEL

Every year ASIS&T's SIG-III (n.d.) organizes an International Paper Contest "to nurture the culture of research in developing countries by recognizing the work of researchers in developing countries." To create more value for ASIS&T members in developing countries, in February and March 2021, ASIS&T SIG-III held two separate roundtable sessions with ASIS&T Africa Chapter and ASIS&T South Asia Chapter via Zoom. These sessions were attended by over 25 members, officers, and advisors of SIG-III, Africa Chapter, and South Asia Chapter.

In response to sharing needs, expectations, and ideas for collaboration with SIG-III, attendees expressed the desire to organize workshops, seminars, symposiums, panels, and webinars, and build global support groups for training LIS researchers in Africa and South Asia to publish research. Our two sessions confirmed that one of the primary reasons for the lack of sufficient representation of voices of LIS researchers in developing countries is their inability to publish research in top-tier LIS journals and conferences with high impact factors, low acceptance rates, and high visibility.

Devendra Potnis, Chair, SIG-III, and Bhakti Gala, Chair, South Asia Chapter presented and led the discussion on the nature of the lack of a conducive research environment in developing countries. Based on their research in developing countries (e.g., Potnis, 2014; Potnis, 2015; Potnis et al., 2017; Potnis & Gala, 2020a; Potnis & Gala, 2020b), the following challenges to conducting and publishing research in developing countries were identified and discussed.

- (1) Lack of rigorous training for conducting research (e.g., lack of doctoral programs in developing countries)
- (2) Lack of access to electronic resources such as EBSCO, dissertations, and journals, among others
- (3) Lack of research culture (e.g., lack of awareness of research collaboration opportunities)
- (4) Lack of institutional mechanisms (e.g., review boards) for approving research designs and methodologies
- (5) Lack of organizational structure supporting researchers, including female researchers
- (6) Lack of funding opportunities at the institutional, regional, and national levels
- (7) Challenges related to planning research projects
- (8) Challenges related to engaging with different types of populations for data collection
- (9) Lack of expertise in data analysis techniques
- (10) Lack of training for composing and publishing manuscripts

Pit Pichappan, a member of SIG-III, recommended adding a lack of mentorship to the list. Md. Anwarul Islam, Co-Chair Elect, SIG-III, shared how researchers in developing countries do not get enough feedback to strengthen their manuscripts when rejected. Most of these journals label the research topics from developing countries as "narrowly focused," and hence, consider these topics of "insufficient interest" to their global readership. He also mentioned the need to raise awareness about predatory journals among novice researchers in developing countries. Humphrey Keah, Communication Officer of SIG-III and a LIS professional working for the United Nations in Kenya shared how lack of research funding can discourage people in developing countries from pursuing a doctoral degree and research careers. Arjun Sanyal, InfoShare Officer, SIG-III, asked for more interdisciplinary collaboration opportunities for information science research in developing countries. Ruwan Gamage, a member of the South Asia Chapter, pointed out that research does take place in developing countries but there needs to be more guidance for publishing it.

Abebe Rorissa, one of the advisors of SIG-III, endorsed the idea of developing a panel proposal that aligns with the theme of the 2021 ASIS&T Annual Meeting. Diane Sonnenwald, an advisor of the Africa Chapter, provided financial guidance to benefit maximum members of ASIS&T in developing countries from future collaborations between SIG-III and the Africa Chapter. Based on her experience of editing *Libri*, an international journal of libraries and information studies, Kendra Albright, another advisor of SIG-III, also thinks that several LIS researchers from around the world would benefit from the collaborative initiatives proposed at these two sessions. Attendees of both roundtable sessions agreed upon and discussed how their research environments in developing

countries pose challenges to conducting and publishing research. The lack of a conducive research environment emerged as one of the primary reasons for the inequality in the LIS discipline where most of the epistemological knowledge is created and published by researchers in developed countries.

To address this inequality and make the LIS discipline more inclusive, systematic efforts are needed to incorporate diverse worldviews of LIS researchers in developing countries and diversify LIS research through the research topics covered, questions investigated, methodologies employed, contexts explored, and populations involved.

PROPOSED PANEL

Goals

This panel is part of the systematic efforts to (a) create awareness about the inequality related to the knowledge sources and creation in our discipline and (b) start building a global support system for better equipping LIS researchers in developing countries to publish high-quality research in top-tier venues. The original scope of this panel was limited to challenges, but during one of the above roundtable sessions, Nadia Caidi, a member of SIG-III, recommended discussing positive stories and solutions for conducting and publishing LIS research in developing countries. Rarely do any past studies propose solutions to overcome the challenges to publishing research in developing countries.

Panelists

This 90-minute panel will be led by six LIS researchers and professionals—(a) Devendra Potnis, Chair, SIG-III, (b) Bhakti Gala, Chair, South Asia Chapter, (c) Edda Tandi Lwoga, Chair, Africa Chapter, (d) Md. Anwarul Islam, Co-Chair Elect, SIG-III, (e) Nosheen Warraich, Chair, International Paper Contest, SIG-III, and (f) Humphrey Keah, Communication Officer, SIG-III—who have cultural roots, academic training, and experience of conducting and/or publishing research in developing countries.

Biographies of Panelists

Devendra Potnis is an Associate Professor at the University of Tennessee at Knoxville. He has published research in *Communications of the Association for Information Systems*, *Government Information Quarterly*, *Information Processing & Management*, *IT for Development*, *International Journal of Information Management*, *Journal of Information Science*, *JASIS&T*, *LIS Research*, *Telematics and Informatics*, *The Information Society*, *The Library Quarterly*, and other reputed journals. He has received funding from the Institute of Museum and Library Services, Online Computing Library Center, and the Association for Library and Information Science Education.

Bhakti Gala is an Assistant Professor at the School of Library and Information Science, Central University of Gujarat, India, and is the chair of the ASIS&T South Asia chapter. She is the winner of the 2014 ASIS&T International Paper Contest held by SIG III and a 2014 Mortenson Associate. She has worked as a project manager for an international research project funded by OCLC and ALISE. She has published her research in international journals like *The Library Quarterly*, *Library and Information Science Research*, *Information Processing and Management*, and *First Monday*.

Edda Tandi Lwoga is a Professor in Information Science and the Deputy Rector at the College of Business Education in Tanzania. She has published more than 80 publications in national and international refereed journals, conference proceedings, books, and book chapters, with 2,598 total citations and an h-index of 23. She is the user representative for Research4Life in Africa, the Chair of the ASIS&T's Africa Chapter, and a member of the Campbell Collaboration's info. retrieval methods group. She has received funding from Sida, DFID, British Council, Elsevier Foundation, Spider, Academy of Finland, CODESRIA, Carnegie Mellon University, and Medical Library Association.

Md. Anwarul Islam is an Associate Professor at the Department of Information Science and Library Management, University of Dhaka, Bangladesh. He received PhD in 2016 from the School of Knowledge Science, Japan Advanced Institute of Science and Technology. He was a visiting fellow at iSchool, SLAIS@UBC, Canada; ACRC Fellow at Nanyang Technological University, Singapore and VLIR-UOS Scholar at the University of Antwerp, Belgium. He is a New Leaders Awardee of the ASIS&T, and currently serving as Chair of the SIG-KM, Co-Chair Elect of SIG-III, and Poster Co-Chair of 84th Annual Meeting of the ASIS&T.

Nosheen Fatima Warraich is an Associate Professor at the Institute of Information Management, University of the Punjab, Lahore-Pakistan. She served as Fulbright Scholar at the University at Albany-SUNY from 2015-16. Dr. Warraich has more than 75 publications in national and international refereed journals, conference proceedings, books, and book chapters. She has served in organizing committees of international conferences as well as editor of the conference proceedings. She has been awarded ASIS&T New Leader Award (2017-19). Currently, she is serving as the Chair of the International Paper Contest jury of SIG-III.

Humphrey Keah is an information practitioner with 20 years' research support experience in the natural sciences and humanities and social sciences. Currently, he consults for the Food and Agriculture Organization of the United Nations in Kenya. Humphrey also taught at the Technical University of Kenya and Intel College, Nairobi. In 2020 he received the ASIS&T InfoShare award and currently is the Webmaster & Communications officer of ASIS&T SIG-III.

Abebe Rorissa is Professor and Director of the iSchool at the University of Tennessee, Knoxville (as of July 1, 2021). Before his current position, he was Associate Professor and Associate Dean for Faculty Development in the College of Emergency Preparedness, Homeland Security, and Cybersecurity, University at Albany. He also worked in four countries as a lecturer and practitioner. He has published in leading journals such as JASIS&T, Information Processing & Management, and Government Information Quarterly. He was a member of the ASIS&T Board, its Executive Committee, & recipient of the ASIS&T SIG Member of the Year Award.

Structure

Abebe Rorissa will moderate this panel. In the first 30 minutes of this panel, panelists will share their specific circumstances and experiences that illustrate the manifestation of challenges to conducting and publishing research in developing countries. In the next 30 minutes, attendees will be divided into groups, with each group facilitated by a panelist, to brainstorm solutions for addressing the challenges related to academic training for conducting and publishing research, accessing resources, institutional support, opportunities for research collaboration and funding, fieldwork, analyzing data, composing manuscripts, and finding mentors for conducting and publishing research. In the last 30 minutes, each group will present the highlights of their group discussions.

EXPECTED OUTCOME

This panel will generate a lively discussion on the challenges and solutions for conducting and publishing research in developing countries, which will be published as a research article in a LIS journal with a high readership in developing countries. LIS researchers in developing countries who could not attend the panel can benefit from this article. This panel is likely to help SIG-III, Africa Chapter, and South Asia Chapter build a community of practice and network of researchers in developing and developed countries, who are interested in boosting the research and publication capabilities of LIS researchers in developing countries. We will also create a report based on the panel discussion, which will identify relevant resources for researchers, and potential action items for the Africa Chapter, South Asia Chapter, SIG-III, other SIGs, and The ASIS&T Board. ASIS&T members who would attend this panel would be invited to be part of a future empirical investigation focusing on seeking novel solutions to addressing the challenges for conducting and publishing high-quality research in developing countries. They can help us spread the word and collect data for our empirical investigation and co-author resulting journal articles.

CONCLUSION

LIS as a discipline often aims to address issues related to lack of diversity and inequality in society. However, most of the knowledge in the discipline is grounded in and influenced by researchers and contextual factors in the West. The goals, structure, and expected outcome of this proposed panel aim to address this problem, and hence, align with the theme of the 84th ASIS&T Annual Meeting—"Information: Equity, Diversity, Inclusion, Justice, and Relevance." This panel can serve as a highly visible springboard for initiating global conversations and efforts for addressing the asymmetry of worldviews and knowledge in the LIS discipline currently skewed heavily toward the knowledge sources in the West. This panel and the expected outcome can meet the growing demand of LIS researchers in developing countries for guidance to publish research in top-tier LIS journals.

ACKNOWLEDGMENT

We would like to thank SIG-III, ASIS&T Africa Chapter, and ASIS&T South Asia Chapter for sponsoring this panel.

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“Unity in Diversity”: A Conversation around the Interdisciplinary Identity of Information Science

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ABSTRACT

As a dynamic and interdisciplinary field of study, information science has a diverse set of methods, theoretical frameworks, tools and processes that continue to be developed, adopted, and extended through further research, teaching, and practice. Some of the methods and frameworks have origins in other disciplines. The interdisciplinary nature of information science may have enabled the field to grow in stature but it may have also contributed to it being perceived, often unfairly and mistakenly, as lacking a strong identity, brand, and reputation, leading to a possible fragmentation of the field. Continued conversations around factors that may help and/or hinder the field from fulfilling its full potential and how it can position itself to build an identity on a strong track record are necessary. The panel has two main goals: (1) to engage researchers and educators in an interactive discussion on the contributing factors and ways in which information science can remain a diverse and interdisciplinary field, realize its full potential, and build a strong identity as well as identify potential barriers it needs to overcome; and (2) to delineate the roles its stakeholders and allies need to play to achieve that goal of a field with “Unity in diversity”.

KEYWORDS

Information science; Identity; Diversity; Interdisciplinary field; Unity in diversity.

INTRODUCTION

Information science is a dynamic, continuously evolving, diverse, and interdisciplinary field of study. This is, in part, due to the fact that we live in an information society where information pervades every aspect of our lives and information is increasingly becoming both an input and output of economic activities. The field has a diverse set of methods, theoretical frameworks, tools and processes that have been formulated over several decades and that continue to be developed and extended through further research, teaching, and practice. However, some of the methods, theoretical frameworks, tools, and processes often have origins in other disciplines such as computer science, behavioral science, communications, philosophy, sociology, and linguistics (Cronin, 2008). As such, they are shared among multiple, but often overlapping, fields (Bates, 1999). Naturally, the more intertwined one or more fields are, the more likely that they will share more of the same elements. That sometimes helps sustain each of the fields and they may thrive as a result of their shared methods, frameworks, tools, and processes. That is why some argue that the interdisciplinary nature of information science with its diverse sub-disciplines better represents the field’s reality and enables it to attract more talent and fresh perspectives, making it a more rigorous field. These characteristics may have enabled the field to grow in stature, size, and scope. It has also allowed researchers and practitioners in the field to address grand challenges in society by bringing interdisciplinary teams together to solve complex problems. However, this may have also contributed to the field being perceived, often unfairly, as lacking a strong identity, brand, and reputation, and leading to fragmentation of the field (see Albright, 2010; Bonnici, Subramaniam, and Burnett, 2009; Buckland, 2012; Raju, 2020; Robinson, 2009; Zins, 2007).

An interdisciplinary field such as information science allows researchers, practitioners, and other stakeholders a relative degree of flexibility and freedom to pursue a variety of research projects or practical initiatives. As a result, it could potentially appear to suffer from lack of identity. It is imperative that researchers, educators, and practitioners regularly come together at fora such as the ASIS&T Annual Meeting and engage in discussions to identify roles that each stakeholder needs to play to help chart a way forward for the field as well as keep its “Unity in diversity”. Hence, the need for this interactive panel proposal.

Our panel addresses diversity from the perspective of research topics, teaching, and practice as well as the various methods, theories, models, and tools used and/or applied in the field of information science. The two main goals of the panel are:

1. to engage researchers and educators in an interactive discussion on the contributing factors and ways in which information science can remain a diverse and interdisciplinary field, realize its full potential, and build a strong identity as well as identify potential barriers it needs to overcome; and
2. to delineate the roles its stakeholders and allies need to play to achieve that goal of a field with “Unity in diversity”.

The following questions will serve as starting points for the interactive discussions and activities:

1. How do you characterize the diversity in information science in terms of areas or topics for research and teaching, its defining features, as well as the various methods, theories, models, and tools used and/or applied? How are the multiple identities of the field shaping it overall? What positive and/or negative impacts have they had?
2. What are the contributing factors and ways in which information science can remain a diverse and interdisciplinary field while building a strong identity (or multiple identities) and stature and distinguishing itself from other allied fields (or reframe and reimagine its multiple identities)?
3. What are the three most pressing barriers or potential hurdles it needs to overcome to remain an interdisciplinary and diverse field with a strong identity and a field with “Unity in diversity”?
4. What role does each stakeholder and/or ally (educators, researchers, practitioners, groups such as the iSchools Caucus, professional associations, standard and accreditation bodies, etc.) need to play for information science to achieve the ultimate goal of an interdisciplinary and diverse field with a strong identity and a field with “Unity in diversity”?

The format for the panel session is as follows: Initially, the six (6) panelists will each share their thoughts and viewpoints on the above four questions with a special emphasis on ways to keep the field diverse and interdisciplinary while building it to have a clear and strong identity (20 minutes). Then, the interactive discussion of small breakout groups with the help of the above discussion questions will follow (50 minutes). It will involve participants sharing their views on this topic while panelists facilitate the breakout groups’ discussions. Finally, the last 20 minutes will be dedicated to summarizing the main takeaways of the interactive discussions, reports from each breakout group, and action items generated. The summaries will be shared with ASIS&T and the broader information science community via a blog post. The eventual outcome of the panel discussions will be a journal article.

PANELISTS

Abebe Rorissa is Professor and Director of the iSchool (School of Information Sciences) at the University of Tennessee, Knoxville. Before his current position, he was Associate Professor and Associate Dean for Faculty Development at the University at Albany, State University of New York (SUNY). He also worked in four countries as an educator and practitioner. He has consulted for academic institutions, national governments, and international organizations, including the United Nations. His research interests include multimedia information organization and retrieval, scaling of users’ information needs/perceptions, use/acceptance/adoption and impact of information and communication technologies, and data analytics. Dr. Rorissa was a Member-at-Large on the ASIS&T Board of Directors and a member of its Executive Committee. He will be the moderator for this panel session.

Hemalata Iyer is an associate professor at the University at Albany, State University of New York (SUNY). She teaches in the MSIS program and in the interdisciplinary doctoral program in information science. Her research interests include knowledge organization and representation; metadata; human information behavior; health information user needs and access; organization and representation of complementary systems of medicine (CAM); culture and representation of information; visual resources management.

Kendra Albright is the Goodyear Endowed Professor in Knowledge Management in the School of Information at Kent State University. She has taught graduate and undergraduate level courses in knowledge management, including Business Intelligence, Information Economics, and the Knowledge Economy across four institutions in three countries, including the University of South Carolina and the University of Tennessee, the University of Sheffield in the UK, and the Georgian Institute of Public Affairs in Tbilisi, Georgia. Dr. Albright’s research interests focus on the ways in which users understand and use information to facilitate positive change and solve organizational problems within the knowledge economy. Dr. Albright serves as a consultant to corporations, government agencies, and non-profit organizations and has been invited to speak at numerous conferences including the Henley Knowledge Forum in the UK. Dr. Albright is widely published and currently serves as Editor-in-Chief for *Libri*, the international journal of libraries and information studies. She holds a Ph.D. in Communications, a Master of Science in Library Science, and a B.S. in Human Development.

Devendra Potnis is an Associate Professor at the University of Tennessee at Knoxville. His research focuses on the adoption of information tools, resources, and services by students, marginalized communities, libraries, microfinance, and governments. He has published his research in *Communications of the AIS*, *First Monday*, *Government Information Quarterly*, *Information Development*, *Information Processing & Management*, *IT and Libraries*, *IT for Development*, *Journal of Education for Library and Information Science*, *Journal of Library & Information Science*, *LIS Research*, *Telematics and Informatics*, *The Information Society*, *JASIS&T*, *Journal of Information Science*, *The Library Quarterly*, and other reputed journals. He has received funding from the Institute of Museum and Library Services, OCLC, and ALISE.

Nadia Caidi is a Professor at the Faculty of Information, University of Toronto, Canada. Her research and scholarship have focused on human information behavior and global migration. Her recent work has examined the changing conceptions of diversity, equity and inclusion in our fields. Her book, "Humanizing LIS Education and Practice: Diversity by Design" (co-edited with Keren Dali), was published by Routledge in 2021. Dr. Caidi was the 2011 President of the Canadian Association for Information Science (CAIS) and the 2016 President of ASIS&T. In 2019, ALISE awarded her the Pratt-Severn Faculty Innovation Award. Dr. Caidi is the Director of International Student Engagement at the Toronto iSchool, and the 2020 recipient of ASIS&T's Watson Davis Award for Service.

Daniel Alemneh is head of Digital Curation Unit at the University of North Texas Libraries and teaching at the College of Information. For the past 20 years, Dr. Alemneh has been actively involved in various professional activities including member of ASIS&T Board of Directors. He was a 2019-2020 Fulbright Scholar at Addis Ababa University's College of Natural Science, School of Information Science. Dr. Alemneh will offer his views on the evolving roles of information professionals in navigating the emerging challenges and opportunities, while managing competing priorities in the current open access, cyber threat susceptible, and big data era.

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North-South Scholarly Collaboration: Opportunities and Experiences in Africa

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ABSTRACT

North-South scholarly collaboration and academic exchange programs help to address the challenges experienced by developing countries in Africa and elsewhere, and provide unique benefits to scholars in developed countries. Many academics in the global north, however, have limited, or no, information about opportunities to visit academics and institutions in developing countries and those in such countries in the global south do not have contacts to whom they can reach out. The intention of the panel is to stimulate future north-south collaborations by increasing awareness of both funded opportunities and low budget initiatives for scholarly exchanges and collaborations, benefits for scholars and their institutions in developed and developing countries, and best practices with respect to north-south collaborations and scholarly exchanges. This panel is sponsored by the Africa Chapter and SIG-III.

KEYWORDS

Developing countries; Knowledge sharing; North-South collaboration; Scholarly exchange programs; Scholarly collaboration.

INTRODUCTION

A goal in the ASIS&T strategic plan (2020) is to improve knowledge sharing opportunities through various means (see GOAL #3). This goal supports ASIS&T's mission and vision of a community of researchers and practitioners in information science and technology, and reflects its values of knowledge sharing, equity, diversity and inclusion. One of the ways to achieve this goal, while also providing multiple benefits to ASIS&T members from both developed and developing countries, are formal and informal north-south collaborations among members through schemes such as visiting professor positions, scholarly exchange programs and mobility programs. These and similar national and university programs foster collaboration across cultural and national boundaries and increase our understanding concerning equity, diversity, inclusion, justice, as well as research and teaching contexts and approaches. For example, opportunities to address gender and ethnic inequities and marginalization can be created (Taba et al., 2019).

Collaborations, including sharing expertise on teaching, publication, postgraduate supervision and grant applications, are especially valuable to developing countries (Garcia-Sanchez et al., 2019; Skandhan & Apodaca, 2020). Similarly, collaborations can provide inspiration for new research questions, access to study populations including indigenous communities (Windchief & Ryan, 2019), and opportunities to learn different teaching techniques for scholars in developed countries. Although collaborations provide much value, challenges (Stupak, 1979), careful planning and preparation, management of expected outcomes (Byrne, 1998) must be addressed. Cultural sensitivity and awareness and socialization experiences should also be addressed (Haussler et al. 2003; Xue et al., 2015). A summary of benefits, challenges and stages of scientific collaborations can be found in Sonnenwald (2007).

Collaborations, especially those across geographic, institutional and cultural boundaries, can be facilitated through participation in scholarly exchange and mobility programs. Longer-term visits help members from developing and developed nations build trust relationships that provide a foundation for effective collaboration (Sonnenwald, 2007). For example, cognitive trust focusing on judgments of competence and reliability, and affective trust focusing on interpersonal bonds and perceptions of colleagues' motivations, intentions and ethics are essential for effective collaboration (Sonnenwald, 2003; 2005). It typically takes time to build cognitive and affective trust, and one of the most efficient ways to do this is through extended face-to-face interaction. Face-to-face interaction can be achieved through visiting positions, e.g., as evidenced by the Erasmus+ program (European Union, n.d.), Fulbright U.S.

Scholar Program (Fulbright Commission, n.d.), and universities' exchange programs including visiting professor and academic exchange programs, the appointment of adjunct professors, mutual degree programs, and memoranda of understanding between academic departments and institutions.

Although the practice of visiting scholars and exchange programs is not new (e.g., Beck, 1987; Calhoun, et al., 1980; Dubinsky, 2014) and the benefits and challenges have been discussed in general (e.g., Beeler et al., 2020; Boudreau & Waschke, 2015) and in specific fields such as the health sciences (Shah, et al., 2020; Sayyid et al., 2019), there is no research focusing on visiting scholar and exchange programs and participants' experiences in Information Science and initiatives in Africa.

As the world emerges from the global Covid-19 pandemic and with the ASIS&T Africa Chapter firmly established with approximately 240 members as of March 2021, a panel discussion on academic exchange and mobility program opportunities with universities in Africa is timely. Many scholars outside Africa do not know about visiting positions across Africa or the options that might be available to enable face-to-face interaction and visits. This lack of knowledge ranges from practical issues (e.g., academic calendars, the assistance concerning local housing and local health care, funding) to professional issues (e.g., career and personal benefits from participation, work expectations, availability of local colleagues for research discussions/collaborations, and possible student interaction.) This panel will address these issues from the perspective of scholars in Africa who have hosted scholars from developed countries and who have created exchange programs that host scholars from developed countries, and from the perspective of scholars in developed countries who have participated in scholarly exchange programs in Africa.

This panel is sponsored by the Africa Chapter and SIG-III.

PANEL ORGANIZATION

This panel brings together academics who recognize the need to increase face-to-face visits and strengthen collaboration between global north-south academics and institutions. It includes academics from developing countries who can offer visiting opportunities, and academics from developed countries who have had visiting appointments and collaboration with institutions and colleagues in developing countries.

The moderator, Sonnenwald, will first introduce the rationale for the panel and each panelist. Second, each panelist will share their perspectives and experiences with north-south exchange programs and collaborations as follows.

Opportunities and experiences from a developing country perspective - University of Pretoria. Ina Fourie Fourie will share her personal experiences and experiences within the Department of Information Science hosting and collaborating with academics from the UK and USA at the University of Pretoria in South Africa. She will also present scholarly exchange programs available at the University of Pretoria, including well-funded and low-budget initiatives, and motivations for participating in these programs. (10 minutes)

Opportunities and experiences from a developing country perspective - University of Cape Town. Jaya Raju Raju will share her personal experiences and that of academics within the Department of Knowledge and Information Stewardship in collaborating with international colleagues, hosting visitors at the University of Cape Town in South Africa, and being hosted as visitors in developed country institutions. She will also present the scholarly exchange opportunities available at the University of Cape Town as well as the challenges of maintaining equitable and inclusive north-south scholarly exchange and collaborative initiatives. (10 minutes)

Experiences as a visiting scholar in South Africa. Heidi Julien

Julien will share her experiences as a visiting scholar at the University of Pretoria (South Africa) on two occasions, including the range of engagements experienced on-site, as well as the long-term collaborations that have continued. She will highlight the importance of building relationships and mutual trust, and explore the benefits arising from these visits. Her discussion will also draw on her experiences as a visiting scholar in other countries. (10 minutes).

Experiences as a visiting scholar in Ethiopia. Daniel Alemneh

Alemneh will reflect on his Fulbright Scholar experience in Ethiopia. The Fulbright Scholar program plays a significant role in contributing to the capacity of host institutions. In addition to the formal teaching and research activities, Alemneh participated in strategic planning initiatives, and served on committees and review boards. He also facilitated local researchers' participation in international partnership programs. Alemneh will discuss how such partnerships also provide benefits to sending institutions in multiple ways, ranging from linking faculty members and students through various collaborative projects to developing a memorandum of understanding (MOU) or other formal agreements that facilitate international collaborations and engagements. (10 minutes).

Managing your expectations as a visiting professor to Africa nations. Abebe Rorissa

The presentation will identify things to expect overall and the need for adjusting your expectations and demands

when you volunteer for or are invited to participate in a visiting professor program in Africa. The presentation draws on Rorissa's experiences as a visiting scholar in Ethiopia and other positions in Lesotho and Namibia. (10 minutes).

Engagement with the audience. (30 minutes)

After the presentations, the moderator and panelists will engage with the face-to-face and remote audiences, inviting them to share their ideas, initiatives, experiences, concerns and opportunities with respect to north-south collaboration and exchange programs. Audience members will be provided the option of submitting questions and comments online, and these will be shared anonymously during the panel discussion. Initial questions to stimulate the discussion include:

1. If you work in a developing country and have participated in a north-south collaboration or hosted a visiting scholar in your country as a host, please share:
 - the two most important benefits you experienced as a result of your participation.
 - the two most important things you learned during the collaboration or during the visit that you wished you had known earlier.
2. If you work in a developed country and have participated in a visiting scholar program or collaboration in a developing country or elsewhere, please share:
 - the two most important benefits you experienced as a result of your participation.
 - the two most important things you learned during your visit or during the collaboration that you wished you had known earlier.
3. Is there a scholarly exchange program you wish to briefly introduce to the audience?
4. If you have not participated in a north-south collaboration or scholarly exchange program:
 - what have been the two main barriers to participation?
 - what two additional pieces of information, resources and/or incentives would you like to have before you commit to an exchange program or collaboration?
5. How could ASIS&T assist in facilitating north-south scholarly exchanges and collaborations?

At the conclusion of the session, the moderator will summarize the outcomes of the panel discussions (2 minutes).

EXPECTED OUTCOMES

By the end of the panel discussion the audience will have increased their knowledge regarding the opportunities, benefits, challenges, and preparatory details for north-south collaborations and scholarly exchange programs. The audience will have new contact information about north-south scholarly exchange programs. Ideas regarding ways ASIS&T could facilitate north-south collaboration and exchanges will be generated.

PANEL MEMBERS

Diane H. Sonnenwald is Emerita Professor at the University College Dublin, Ireland. She currently conducts workshops teaching collaboration skills and strategies, and consults with CILIP and the European Commission. She has been a Distinguished Visiting Professor at National Taiwan Normal University and an Erasmus+ Visiting Professor at the University of Osijek, Croatia. Diane has received 25 grants from international foundations, corporations and funding agencies and published over 130 publications. Her research has focused on interorganizational and interdisciplinary collaboration, and on the design and evaluation of emerging and future technologies. She served as ASIS&T President in 2012, and in 2020 she was awarded the ASIS&T Award of Merit.

Ina Fourie is a Full Professor and Head of the Department of Information Science, University of Pretoria, South Africa. Ina holds positions in the leadership of the ASIS&T Executive Board and ISIC (Information Seeking in Context) Steering Committee. Ina has collaborated with researchers from Israel, UK, USA, Sweden and The Netherlands. Her research focuses on information behavior, especially health information behavior in cancer, palliative care, grief and bereavement, autoethnography, information literacy and more recently participatory design, Third Space and information sharing. She has been a visiting academic to the USA and New Zealand.

Jaya Raju is a Full Professor and Head of the Department of Knowledge and Information Stewardship at the University of Cape Town in South Africa. She is a specialist researcher and author in library and/or information science education and its epistemological implications for the discipline and for professional practice, particularly in the African developing context. She is Co-editor-in-Chief of *Library Trends*, the inaugural Co-editor of the ALISE Book Series on LIS education and research, and serves on the editorial advisory boards of several journals internationally. Raju is also Subject Chair (LIS and multidisciplinary journals) on the Scopus Content Selection & Advisory Board and Co-Chair of IFLA's Building Strong LIS Education (BSLISE). Jaya Raju and her Department have hosted visiting scholars from the US and the UK, and she and her colleagues have also been hosted as visitors in Canada, the US and the UK.

Heidi Julien is a Professor in the Department of Information Science, University at Buffalo, USA and a Research Associate at the University of Pretoria, South Africa. She has been involved in ASIS&T in a range of roles for over two decades. Heidi serves on the JASIS&T Editorial Board, and several other journal editorial boards. She is also active in ALISE, serving as President in 2018-19, and she serves on the Steering Committee for ISIC (Information Seeking in Context). Heidi publishes primarily in the areas of information behavior, digital/information literacy, and research methods; she won the 2020 SIGUSE Award for Outstanding Contributions to Information Behavior. She has worked as a scholar in New Zealand, Canada and the USA, and has been honored to serve as a visiting scholar in South Africa, China, Australia and New Zealand, in addition to giving invited talks in several other countries.

Daniel Alemneh is the Director of the Digital Curation Unit at the University of North Texas Libraries and Adjunct Professor at the College of Information, University of North Texas. For the past 20 years, Alemneh has been actively involved in various professional activities including serving on the ASIS&T Board of Directors. He was a 2019-2020 Fulbright Scholar at Addis Ababa University's College of Natural Science, School of Information Science, in Ethiopia.

Abebe Rorissa is Professor and Director of the School of Information Sciences at the University of Tennessee, Knoxville, USA. Prior to his current position, he worked in four countries as an educator and practitioner. He has consulted for academic institutions, national governments, and international organizations, including the United Nations. His research interests include multimedia information organization and retrieval, scaling of users' information needs/perceptions, use/acceptance/adoption and impact of information and communication technologies, and data analytics. Abebe was a Member-at-Large on the ASIS&T Board of Directors and a member of the Board's Executive Committee.

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Antiracism in the LIS Profession: Not Just Lip Service

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ABSTRACT

With rising cases of brutality, gun violence, and racial injustice towards particularly the Black and AAPI (Asians, Asian Americans, Pacific Islanders) communities, racism is being recognized and declared as an emergency and public health threat. Diversity, equity, and antiracism are core to the Library and Information Science (LIS) profession as we strive to uphold the principle of “libraries serve humanities” and the motto of “free to all.” During this extended period of ‘racial-injustice as a public crisis’, what are the roles of LIS professionals in battling racism, violence, and other systems of oppression? This panel session features experienced LIS professionals and educators who specialize in DEI, reporting their activities, stories, and thoughts on antiracism. A breakout room activity is envisioned following panelists’ presentations, with participants discussing and sharing their antiracism initiatives. Participants will also brainstorm the next course of action in the LIS profession’s journey in battling racism.

KEYWORDS

Antiracism in LIS, Racism as Public Health Threat, LIS Core Principles in Battling Racism, Actions and Initiatives, Equity in Service & Access

INTRODUCTION

Battling racism has been a very long and never-ending journey in the Western world. As indicated by Kendi (2019), “We are surrounded by racial inequality, as visible as the law, as hidden as our private thoughts” (p. 22). During the tumultuous time of the COVID-19 pandemic, systemic and structural racism once again have been rearing their ugly heads in the US and around the world. They have manifested through multiple cases of brutality, violence, and racial injustice, including the deaths of Breonna Taylor, Ahmaud Arbery, and George Floyd. There has also been an increased number of gun violence and hate crimes towards the AAPI (Asians, Asian Americans, Pacific Islanders) communities. Several government officials and local administrative leaders such as Boston’s former mayor Martin J. Walsh declared racism as an emergency and a public health crisis. In his “An Executive Order Declaring Racism an Emergency and Public Health Crisis in the City of Boston,” Walsh (June 12, 2020) stated:

WHEREAS; racism is threat to public health and safety, and is a paramount social determinant of health, shaping access to the resources that create opportunities for health, including public safety, housing, education and employment, and is a persistent barrier to health equity for all Bostonian; . . .

WHEREAS; racial justice is the creation and proactive reinforcement of policies, practices, attitudes and actions that produce equitable power, access, opportunity, treatment, and outcomes for all people regardless of race; . . .

WHEREAS; all Boston residents are welcomed to join in working toward a city where all residents live fulfilling lives free of racism, poverty, violence, and other systems of oppression.

(p.1-2)

Recently, Rochelle P. Walensky, director of the Centers for Disease Control and Prevention (CDC), also declared racism a serious public health threat. In her statement, Walensky (April 8, 2021) indicated that “Racism is not just the discrimination against one group based on the color of their skin or their race or ethnicity, but the structural barriers that impact racial and ethnic groups differently to influence where a person lives, where they work, where their children play, and where they worship and gather in community. These social determinants of health have life-long negative effects on the mental and physical health of individuals in communities of color.”

During this extended period of “racial-injustice as a public crisis,” what are the roles of information institutions and LIS professionals in battling racism, violence, and other systems of oppression? Cindy Hohl (2020), the President of American Indian Library Association, wrote in her “A Call for Action” piece on *Library Journal*, “The time is now

for library leaders to get it right when crafting intentional diversity, equity, and inclusion plans, as we focus our collective antiracism efforts towards helping our colleagues engage in thoughtful dialogue across our networks” (p. 12). Hohl declared that LIS professionals should resist layering empty slogans and using incomplete diversity plans. She further points out that LIS professionals need to take responsibility for our own actions. Diversity, equity, and antiracism are core to the LIS profession, as articulated by Grawford and Gordan (1995) in one of their added laws of librarianship: “libraries serve humanity.” By emphasizing humanity, Crawford and Gordan (1995) indicate that “we mean the individual *and* humankind as a whole. Libraries do not exist to serve exclusivist groups” (p. 8). The principle of “libraries serve humanity” echoes profoundly with the three-word motto engraved at the entrances to the Boston Public Library’s Central Library and BPL branches—“Free to All.”

In his book *How to be an Antiracist*, Ibram X. Kendi (2019) alerts that “The opposite of racist isn’t ‘not racist.’ It is ‘anti-racist’ ... One endorses either the idea of a racial hierarchy as a racist, or racial equality as an anti-racist. One either believes problems are rooted in groups of people, as a racist, or locates the roots of problems in power and policies, as an anti-racist. One either allows racial inequities to persevere, as a racist, or confronts racial inequities, as an anti-racist. There is no in-between safe space of ‘not racist’” (p. 9). In the LIS field, Hohl (2020) recognizes that “Guilt can be palpable, and so can racism, unconscious bias, microaggressions, and acts of prejudice... *Toxicity. Disease. Ignorance.* We see these continue to surround our field as colleagues dodge responsibility for their actions” (p. 12). She further calls for LIS professionals to take responsibilities and implement concrete plans for changes: “Simply signing a diversity pledge is not taking the first step forward until all our actions are in alignment with our words and we are standing shoulder to shoulder” (p. 12). In their recent report entitled “National Movements for Racial Justice and Academic Library Leadership,” Frederick and Wolff-Eisenberg (2021) also specify the need for implementing strategies and measuring changes: “Improving equity, diversity, inclusion, and anti-racism does not just require strong leadership... but a set of strategies, implementation of those strategies, and mechanisms for measuring change and maintaining accountability” (p. 8).

In this panel session, the focus of the presentation and discussion will be on actual actions—initiatives, programming, projects, and services that have been implemented in our professional practice to combat systemic/structural racism. Panelists are from both practice-based and academic settings, reporting their activities, stories, or thoughts on antiracism in our profession. The following are some of the questions that will be discussed in their presentations:

1. What is your opinion on the importance and value of the LIS profession advocating and practicing antiracism in our field?
2. How has racism manifested in our profession? What are the various dimensions of racism in our field?
3. Do you and your community have a good pulse check on racism, hate, or violence towards BIPOC (Black, Indigenous and People of Color)? Do you and your organization reach out and connect with BIPOC members of your community?
4. What antiracism initiatives, staffing, and programming have your organizations or institutions implemented and how effective are they?
5. What obstacles or challenges do LIS professionals face in our endeavor to move forward with our antiracism and DEI efforts?
6. What are lessons you have learned in your efforts to combat racial injustice?
7. Cindy Hohl (2020) reminds us that the antiracism has “no finish line.” What actions do you recommend implementing antiracism and DEI programming as a long-term endeavor to fight against structural and systemic racial inequality and injustice?

PANELISTS

Panelists are very well experienced practicing LIS professionals and LIS educators who specialize in DEI.

- Organizer and Moderator: **Rong Tang**, Professor, School of Library and Information Science, Simmons University, USA
- **Rebecca Davis**, Assistant Professor, School of Library and Information Science, Simmons University, USA
- **Jia Tina Du**, Associate Professor, UniSA STEM, University of South Australia, Adelaide, Australia
- **Xan Goodman**, Health Science Librarian, Racial Healing Circle Facilitator, University of Nevada, Las Vegas; Chair, MLA DEI Committee, USA
- **David Leonard**, President, Boston Public Library, USA
- **Bridgett Pride**, Reference Librarian, Schomburg Center for Research in Black Culture, New York Public Library, USA

PANELISTS' BIO AND PROFESSIONAL EXPERIENCE WITH DEI

Rebecca Davis, Assistant Professor, School of Library and Information Science, Simmons University

Dr. Rebecca Davis (she/her/hers) is an Assistant Professor in the School of Library and Information Science (SLIS) at Simmons University. She is a member of the SLIS Diversity, Equity, and Inclusion (DEI) Committee. Her research focuses on diversity issues in academic libraries and the field of Library and Information Science (LIS). Rebecca received an Early Career Development Grant in 2020 from the Institute of Museum and Library Services (IMLS) for her project African American Undergraduates' Use of Academic Libraries. She is working with a SLIS colleague to learn about first-generation graduate students' information seeking behaviors when applying for graduate school. Rebecca has given presentations on implicit bias, microaggressions and anti-racism in LIS. She teaches user services courses, has worked in academic and health sciences libraries, and is from North Carolina.

Xan Goodman, Health Science Librarian, Racial Healing Circle Facilitator, University of Nevada, Las Vegas; Chair Designate, MLA DEI Committee

Xan Goodman is an Associate Professor and Health Sciences Librarian at the University of Nevada, Las Vegas. She is co-editor of the ACRL publications, *Faculty-Librarian Collaborations Integrating the Information Literacy Framework into Disciplinary Courses* (2020), and *Disciplinary Applications of Information Literacy Threshold Concepts* (2017). Xan is lead author of the article *Teaching cultural humility & cultural competence in dental medicine*. She is also an ALA trained racial healing circle facilitator. Xan was appointed the first chair of the Medical Library Association, Diversity, Equity, and Inclusion Committee. The MLA DEI Committee acts in advisory capacity to ensure DEI is infused throughout MLA. Xan is also one of the five librarian authors of the withdrawn editorial, *Starting with I Combating Anti-Blackness in Libraries* which outlines concrete steps libraries can take to avoid anti-Black practices. Xan is an American Library Association Spectrum Scholar and a born and raised Detroit.

Jia Tina Du, Associate Professor, UniSA STEM, University of South Australia, Adelaide, Australia

Dr. Jia Tina Du is an Associate Professor of Information Studies and Director of Information and Innovation Laboratory in the UniSA STEM, University of South Australia. Her research interests are in applied and interdisciplinary studies related to information behavior, interactive information retrieval, marginalized communities, and social impact of digital technologies. Over a 15-year academic career, Tina has applied her disciplinary knowledge from the fields of information studies, user experiences and community development to successful collaborations with colleagues in areas ranging from computer-supported collaborative work to web geographic information system-based cultural heritage mapping. Her research has resulted in over 110 peer reviewed publications. In the last five years, Tina's focus has turned to "IT and Social Justice". By integrating her information and technology expertise with a passion for social justice and equality, she is helping people from marginalized groups overcome the challenges of technology and use it in their everyday lives. This includes people from Aboriginal, migrant and older communities who often find the digital world complex and daunting.

David Leonard, President, Boston Public Library, USA

David Leonard has led the Boston Public Library since June 2016. In this role, David oversees a collection estimated to contain more than 23 million books, maps, manuscripts, prints, and an ever-expanding digital collection, and a system comprising the historic Central Library in Copley Square, 25 neighborhood branches, and an archival center. The BPL also serves as the Library for the Commonwealth of Massachusetts. Prior to his formal appointment as President, David served as the Library's Interim President, during which he focused on the completion of the \$78 million renovation of the Central Library in Copley Square, which opened in July 2016. David's prior background spans academia, the non-profit sector, and more than a decade of private IT consulting, counseling clients about business development, management, and technology. David is currently enrolled in the PhD. program in Library Information Science at Simmons University, and holds degrees in Philosophy and Mathematics from the University College Dublin. David has led the formalization of the BPL's commitment to becoming an anti-racist institution which includes a review and set of action steps pertaining to its collections, services, outreach, programs, partnerships and culture; this work is ongoing.

Bridgett Pride, Reference Librarian, Schomburg Center for Research in Black Culture, New York Public Library, USA

Bridgett Kathryn Pride (she/ her) is the reference librarian for the Manuscripts, Archives, and Rare Books Division and the Art and Artifacts Division of the Schomburg Center for Research in Black Culture. She is part of the inaugural class of Cultural Heritage fellows for the Rare Book School at the University of Virginia. Bridgett is a partner at J.Ivy Consulting, where she co-facilitates trainings, workshops, and improvement plans for institutions committed to becoming anti-racist. Bridgett received her MLS, and a MA in History from Simmons University in

2018. She was a part of the Diversity, Equity, Race, Accessibility, and Identity in LIS (DERAIL) forum, and served as the 2018 project manager. She studies American women and their intersectional identities with gender, race, and class in the 19th and 20th centuries. Currently her research covers the history of zine making in black communities as it pertains to activism and social justice.

PANEL FORMAT

This will be a 90-minute virtual panel that involves presentations and breakout room discussions.

- Overview and Introduction [3 minutes]
- Panelists' Presentations [50 minutes, 9 Minutes per speaker; 5 minutes Q&A at the end]
- Breakout Room Discussions [22 minutes]
- Report back [12 minutes]
 - Participants will have an opportunity to share in the larger room about their initiatives.
- Wrap up [3 minutes]

Breakout Room Discussions Questions

1. What antiracism initiatives, staffing, and programming have your organizations or institutions implemented and how effective are they?
2. How may the LIS profession address racism at the personal, cultural, institutional, and society levels?
3. What are the next steps or course of action?

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Collaborative Efforts and Success Story of an Open-Learning Program: Partnership Growth of the Research Data Management Librarian Academy (RDMLA)

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ABSTRACT

Launched in October 2019, the Research Data Management Librarian Academy (RDMLA) addresses the learning gaps in RDM training. Through a unique partnership among practicing librarians, LIS faculty, and industry, the RDMLA has produced a dynamic open learning experience, highlighting the benefits of collaboration and skill-sharing. This collaboration's success lies in how the project leveraged each partner's strengths and experience while centering on the shared purpose, dedication to equitable learning, and mutual respect among the team members. This panel focuses on the collaborative efforts undertaken by the RDMLA leadership and instructors to develop an open-access professional development education program. Five panelists will share their experience working on this large collaborative project from varying perspectives, the lessons learned while developing their content, the challenges they encountered, and their understanding of the benefits of such a collaborative endeavor in producing free, open-access learning to foster a community of practice in RDM.

KEYWORDS

Research Data Management Librarian Academy; collaboration and partnership growth; open learning and diverse learner needs; education equity; global RDM community of practice

INTRODUCTION

Launched in October 2019, the Research Data Management Librarian Academy (RDMLA) addresses the learning gaps in RDM training discovered in 2018 needs assessment survey and environmental scan. The findings provided insights into RDM practices, the state of RDM training, and exposed missing areas, key among them, a holistic, accessible, self-paced, and expandable curriculum. The RDMLA curriculum framework consists of eleven units addressing expressed RDM needs while avoiding redundancy in current training offerings. The first eight units were released in October 2019, and an additional three units were made available in late 2020. RDMLA currently has over 5,200 registered learners from 159 countries. Through the RDMLA, we seek to build a global community of practice of RDM and further advance RDM practice in libraries and beyond.

This panel focuses on the collaborative efforts undertaken by the RDMLA leadership and instructors to develop an open-access professional development education program, with an emphasis on promoting learning equity and providing free, open access worldwide. Panelists will discuss their experience working on this large collaborative project, lessons learned while developing their content, and the benefits of producing free, open-access education courses.

PROJECT SPECIFICS AND CHALLENGES

RDMLA is a collaborative effort of LIS faculty, librarians from health sciences and research institutions, and industry professionals. Partner institutions include Harvard Medical School, Harvard Library, Simmons University, Brown University, Northeastern University, Tufts University, Boston University, MCPHS University, DataONE, National Taiwan University, National Institutes of Health, Indiana University-Purdue University Indianapolis, and Elsevier. The partnership has been expanding, including upcoming partnership with MLA and LEADING.

The mission of the RDMLA is to build a dynamic RDM-centric education program that targets the expansion of librarians' toolkits to improve skills and provide professional development. With a focus on equitable learning, course content is constructed to service librarians in different geographical locations, varying levels of proficiency, and professional experience. To stay true to this mission, the RDMLA partners with working librarians and LIS

faculty who are proponents of open-access data and open education. When a learning gap is identified, instructor/s with expertise and working knowledge on a topic are invited to develop new content for the RDMLA, ensuring the course remains an active and effective resource.

Work on the RDMLA began in 2018 with an environmental scan of available RDM training opportunities for librarians, in addition to a needs assessment survey. With learning gaps and training needs identified, the RDMLA leadership secured Elsevier as a funding partner and invited librarians and LIS faculty from New England to participate in content construction. In 2019 concentrated work began on the course with the assistance and guidance of an instructional designer. From February through August, unit subject matter and learner engagement were finalized, video lectures produced, and course build on Canvas Network was completed, culminating in the formal launch of the RDMLA on October 7, 2019. Immediately following the launch, the RDMLA leadership started planning for new units to address learning gaps that were not covered in the first eight units, as well as growing the partnership with Simmons University to include a continuing education credits certificate. Throughout 2020, three new units were produced and new partnerships with DataONE and National Taiwan University (NTU) were cultivated. Moving into 2021, the RDMLA is continuing to not only expand available educational content but also collaborating with new partners with the creation of mini-modules that focus on current topics relevant to librarians' immediate needs. Further, the leadership is considering how best to serve the growing community of practice beyond just providing an ongoing professional development course. Some of the continuing efforts include:

- Collaboration with new partners, such as DataONE and the Medical Library Association (MLA), to both expand and provide content relevant to the needs and professional growth of librarians, but also to expand the visibility of the course.
- In order to sustain continued growth and adhering to RDMLA's mission, new partnerships outside of the local New England community have become a top priority. So far, partnerships with NTU, DataONE, MLA, and National Institutes of Health (NIH), LEADING, have been established, with more forthcoming.

Throughout the collaborative process, some of the key challenges encountered include:

- Instructor and Leadership bandwidth - RDMLA is a "passion project" outside of team members' routine work tasks, which requires collaborator commitment and effective means of producing content and moving the project forward in a productive manner that is adaptive to competing schedules and priorities.
- Construct and maintain the "RDMLA shared mental model" - team members brought their expertise, creativity, and sets of interest and norms carried out in their institutions, which may facilitate or impede the project progress. Thus, recognizing the disparities and commonalities that can subsequently form project working norms is essential in keeping the team members aligned.
- Communication - Prior to course launch, monthly in-person team meetings were held to give updates on the unit and course development progress, while all other team conversations and announcements were delivered via email. With the stay-at-home orders associated with the Covid-19 pandemic, all project and team meetings were moved online (conducted via Zoom), but regular communication still occurred via emails.
- Underlying connection and coherence of the units - Although instructors were developing their unit content independently, they were not siloed and worked collectively to establish links among the eight units. While the instructors aimed to draw connections between their unit/s and others, the challenge fell to the project team and instructional designers to present and deliver each RDMLA course unit as complete coverage of the specific topic and bring all eight (now eleven) units together as a coherent whole. Furthermore, through a usability evaluation conducted in Fall 2019, partners recognized the need to address learning gaps for learners with diverse needs, and have been working on improving the RDMLA content to be more accessible.
- Moving beyond local partners - Due to proximity and existing connections, the RDMLA project leaders were easily able to find willing instructors for the first eight units from local New England (primarily Boston) universities. Yet, in order to keep the RDMLA from becoming geographically stagnant and fulfilling the course's mission of being a global community of practice, the challenge of identifying and approaching potential collaboration partners - both within the United States and internationally - has become a primary focus as the course continues to develop and grow.

PANEL SESSION AND PANELIST

This virtual panel session will start with an introduction of the panelists from Dr. Rong Tang, who will also provide a timeline of RDMLA partnership growth, followed by panelists' presentations, each for 10 minutes addressing the discussion key points listed below. Then Dr. Tang will open up the floor for questions and facilitate a discussion among the panelists and audience.

- Driving reason to participate in the collaborative process
- The perspective of RDM and how it shapes the understanding of RDM knowledge and expertise

- The perspective/approach of RDM and how it influences the course unit development
- Challenges confronted during the collaborative process
- Knowledge and skills gained through the collaborative process
- Perceived benefits and implications of this collaborative approach in facilitating communal learning

We invited four instructors of the RDMLA course and one of the co-leaders of the RDMLA project to participate in this panel to share their experience from various perspectives, ranging from an RDM practitioner, an LIS faculty, an RDM service program manager, and a project leader.

- Ceilyn Boyd (Unit 3 Instructor; Research Data Program Management, Harvard Library)
- Andrew Creamer (Unit 2 Instructor; Scientific Data Management Specialist, Brown University)
- Adam Kriesberg (Unit 11 Instructor; Assistant Professor, Simmons University)
- Elaine Martin (RDMLA Co-leader and Unit 1 Instructor; Director of Countway Library of Medicine, Harvard Medical School).
- Rebecca Morin (Unit 4 Instructor; Head of Research and Instruction from Hirsh Health Sciences Library, Tufts University)

Key points of each panelist's perspectives are summarized in the following subsections:

Elaine Martin - A collaborative partnership is an agreement between different organizations to accomplish a mutual goal. RDMLA is an example of a successfully multi-institutional partnership with the goals of, 1) advocating for the role of librarians in research data management; 2) retooling the librarian workforce for this new role; and 3) creating a community of practice at a global scale. RDMLA's success is based on the variety of expertise provided by the partners and the different types of organizations represented by the partner institutions: industry, libraries, and school of library and information science as well as its international nature. In addition to a dedication to these specific goals, partners contribute to the development of RDMLA in different ways that are tailored to their specific resources. Some partners develop content for course modules, others provide language translation; others provide expertise in identifying current trends; while some provide ongoing financial support. All partners participate in ongoing strategic planning, contributing to new directions for RDMLA, and ongoing communication including attending meetings and participating in retreats. As a co-leader of RDMLA, Dr. Martin will focus her presentation on the development of the RDMLA partnership, the evolution of the partnership, and the overall benefits of the partnership to the LIS community.

Andrew Creamer - I was drawn to the RDMLA project being a free and living project that would evolve over time and to its mission to make it less English-centric, as a resource for librarians. I serve faculty and students in the sciences and am also an informationist on several research teams, so these roles have shaped my perspective on research culture. My goal was to set a foundational knowledge on the types of research and research roles in the basic and clinical sciences, and how learners can engage with research culture, while also being aware of the pressures that researchers are under, and how librarians can help make connections with tools and resources that support transparency. RDM, as a part of librarianship, has to continue to update and evolve. There are some practices that remain, but the field and practitioners have to continue to innovate. This course accounts for various RDM roles as well, including management that helps to expand the view on the breadth of positions out there. I think as we continue to shift to virtual and remote experiences and the concepts of credentialing and degrees evolve in the 21st century, open-access tools will be more widely incorporated.

Ceilyn Boyd - Collaborating in the design and development of the RDMLA courses has been a rewarding experience. The opportunity to participate was timely, arising just as my organization prioritized professional development in data services and project management for our library staff. RDMLA offered a means to learn from and build closer ties to other libraries while also developing course modules to benefit librarians and researchers worldwide, and those within my library system. Like many libraries, we will continue to offer specialized data services training and instruction to our staff and research communities. But the RDMLA remains a key professional development resource for us to provide comprehensive library training across the entire research data lifecycle.

Rebecca Morin - I was drawn to participate in the RDMLA because research data management is a source of stress and confusion for a lot of librarians at all levels of advancement in the profession, and it doesn't need to be this way. My firm belief is that RDM is a cooperative effort. This extends beyond expected institutional collaborations with groups such as IT and research cores; while these relationships are essential to RDM success, I have found the best ideas and greatest support from other librarians in the field. As the Head of Research and Instruction, I work closely with students and other researchers and have the valuable opportunity to observe institutional RDM expectations and the ability to help shape how my team approaches and communicates about RDM. Unit 4 teaches important lessons about institutional character and identifying stakeholders, but it is built around a core of real professionals sharing their real experiences establishing RDM programs, not all of which were successful. I think the communal learning

environment established in the RDMLA is an ideal environment to share these experiences, while also serving as a safe and accessible intellectual space to learn new concepts and try new skills.

Adam Kriesberg - Research data management combines multiple skill sets from across the information science professions and I recognized the opportunity to contribute my perspective and background to the existing RDMLA curriculum when I spoke with the project team. As a LIS educator teaching courses on digital curation, digital preservation, and archiving, I understand that many professionals in the field do not have experience or coursework in data management. I see the RDMLA project as a key educational resource for anyone interested in developing skills in RDM. The low barriers to access, multiple language support, and open licensing of the materials are also valuable in making RDMLA courses available around the world. What makes RDMLA valuable to learners is that it brings together experts from different institutions, in different roles, with different approaches to the work. This makes for a dynamic set of courses with something to offer anyone looking to learn more about research data management and apply it to their professional context.

LESSONS LEARNED

The following important lessons learned may be beneficial to those who wish to undertake a similar project:

- Focus on shared purpose and goals - The key to the collaboration's success was not an abundance of resources, it was the shared commitment to make the RDMLA a viable learning tool. This common goal inspired both teams to be diligent with their time and provide ongoing support to all members. Mutual respect created an open environment allowing for honest communication and collaborative attitudes in solving translation issues.
- Start local and reach out - When getting a project off the ground, local partners make the process easier (similar academic environment and interest, low communication cost), can also give leads to other individuals who may be interested and/or can contribute to the project. Furthermore, continue to reach out to a broader group of potential partners.
- "It takes a village" - A team needs to consist of more than just instructors. Content experts and coordinators are essential to make the project successful. Bringing different perspectives is also helpful in identifying potential pitfalls and opportunities.
- Careful planning and flexibility - Planning from all parties helped minimize cost and maximize productivity, with the understanding that not only timelines but other planning, funding, and development aspects may need to change midstream.

CONCLUSION

This collaboration was successful due to the emphasis placed upon valuing partners and each member's contribution. Positive participation was promoted throughout the process, including recognizing and leveraging each team member's strengths. Further, the project team continues to work toward increasing the number of diverse voices in both data and librarianship, as well as connecting with international partners that add perspectives and relevance to learners outside the U.S. Our usability tests highlighted the value of addressing diverse learners' needs, and our strategies for improving design have focused on filling the learning gaps for all learners. This union continues post-launch with semi-monthly team meetings, presentation engagements, and conference presentations to promote our course. We share experiences to inspire similar collaborative projects. The dedication to equitable learning and growing a global community of practice was the essence of this successful and growing partnership.

Endurance and Coherence: The Post-2020 iSchool

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ABSTRACT

The iSchools Organization encompasses 121 information and library science schools around the globe, and is rapidly expanding. Officially begun in the early 2000s as a way to bolster a sense of field-wide purpose and identity relevant to the twenty-first century, among other objectives, iSchools are positioned as those sharing an interest in information, people, and technology. Early questions about endurance of the iSchools movement are now largely overshadowed by, and joined with, questions about coherence of the iSchools movement. This 90-minute virtual panel will present international findings about issues that are currently, as of 2020-2021, top-of-mind for iSchool leaders, pertaining to: 1.) views on and of the field of information; 2.) faculty and institutional relationships; and 3.) extra-unit alliances and alignments, including with and within the iSchools Organization itself. It draws mainly upon interview data from the funded project *i4G: Shaping the iSchools' Identity and Interaction in a Globalized World*.

KEYWORDS

diversity; information science field; interdisciplinarity; internationalism; iSchools

BACKGROUND

The iSchools Organization encompasses 121 (as of April 1, 2021) information and library science schools around the globe, and is quickly expanding. Officially begun in the early 2000s as a way to bolster a sense of field-wide purpose and identity relevant to the twenty-first century, among other objectives, iSchools are positioned as those that “share a fundamental interest in the relationships between information, people, and technology” (iSchools Inc., n.d.; Larsen, 2010). Formation of the iSchools Organization led to a wave of interest and curiosity around the iSchools, the iField, and the futures thereof, particularly relative to library science traditions and professional ties. Early publications (e.g., Burnett and Bonnici, 2013; Dillon, 2012; Olson and Grudin, 2009; Wobbrock et al., 2009) often hinted at—or sometimes explicitly raised—questions of *endurance*: Does the iSchool direction have lasting power? Does the iSchool movement represent a break from or a conflict with existing concerns? Will iSchools Organization and iField momentum follow from tight inner circle trail-blazing, or emanate from a critical mass of membership?

Over the last two decades, the uniting emphasis behind the iSchools Organization—a triad of information, people, and technology, inextricably linked—has become an accepted outlook within, and the public image and messaging for, many information and library science schools internationally. The focus of questions about the iSchools, the iField, and the futures thereof is now shifted, and may be said to be less about endurance and more about *coherence*. As one example, iSchools share some similarities across curricular coverage and interest in moving toward more shared content (e.g., data science for Lyon and Brenner, 2015), but not necessarily with common foundations or frameworks from accrediting bodies. As another example, many iSchools desire collaboration and the ability to leverage funding (per the iSchools Organization’s “Goals,” iSchools Inc., n.d.), but faculty compositions are multidisciplinary by necessity (Dillon, 2012; Olson and Grudin, 2009), and interdisciplinarity dominates individuals’ undertakings (e.g., Luo, 2012). Given iSchools’ heterogeneity and the iSchools Organization’s wide expansion, to what does ‘being an iSchool’ translate, beyond its broadly encompassing information-people-technology mantra? And, is a united global front with regards to information-related issues possible, or even desirable?

The year 2020 was one of historical upheaval—a global pandemic and resultant restrictions on movement, along with widespread social and political unrest and calls for racial justice that emanated worldwide—and 2021 is continuing these conversations. Thus, it is worthwhile to take stock of what is happening in iSchools at present, and of the iSchools Organization’s mission, so to make sense of meaningful individual and collective roles going forward. To positively impact the real worlds of individuals, organizations, and societies is one of the defined purposes of the iSchools Organization, and is highlighted within its “Vision” (iSchools Inc., n.d.). This **90-minute virtual panel** will broadly address the Annual Meeting themes of, especially, diversity and relevance by presenting international findings about issues that are currently, as of 2020-2021, top-of-mind for iSchool leaders. These issues include: 1.) views on and of the field of information; 2.) faculty compositions and institutional relationships; and 3.) extra-unit alliances and alignments, including with and within the iSchools Organization itself. This panel draws mainly upon interview data from an Andrew W. Mellon Foundation-funded project entitled *i4G: Shaping the iSchools’ Identity and Interaction in a Globalized World*, aimed at, in part, assessing the iSchools Organization’s value propositions and their realizations. More about the *i4G* project and the iSchools Organization’s “Vision” and “Goals” follow below in sub-sections.

The *i4G* Project

Begun in late 2019, the *i4G* project has thus far collected documentary data from all 121 member schools of the iSchools Organization, and interview data from leaders at 71 iSchools across the three North and South American, European, and Asia-Pacific regions. Regional sample sizes at the time of writing this proposal are found in Table 1.

Region	Number of iSchools with leaders interviewed	Percentage of Total Regional iSchools with leaders interviewed
North/South America	35 / 54*	65
Europe	17 / 34	50
Asia-Pacific	19 / 33**	58
	71 / 121	59 %

Table 1. Regional sample sizes, as of April 2021

*Only 53 N/SA iSchools contacted to date.

**Only 32 A-P iSchools contacted to date.

Interview data relates to field-wide challenges, institutional contexts, and iSchools Organization membership. As a majority of interviews were conducted after the spread of COVID-19, this complicated data collection while also presenting a unique opportunity to hear iSchool leaders’ concerns and their unit-based and institutional responses.

As mentioned, the project is partially aimed at critically assessing the iSchools Organization’s value propositions and realizations of these. Namely: *What are the strengths and weaknesses of these, in terms of a common basis for a shared, sustainable program? What does the iSchools community, as a global organization, value? Are these values expressed in every iSchool? What actions are the iSchools taking to realize these values?* One deliverable of the project is a digital “Diversity Map” of all iSchools, to be made available publicly online, showcasing key: missions and activities; functional and operational attributes; partners and stakeholders; and issues and concerns.

A common coding framework has been developed, and data analysis is ongoing. Thus far, all preliminary analysis and much focused analysis has been completed. To date, findings suggest that while many of the same aspirations and hesitations around common purpose and identity of iSchools persist, these are exacerbated rather than eclipsed—or clarified—by the reach of the iSchools Organization at present. That is, iSchool leaders of 2020 and 2021 perceive of endurance and coherence as intertwined issues; they gesture to challenges of, as well as potential for, coordinating a worldwide effort and setting priorities across constituencies, each with a local reality and distinctive approach.

The iSchools Organization’s Vision and Goals

Enhancing public visibility, capitalizing upon scholarly opportunities, bolstering a shared identity, and informing public policy—all in ways that will positively impact the real worlds of people, organizations, and culture—are highlighted within the iSchools Organization’s “Vision” and “Goals.” Specifically, the iSchools Organization’s “Vision” reads as follows (iSchools Inc., n.d., emphasis added):

The iSchools Organization seeks to **maximize the visibility and influence of its member schools, and their interdisciplinary approaches** to harnessing the power of information and technology, and maximizing the potential of humans. We envision a future in which the iSchool Movement has spread around the world, and **the information field is widely recognized for creating innovative systems and designing information solutions that benefit individuals, organizations, and society.** iSchool graduates will fill the personnel and leadership needs of organizations of all types and sizes; and our areas of research and inquiry will attract strong

support and have profound impacts on society and on the formulation of policy from local to international levels.

The iSchools Organization's "Goals" are (iSchools Inc., n.d., emphasis added) to:

1. Lead and promote the information field. Member schools are committed to collective efforts that will **shape the information field, communicate its purpose and value and enhance its visibility**.
2. Create effective responses to strategic research and academic opportunities. Member schools **work together to enhance academic initiatives and to leverage funding** for important research challenges in the information field.
3. Provide support for, and solutions to shared challenges. Member schools **provide one another with mutual support and a collective identity**, helping constituent schools respond to local challenges and advance the information field.
4. **Provide informed perspectives on matters of public policy** as they affect the collection, organization, dissemination, use, and preservation of information.

PROCESS

This panel will begin with an introduction to the concept of an iSchool and to the iSchools Organization, and to the *i4G* project by the moderator. Next, the moderator will offer a succinct, high-level overview of data collected from the three regions—North/South America, Europe, and Asia-Pacific. Then, a representative from each of the three regions will present an in-depth portrayal of issues surrounding diversity and relevance from their regionally contextualized perspective. To direct these presentations, ensure their streamlined accessibility, and enable comparison, regional representatives will speak within the three-part framework outlined earlier:

- 1.) About views on and of the information field, particularly its trending topics, its major challenges, and the evolving research activities addressing these (emphasizing the iSchools Organization's Goals 1, 3, and 4 especially);
- 2.) About faculty compositions and institutional relationships, particularly iSchools and their parent institutions, their collaborations and funding sources, and their graduates' employment prospects and statistics (emphasizing the iSchools Organization's Goals 1, 2, and 3 especially); and
- 3.) About extra-unit alliances and alignments (including with and within the iSchools Organization itself), particularly having to do with branding, community-making and -maintaining, and services provided (emphasizing all of the iSchools Organization's Goals, 1, 2, 3, and 4).

The introduction and regional presentations will be strictly timed, accounting for no more than 50 minutes of the total 90-minute panel session. This means that 40 minutes will remain for at least one summary question portion, and an (optional) audience involvement portion. Prior to the audience involvement portion, up to 15 minutes will be devoted to audience questions regarding the iSchools Organization and iSchool operations in the three regions.

AUDIENCE INVOLVEMENT

After the panel introduction, regional presentations, and first summary question portion are complete, the audience will be arranged into up to three breakout groups (led by regional representatives) and encouraged to spend 15 minutes assessing, per one of the *i4G* project's guiding research questions, the strengths and weaknesses of the iSchools Organization's "Vision" and "Goals," in terms of a common basis for a shared and sustainable program—be this across regions or the world. The presenters and audience will then come back together for a short, synthesizing discussion of compelling ideas and possible 'next steps.' Any remaining time (potentially, 5 minutes) will be used to consider and address remaining audience questions.

PANELISTS & CONTRIBUTIONS

Moderator

Either the *i4G* project's Principal Investigator, Dr. Gobinda Chowdhury, or one of its three Co-Investigators, Drs. Gary Marchionini, Vivian Petras, or Lihong Zhou, will serve as moderator of this virtual panel, introducing the concept of an iSchool, the *i4G* project, and high-level international data. They will also call on and time each regional presenter; lead and time the summary question portion(s); and time the audience involvement portion.

North and South American Region Presenter

The Postdoctoral Research Associate for North and South America, Dr. Leslie Thomson, will present *i4G* project data from this region and lead or help to lead one audience involvement break-out session.

European Region Presenter

One of the Research Assistants for Europe, Ben Kaden or Michael Kleineberg, will present *i4G* project data from this region and lead or help to lead one audience involvement break-out session.

Asian-Pacific Region Presenter

The Research Assistant for the Asian-Pacific region, Di Wang, will present *i4G* project data from this region and lead or help to lead one audience involvement break-out session.

CONCLUSION

This panel will present findings about issues that are currently, as of 2020-2021, top-of-mind for iSchool leaders, drawing mainly upon interview data. The presenters that compose this panel are highly international and, as insiders, are compiling a truly international set of findings that preserve important context about interviewees, their cultures, and their viewpoints. The data gathered and being analyzed for this project and panel is also very contemporary, and reflective of the massive changes that have occurred in iSchools specifically, and in higher education and academia generally, over the last 18 months. This panel will represent an accessible opportunity for the broader information and library science community to offer input as to the preferable future directions of the iSchools, and into how iSchools may live up to their vision of positively influencing the real worlds of individuals, organizations, and society.

ACKNOWLEDGMENTS

We thank all the iSchool leaders, faculty, and other affiliates who offered their time and perspectives on the i4G project. We gratefully acknowledge the support of the Andrew W. Mellon Foundation in carrying out this project.

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Quality, Reuse and Governance of Open Data

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ABSTRACT

In recent years, the amount of open data from governments and academic communities have increased rapidly. Open data are expected to promote the transparency and accountability of governments and academic communities, enable public participation, and facilitate digital innovation. However, open data are still facing problems such as unsatisfactory quality, insufficient data governance, increasing preservation cost and ineffective data reuse at present. This panel will invite experts in related fields to discuss the quality, reuse, and governance of open data, and propose feasible solutions from an international perspective. We will verify and promote the action plan in practice, and have more academic discussion with ASIS&T and relevant academic communities.

KEYWORDS

Open Data; Data quality; Data reuse; Data governance.

INTRODUCTION

With the growth of Open Government Data (OGD) and Open Scientific Data (OSD) projects in the past decade, open data have become essential information resources and contribute to many fields. Academic interest in this domain has been growing. Studies on the curation, quality, provenance, and reuse of open data have increased rapidly. To share new ideas and deepen the research on open data in the background of the rise of digital humanities, it is necessary to promote communication and collaboration between scholars and practitioners.

Open data are data that “can be freely used, modified, and shared by anyone for any purpose” (Vetrò et al., 2016, p. 325). It also can be construed as “an information policy which provides a particular framework for governing the reuse by third parties of datasets that are produced by public institutions” (Bates, 2014, p. 390). Since the eight Sebastopol principles of OGD were put forward in 2007, more and more governments have been committed to data openness. Besides, the FAIR (Findable, Accessible, Interoperable, Reusable) Data Principles were put forward (Wilkinson, et al, 2016) based on the Principles and Guidelines for Access of Research Data issued by OECD (2007) and the G8 Minister Statement (2013). With the advance of OGD and OSD, open data are expected to bring great economic and social values, including promoting the transparency and accountability of governments and scientific communities, enabling public participation in scientific research and public affairs management, facilitating enterprise innovation based on data exploitation, etc.

However, around the curation and reuse of open data, problems related to technique, ethics, and users are emerging, involving unsatisfactory data and metadata quality, inadequately trained users, insufficient data governance, increasing preservation cost, and ineffective data reuse. Peled (2013) criticized that the open data initiative of the United States benefited limited stakeholders and empowered those who already have the funds and expertise to use the data but failed to guarantee the universal use by the public. Besides, the meager open data implementation rate and impact are attributed to data quality issues like incompatible data formats and incomplete data (Myongho, 2018) and data organization and representation issues, such as the lack of metadata related to data sets, etc. (Zuiderwijk et al., 2012, DMG, 2020). According to the Open Data Barometer survey (2013), open government data initiatives are scattered, not well-understood, and even contradictory. Due to the lack of data reading and writing skills, users will face difficulties in data access, capture, and organization, which will affect the understanding and use of open data (Bowne-Anderson, 2018).

For this panel session, we invited six researchers and professionals from different countries to engage in a frank discussion around issues and possible options (data management policy and management mode). Considering their research and practice experiences, these experts will explain the quality, reuse and governance of open scientific data and open government data from different perspectives. Professor Fang Wang engaged in open data research for many years, involving the risk of OGD (Wang et al.2019), the dynamic mechanism of inter-agency government data sharing (Wang, 2018), the utilization rate of government websites (Wang, 2014), and the construction of emergency management ontology (Wang, 2020), etc. Besides, she is also leading a project on scientific data management funded by the Chinese Academy of Sciences. Professor Ryan Shaw was an experienced data expert who understands information organization from historical philosophy (Shaw, 2013). Dr. Yejun Wu studies the organization and

retrieval of information resources (Wu, 2020). Professor Xiaomi An has worked on the designation of information policy in the European Standards Governance Council. She also was one of the founders of the China Big Data Governance and Information Resources Collaborative Innovation Community and deputy director of the Community since 2016. Dr. Yujia Zhai is good at integrating communication theory with computer algorithm to reveal the law of information discovery and transmission from mass media discourse (Zhai, 2020). Dr. Xuemei Ji concerns online public opinion analysis, informetrics, and sentiment analysis (Ji, 2015). These experts from different fields are expected to provide international, inclusive and complementary perspectives. The panel will provide a significant opportunity for engagement in conversation as we move towards a collaborative effort to promote open data governance. The panel will use offline meeting room and online Zoom meeting at the same time. Participants can join in the discussion with high interaction. The whole meeting will be recorded for follow-up viewing and provide a reference for researchers.

OPEN DATA QUALITY

As the number of open data sets and data sources continuously grow, problems in data quality have attracted increasing attention from data owners, managers, and consumers. It requires stakeholders of open data to develop the capacity to “understand how the quality of data affects the quality of the insight we derive from it” and evaluate the quality of open data effectively. Data quality is defined and measured by Jayawardene et al. (2013) from three dimensions, including accuracy, integrity and consistency. Vetrò et al (2016) established a fine-grained evaluation index to measure the quality of OGD from seven aspects, completeness, accuracy, traceability, timeliness, expiration, compliance, and comprehensibility. The data quality assessment methods include data and process analysis, data quality requirements analysis, and data quality analysis (Batini et al. 2009). Most of these approaches follow a user-centered, top-down approach, where requirements are solicited from users before the data is explored. These methods are not enough to evaluate data quality accurately and completely, because data quality may span a large number of dimensions. Besides, Shazia (2017) analyzed the lack of knowledge on the scale and the impact of data quality problems across datasets based on various international open data portals. Therefore, we believe that before we try to solve this problem, it is necessary to conduct a global study to explore the extent of this problem with a consistent comparison benchmark.

OPEN DATA REUSE

Data reuse promotes reproducible research, fosters innovation and collaborations, and reduces research costs, which may bring significant economic and social benefits. Many factors impact data reuse, among which documentation and context are necessary factors (Faniel, 2019). Each domain and each type of data will present its requirements for reuse by authors. The social role of data in scientific work should also be considered when discussing reuse (Neff, 2017). Again, we acknowledge the complex decision-making process of data sets creation. Due to different data formats and conditions, data reuse faces different challenges. For example, original consent forms often do not include the possibility of data reuse, or are not available to the data consumer, such as the UK Data Service (<https://ukdataservice.ac.uk/>). The reuse of qualitative data will cause many problems, including ethical considerations and the documentation or protection of personal data are a complex and multi-layered category in themselves (Poth, 2019).

The FAIR data principles assemble high-level, interdisciplinary best practices to make data findable, accessible, interoperable, and reusable. It provides an essential reference point for thinking about data reuse. We hope that this panel can explain the challenges of preparing datasets for reuse and deepen the discussion to provide concrete, measurable, operational suggestions for data providers to make their datasets more reusable.

OPEN DATA GOVERNANCE

Data opening requires multi-stakeholder cooperation to generate and collect data for comprehensive analysis. This leads to the challenge of data harmonization from different sources, formats, and standards. Besides, format conversion, language translation, and mapping between terms will also bring additional burden. Gu et al. (2020) summarized the experience of data curation in IMI eTRIKS supported projects and found some problems in open data projects, including underestimation of the time required to clear legal hurdles, resource allocation of data management, cultural differences of standards, lack of a proper data-management plan and metadata descriptors. Also, as time goes on, open data that is initially considered to be of high quality may become unqualified.

Therefore, we will share the cases of different national institutions, scientific data centers, and scientific research institutes in open data governance at the panel session and discuss the modes of open data management and protection. On this basis, this panel will make an effort to advance the research on the governance of open data and reach a consensus on future research focuses.

ABOUT THE PANEL

This panel is different from previous similar panels in two aspects: (1) it involves both open government data and open scientific data, (2) it focuses on technique and management issues related to data governance for data quality

and reuse. The panel took the form of a round table. The speakers plan to speak for 75 minutes, discuss the opportunities and challenges of open data research from different perspectives, and put forward corresponding solutions. Then, the audience will interact and ask questions for 15 minutes. The group will be presided by Professor Fang Wang from Nankai University, China.

PANELISTS' BIOGRAPHIES

Fang Wang, a Professor of Information Science and the director of the Center for Network Society Governance at the Business School of Nankai University, China. She was a Fulbright Scholar in UMASS Amherst (1999-2000). She has presided more than 40 research projects funded by the NSFC and other foundations. She has published more than 170 papers in *JASIST*, *Government Information Quarterly*, *Journal of Documentation*, *Journal of Information Science*, and other Chinese and English journals as well as 11 books or chapters. Her research interests include government data openness and sharing, scientific data curation, knowledge discovery, and diffusion, etc. Her research center has hosted more than 10 academic meetings or seminars with more than 2300 participants and owns experience in conference organization. Now she is chairing her second Major Program of National Social Science Foundation of China on "Intelligent governance of digital government based on data sharing and knowledge reuse."

Ryan Shaw, an Associate Professor at the School of Information and Library Science at the University of North Carolina at Chapel Hill. In partnership with classical archaeologist Adam Rabinowitz, he operates PeriodO (<https://perio.do/>), a public domain gazetteer of scholarly definitions of historical time periods. PeriodO eases the task of linking among datasets that define periods differently and is used extensively by data-sharing infrastructure projects such as ARIADNEplus. More broadly, Ryan is interested in the role information technologies play in the conceptualization and modeling of our worlds and pasts.

Yejun Wu, an Associate Professor in the School of Library and Information Science at the Louisiana State University. His research areas are primarily focused on (1) knowledge organization systems (such as taxonomy, thesaurus, topic map, and ontology) and their applications in facilitating learning, information retrieval, and knowledge discovery, (2) data processing and reuse.

Xiaomi An, a Professor at the School of Information Resources Management in Renmin University of China (RUC), the director of E-government Research Center at RUC, chairs of Big Data Governance Research Group at the Key Laboratory of Data Engineering and Knowledge Engineering of the Ministry of Education at RUC. She received her Ph.D. degree from University of Liverpool in 2001, Fulbright research scholar program of UCLA (2012 to 2013) and distinguished visiting scholar program of University of Sheffield (2016). Xiaomi An was one of the founders of the China Big Data Governance and Information Resources Collaborative Innovation Community and deputy director of the Community since 2016. She is now chairing her second Major Program of National Social Science Foundation of China on "Studies about data governance and data use capability in Chinese government".

Yujia Zhai, an Associate Professor in Tianjin Normal University and a researcher in the field of knowledge diffusion. He is good at the integration of communication theory and computer algorithm application. He has published more than 20 papers in *JASIST*, *JOI*, *TBD*, and other important academic journals in the field of information science. At present, he has undertaken and participated in several national scientific research projects. He holds a doctorate in Business School of Nankai University and is currently a postdoctoral researcher in Wuhan University. Yujia Zhai can work in a multicultural environment. He believes that diversity, fairness, and inclusiveness are the core of academic research.

Xuemei, Ji, an Associate Professor in the Information Management Institute at Shandong University of Technology, China. Her research field concerns online public opinion analysis, informetrics, and sentiment analysis. She has published more than 20 academic articles in journals. She has presided and completed one research project funded by NSSFC.

ACKNOWLEDGMENTS

We thank all the volunteers and participants of this panel who provided helpful comments and discussion. Authors 1 and 2 gratefully acknowledge the grant from NSSFC (20ZDA039).

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Motivation, Building Relationships, and the Role of Belonging in Distance Learning

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ABSTRACT

This SIG-ED panel addresses the role of belonging in distance learning in a variety of learning contexts, including typical online courses as well as in independent studies and other mentoring contexts. The panel explores the impact of belonging on student success and considers how instructors' choices in course design, technology use, mentoring, and other aspects of distance learning can enhance or detract from fostering a sense of belonging.

KEYWORDS

distance learning; belonging; mentoring; graduate students; undergraduate students.

INTRODUCTION

University belonging is associated with the following components: feeling valued as a member of a group and an individual, developing meaningful relationships through opportunities for self-growth and work/life balance, and an atmosphere that promotes diversity, inclusion, and a sense of pride among members of a community (Slaten et al., 2018). Belonging is also connected to feelings of being respected, accepted, and valued as part of one's academic context and experience (Freeman, Anderman, and Jensen, 2007). Advisor support, building relationships with faculty, supporting work-life balance, and other factors all contribute to a sense of belonging for graduate students (Curtin, Stewart, Ostrove, 2013; Pascale, 2018). Additionally, having a feeling that one belongs is significantly and positively correlated to a student's well-being, an increased academic motivation, increased academic success, and a lower intention to drop out (Suhlmann et al., 2018). Feeling as if one belongs can also contribute to one's ability to self-regulate learning and seek and provide academic help in the classroom (Won, Hensley, and Wolters, 2021). Belonging ultimately helps students develop relationships and motivates them to be more successful in both academic and life contexts throughout their education. Although it has not been adequately addressed within our field, belonging has a variety of positive outcomes that are valuable to explore in the context of library and information science and computer science courses.

This panel of international researchers and instructors will examine the concept of belonging in the context of distance learning and also throughout the ongoing COVID-19 pandemic. Panelists will discuss the impact of belonging on student success and examine how instructors' choices in course design, technology use, mentoring, and other aspects of distance learning can enhance or detract from fostering a sense of belonging. Belonging will be addressed in the context of both introductory and advanced distance learning courses, as well as in mentoring students in independent studies. In the following section, the format of the panel will be presented, and each panelist introduced. The panelists will enhance the panel with their experience with and evaluation of belonging in distance learning courses. The panelists will give brief presentations on several different areas, including on different uses of technology, along with didactical concepts and best practice examples.

FORMAT

The format for the event will follow a 90-minute panel structure and will be presented in a virtual format. Presenters will give 15-minute presentations on their areas of expertise, as outlined below. At the beginning of the session, the panel moderator, Rachel Williams, will provide a brief introduction to the panel (5 minutes) and an overview of belonging in university learning and specifically distance learning. At the start of the session, participants will be encouraged to say hello in the chat and include tags in the chat: their country, their job title, and their motivation to

participate in the session. Participants will be prompted to respond to the question: “Are you a lecturer or instructor currently, and if so, have you tried to enhance the feeling of belonging during distance learning? If so, how? If not, for which purpose would you like to learn about motivation, building relationships, and the role of belonging in distance learning?” While participants are introducing themselves during the chat, Dr. Williams will introduce each of the speakers and outline the structure for the panel discussion. Each panelist or group of panelists will give 15 minute presentations related to their scholarship on belonging and distance learning. Thereafter, the moderator will give her presentation and open the panel up for questions from the audience. There will be an additional 15-20 minutes at the end for questions from the audience and a guided discussion on implementing strategies that support belonging in library and information science courses. During the last 10 minutes of the session, each of the panelists will share concluding remarks regarding belonging in distance learning as they relate to current events and how belonging can support building diversity, equity, inclusion, and justice within our field.

PANELISTS

The presenters include a host of international scholars with expertise in teaching a variety of distance courses. The panelists represent a variety of teaching areas, including technology, information services for diverse users, public libraries, evaluation, and computer science didactics.

Rachel D. Williams, Moderator

Rachel Williams is an Assistant Professor at Simmons University School of Library and Information Science. Dr. Williams’ research examines public librarianship as a profession. Her scholarship gives attention to the ways in which public libraries support patrons and communities in crisis, developing healthy boundaries and professional resilience, and exploring the connections between social work and librarianship. Dr. Williams teaches courses about technology, public libraries, and evaluation.

As a panelist, Dr. Williams will discuss belonging in the context of mentoring. Relying on the cases of several independent studies supervised with graduate students in library science, this talk discusses the importance of mentoring students as a way to foster a sense of belonging, which contributes to the success of students, both academically and post-graduation. Each of the factors associated with Slaten et al.’s (2018) belonging model will be discussed in the context of mentoring as an important component in distance learning.

Danielle Pollock

Danielle Pollock is an Assistant Professor at Simmons University School of Library and Information Science and the current chair of SIG ED. Her research centers on innovation adoption and the drivers and consequences of changes in information behavior in research-focused communities. Her teaching areas include technology for information professionals; metadata; database management; and intersectionality, technology, and information professions. As a panelist, Dr. Pollock will bring insights from teaching critical approaches to technology in a distance learning environment as well as her recent work with first-generation students pursuing advanced degrees during the COVID-19 pandemic.

Introduction of new technologies into a distance learning environment can create opportunities for innovative teaching and increase students’ ability to participate in higher education, especially during the ongoing global pandemic. However, such technologies can also introduce issues related to accessibility, digital equity, and student privacy that may particularly impact students from marginalized and historically underserved groups. The values and assumptions embedded in the design of these technologies have the potential to enable or constrain types of learning, community formation, and interaction. Using a design justice framework (Costanza-Chock, 2020), this talk will focus on the design of online learning environments, including how features and affordances of commercial technologies used for distance education such as Zoom, chat platforms, proctoring software, and social media can enhance and detract from creating a sense of belonging for university students.

Agnes Mainka

Agnes Mainka is a Postdoctoral Researcher at the Department of Computer Science at the University of Osnabrück, Germany. Dr. Mainka graduated from Heinrich-Heine-University Düsseldorf, Germany in March 2017 and joined the University of Osnabrück in August 2020. She received her B.A. and M.A. at the Department of Information Science from the Heinrich-Heine-University, Düsseldorf, where she also has completed training in didactics in higher education. Currently, she works in a project group that focuses on digital learning in higher education. In her research, she focuses on students starting their study at the University Osnabrück during the COVID-19 pandemic. She investigated in a longitudinal study how students have to cope with distance learning. As panelist, Dr. Mainka will bring insights from her interviews with students experiencing the digital semester during the COVID-19 pandemic at a German University. She will outline how belonging and personal contact impacts a successful curriculum.

The start into student life at a university was very different during the COVID-19 pandemic in 2020. In a longitudinal study across students in their first and third semester of higher education at the University Osnabrück, Germany, the relationship between belonging and learning outcome in distance learning was evaluated. Students who started during this time could mostly attend classes only remotely via video conferences or other e-learning opportunities. This circumstance has allowed us to observe the impact of belonging for students in distance learning in relation to learning performance as well as to the type of e-learning (synchronous or asynchronous, online or offline, teacher- or self-guided learning, individual or team-oriented learning (Gupta et al., 2010)). Students in Osnabrück have experienced a wide range of diverse opportunities of distance learning during this winter term. The opportunities were determined by the skills, experience, and motivation of the lecturers to offer online learning. The University Osnabrück has already established an online infrastructure that allows lectures to implement several e-learning tools, online exams, lecture recordings, live streaming, online video meetings and many more. Therefore, the lectures did not have to start from scratch but in many cases were urged for the first time to use the digital infrastructure of the university. This was noticed by the students who were mostly pleased about or on the other hand disappointed about the lecture's motivation which in the end had a strong impact on the students feeling of belonging to the university.

Michael Brinkmeier and Elisaweta Ossovski

Michael Brinkmeier is the holder of the Chair for Computer Science Didactics at the University Osnabrück, Germany. He graduated from the Institute of Mathematics at the University Osnabrück in December 2000. After working for a year as a Software Engineer, Prof. Dr. Brinkmeier joined the Institute for Theoretical Computer Science at the Technical University Ilmenau as a postdoc researcher in the field of graph and network algorithms. In 2009, he changed to high school education and worked for four six years at a high school. During this time, he achieved the state examination as Computer Science and Mathematics Teacher. In 2015, he got the call for the professorship for Computer Science Didactics in Osnabrück.

Currently Prof. Dr. Brinkmeier is responsible for the teacher education and the first semester course, teaching programming and algorithmics to students. His research interests are graphical programming languages, algorithmic problem solving and the didactics of programming and algorithmics.

Elisaweta Ossovski is a doctoral candidate at the Institute of Computer Science at the University Osnabrück, Germany. After receiving her B.Sc. and M.Ed. in Computer Science and Maths, she started her research in 2019 with a doctoral scholarship from the ELES Studienwerk. She focuses on designing courses for beginners in Computer Science with digital strategies, including Flipped Classroom scenarios with interactive learning material and programming classes. Her research is about the effects of these concepts for different parts of the course as well as general topics concerning programming beginners. As a panelist, Elisaweta Ossovski will outline her experiences with a large Computer Science distance learning class especially concerning evaluation results and observed behavior of the students.

Due to the COVID-19 pandemic a concept for a distance learning class had to be created for a large introductory computer science module (CS1). Since the audience consisted of freshman students of different subjects with varying prior knowledge, we applied a self-guided learning approach with slideshows similar to videos and an interactive online script. It was accompanied by active video conference classes and systematic monitoring of learning by submission tasks, which were discussed with student tutors. In order to create a sense of belonging, gamification elements as well as Easter eggs like hidden links to videos, memes etc. were added to the basic distance learning concept. In the talk we will give a short presentation of the elements of the course concept and discuss the impact on the students with a special focus on the experiences and evaluation on the aspects of satisfaction and belonging.

ACKNOWLEDGEMENT

This panel is sponsored by ASIS&T Special Interest Group on Education (SIG ED).

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Conceptualizing Relevance of Information as a Social Justice Issue: An Interactive Panel Discussion

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ABSTRACT

Relevance is a notion whose meaning and purpose have been widely discussed in information retrieval research. The ultimate aim of relevance—what Tefko Saracevic has called the “you know” principle—is to ensure that users have the information necessary to meet their goals. What is often missing from this discussion is a critical assessment of who gets to decide what information is relevant, under what circumstances, and for what purposes—especially in relation to marginalized populations. The limited discussion of social justice in information relevance research is a gap this interactive panel discussion seeks to address. Five emerging, junior, and senior researchers will each identify and outline social justice themes of information relevance (e.g., intersectionality, Black feminist lens, geography, immigration status, and holistic critical relevance) that have been evident in their own scholarship. Audience members will have an opportunity to expand on one of the five themes in concert with a panelist before participants consider together future directions for relevance of information in a social justice context. While each participant may have different definitions of social justice, a broad interpretation of the term will frame the conversation by indicating how information relevance can move society towards a fairer and more equitable future.

KEYWORDS

Diversity; Equity; Inclusion; Relevance; Social Justice.

INTRODUCTION

The varied meanings of relevance have been widely discussed in information science literature with a particular emphasis occurring within information retrieval scholarship (Vickery, 1959; Saracevic, 1975; Mizzaro, 1997; Saracevic, 2012). Select manifestations have included system, topical, cognitive, situational, and affective relevance—each with their own histories, interpretations, and criteria (Borlund, 2003; Chatman, 1991; Ingwersen and Jarvelin, 2006; Saracevic, 2007). But the varied interpretations of relevance have not detracted from the near universal understanding of relevancy or what Saracevic has called the “you know” notion or umbrella aim: ensuring that the user has the information necessary to meet their goals (Saracevic, 2016, p. 143).

What is often missing from the conversation, however, is a discussion of who determines relevancy and how the “you know” of individuals from marginalized populations is undervalued by and within society and institutions (Cooke and Kitzie, 2021; Gibson and Martin, 2019; Threats and Bond, 2021). This requires information science researchers to move beyond the system to user paradigm in order to understand how information and technology is understood as relevant across the complex lives of the humans who use them (Cibangu, 2015; Tang et al., 2021). Therefore, this panel asks what makes information (and technology) relevant in a social justice context? Social justice is discussed broadly but can be understood as a philosophy in which “individuals and groups are treated fairly and receive an equitable share of all the benefits in society” (Mehra, Rioux, and Albright, 2010, p. 4820). This panel brings together emerging, junior, and senior Information Science scholars to identify, discuss, and lead participant engagement of five components of information relevancy from a social justice perspective (e.g., intersectionality, Black feminist lens, geography, immigration status, and holistic critical relevance).

PANEL FORMAT

This 90-minute panel will include three segments. In the first segment, each panelist will speak on their theme of relevance for about 10 minutes. Then, audience members will spend 20 minutes in one of five break out groups to further discuss and expand the components. Finally, all participants will return for a 20-minute reporting and exchanging of ideas. Ultimately, participants should leave the session with a greater understanding of information relevance from a social justice perspective including its application for research, practice, and pedagogy.

Joseph Winberry*Exploring Intersectionality: The Role of Identity in Determining Relevance of Information*

Intersectionality refers to a person's fully integrated identity which consists of various singular identities such as race, ethnicity, gender, sexual orientation, age, and level of ability among others (Collins and Bilge, 2020). As an example, this researcher is a white, cis-gender male Ph.D. student who is gay. The intersections of these identities create the researcher's whole identity with the advantages (e.g., white, cis-gender male) and disadvantages (e.g., Ph.D. student, gay) these identities have in society and in academia. Intersectionality was conceptualized by legal theorist Kimberlé Crenshaw (1989) and has since been applied to research across many disciplines including library and information science (LIS). However, several scholars have critiqued the limited understanding and use of intersectionality in LIS research, practice, and education (Chou, Pho, and Roh, 2018; Gibson and Bowen, 2019; Villa-Nicholas, 2018). Given that the composition of a person's full identity can be a determinant of information need, understanding and using intersectionality more in LIS scholarship will help ensure stakeholders are prepared to include and serve diverse people (Cooke, 2016).

Winberry's ongoing research examines how intersectionality is represented in the information designed for older adults. At a time when the population of older people is growing in the United States and around the world, older adults are also becoming more diverse (Dalmer, 2017). The information needs of older people are not uniform and aging services providers—the organizations who provide information and services to older people—must be prepared to address the needs of diverse elders (Winberry, 2018). Through an action research partnership, information for intersectional aging populations (e.g., older people who are also people of color, or immigrants/refugees, or LGBT+, or who are disabled, or who have low incomes or have a combination of these identities) is being created, identified, collected, represented, and shared by Winberry and an aging services organization (Winberry, 2020). By helping to meet the information needs of diverse older adults, LIS scholars can demonstrate a commitment to social justice for a population that may experience ageism and other discrimination based on their identity (Winberry and Mehra, 2021). Ultimately, in order to support the creation and dissemination of relevant information, LIS scholars are urged to consider how they may incorporate intersectionality into their own research, practice, and pedagogy.

Laverne Gray*Black Feminist Collectives: Revealing a Social Justice Information Communal Context*

A Black feminist lens recognizes both the experiential and collective aspects of information (Gray, 2015, 2019). It represents a social-cultural prism unique to the combined racialized and gender dynamics in the information studies theoretical landscape (Collins, 1998; hooks, 1990, Gray, 2019). Gray's research resists white normative informational interpretations by uncovering a collective vision rooted in epistemic traditions of African American women's communal social justice. To accomplish this, her research provides an unapologetic foundation in Black feminist thought, reinterpreting the concepts associated with information community (Fisher, Unruh, & Durrance, 2003), with a collective vision. Black feminist thought "consists of specialized knowledge created by African-American women...(and) encompasses theoretical interpretations of Black women's reality by those who live it" (Collins, 1991, p. 22). The specialness is attributed to a standpoint that all African American women share multiplicity of oppressions at the hands of a dominant white patriarchal system (Collins, 1991). Gray's work does not take for granted that information is a separate source or *a thing* (Buckland, 1991) that provides a pathway to the betterment of those deemed marginal. Gray's work argues that information is imbued within collective and cultural consciousness personified within an abundant rather than deficit environment (Gray, forthcoming). Gray uses the narrative of self in her identity as an African American woman to interrogate the location of information in the Black feminist collective space. Her work is auto-ethnographic, historical, and critical-feminist, in that she infuses her positionality to reveal the dimensions of information that have yet to be addressed. Such as the racial-gendered information constructs in a Black feminist experience.

The notion that information as collective in the Black feminist experience is rooted in Gray's study of activist mothers in 1960's public housing and their community activism. The bonding of such 'outsiders' manifests a collective activity towards communal justice. The study centers the narrative and activities of the collective of Black women and reveals the Black Feminist Information Community (BFIC) theory (Gray, 2019). The theory contains five elements Place/Space, Voice, Information, Mobilization, and Belief System. Each element represents aspects of the collective experience of the social justice activities of the mothers. What she found and will elucidate during the discussion an understanding of the importance of the cultural information collectives in seeking justice for communities.

Jean Hardy*Geography and Identity in Unequal Information Access*

Lesbian, gay, bisexual, transgender, and queer (LGBTQ) people living in rural communities face particularly intense barriers to accessing appropriate and relevant information. Without access to the physical institutions that are ingrained in histories of information transmission in the LGBTQ community (e.g., gay bars, bookstores, community centers), digital tools have been lauded as being the safe spaces rural LGBTQ people need. Yet, new digital tools don't reflect the geography of rural people and the material impact rurality has on their situation. For example, in my research on the use of location-based social networks designed for gay men (Hardy and Lindtner, 2017), I found that rather than tools for relationship establishment and maintenance, online social networks became constant reminders of how few gay people actually lived in small rural towns. Without reliability and relevance of information, rural LGBTQ people in my research often turned to very fragile interpersonal and local information networks to figure out how to exist as a queer person in their rural locales (Hardy, 2021). Interpersonal and in-person networks were often home to more reliable and relevant information, especially when it came to more discrete informational needs, such as which doctors would supervise hormone-replacement therapy for trans people or which restaurants were okay to be openly affectionate in a same-gender relationship. Yet, because of the fragile nature of these networks, one person leaving town could set a rural information network back, especially if that person was a key information node, or resource, for others.

In this way, geography or location is an essential influencing component of establishing a social justice-oriented understanding of information relevancy. In that social justice recognizes the inherently unequal reality that many people face, and seeks to change the world to demand equity, a social justice-oriented understanding of information relevancy, then, should also recognize the inherently unequal nature of information. In particular, as I've started to demonstrate here, by perpetuating unequal information access, the design of ICTs may negatively impact perceived relevance of information. Instead of focusing on what tools or tactics are most impactful for information relevance, how might we reframe our understanding of information relevance to focus on the material resources one has at hand?

Baheya Jaber*The Role of Immigration Status in Immigrants and Refugees' Information Behavior: Strategies for Increasing Information Relevance in a Social Justice Context.*

Immigrants and refugees leave their countries of origin for many reasons including the chance for new opportunities, and to escape oppression, struggle, and assault (Gericke, Burmeister, Lowe, Deller, & Pundt, 2018; Martin & Nakayama, 2018; United Nations, 2021). The information behavior (IB) of immigrants and refugees involves determining their information needs, searching for information, and making usage of that information. The complexity of the information needs of immigrants and refugees are shaped by their immigration status. For instance, country-specific structures such as immigration laws shape the kind of information that immigrants and refugees need and when they need it (Caidi, Allard, & Quirke, 2010). When both groups arrive to the host country, they recognize an urgent need for information about housing, transportation, education, employment, social services, and healthcare. They are bound to receiving information from their small world (e.g., family, friends, ethnic society members) through informal channels, or through limited access to the outside world via formal sources of information (e.g., medical professionals, lawyers, social workers, mass media, public libraries, non-governmental organizations, detention centers, refugee camps) (Fisher, Durrance & Hinton, 2004; Hassan & Wolfram, 2020; Oduntan & Ruthven, 2020; Solberg & Peters, 2020; Wang, Huang, Li, & Chen, 2020; Zimmerman & Beam, 2020; Zimmerman, 2018).

Immigration status, therefore, does not refer just to their position as an immigrant or refugee, but also where they are within that process of transition. Immigrants who have been situated in a new country for a longer period of time may have developed the skills necessary to obtain social inclusion in comparison to an immigrant who has just recently arrived (Caidi & Allard, 2005; Lloyd, Lipu, & Kennan, 2010). Immigration status can determine whether information is relevant and suitable to a person's needs which in turn demonstrates a gap and social justice concern between the information behavior of this marginalized group and other stakeholders when deciding what information is relevant (Borlund, 2003; Fisher, Durrance & Hinton, 2004; Saracevic, 2016). This presentation will explore immigration status as a social justice component of information relevance by discussing the application of the Strategic Diversity Manifesto (SDM) (Mehra & Davis, 2015) to assess the information services that public libraries, and immigrant and refugee agencies are offering to meet the diverse information needs of those who have unique backgrounds (e.g., gender, racial, differently abled, LGBTQ+). The findings promote strategies that information organizations can undertake in order to consider the immigration status of their patrons in a way that gives immigrants and refugees the agency to advance their life experiences, satisfy their information needs, help them adjust to their current lives, and promote their assimilation and societal inclusion in order to continually build

and maintain a just society (Khoir, Du, & Koronios, 2015; Muhambe, 2018; Obeid, Haddad, Salame, Kheir, & Hallit, 2019; Oduntan & Ruthven, 2020; Shuva, 2021).

Bharat Mehra

Holistic Critical Relevance to Further Social Justice Design and Implementation in the Field of Information

Social justice in library and information science (LIS) seeks to achieve action-oriented, socially relevant impacts through information-related work (Jaeger, Shilton, and Koepfler, 2016; Mehra and Rioux, 2016). Towards this goal, how might a picture of holistic critical relevance to further social justice in the field of information (broadly construed) look like? Holistic relevance integrates psychological (e.g., cognitive, affective), behavioral (e.g., observable actions and behavior), socio-constructivist (e.g., situational), interpretivist, humanistic, community-based, and other lines of thought and knowing. Mehra will summarize key themes surrounding the notion of relevance from the panelists' presentations (e.g., intersectionality, Black feminism and communal-collective perspective, geography or location-driven context, and immigrant refugees' human information behaviors, etc.). He will integrate these and propose an impact-driven concept of critical relevance that expects information professionals to better operationalize and implement social justice in ways that are fair, just, inclusive, and equitable (Jones, 2020; Mehra 2021a; Jaeger, Gorham, Taylor, and Kettlich, 2014). The push is for critical relevance to generate community-based social justice impacts that are intentional (deliberate), systematic (rigorous), constructive (i.e., asset-based), action-oriented, and outcome-driven (Cooke and Sweeney, 2017; Freire, 1970; Mehra Elmborg, and Sweeney, 2019). The assessment addresses the gap of the "how-tos" in developing theory-and-practice driven relevance in information scholarship that acknowledges and changes imbalanced status quo power dynamics in tangible and meaningful ways (Bates, 2005; Mehra, 2021b).

ACKNOWLEDGEMENT

The panelists would like to thank Megan Threats for reading and providing feedback on this paper during the early planning stages.

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A Bibliometric Analysis of the Annual Meeting Proceedings of the Association for Information Science and Technology

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ABSTRACT

In this study, we analyzed two decades of the proceedings of the Association for Information Science & Technology (ASIS&T) to uncover bibliometric patterns. We found 3,129 publications from 2000-2020, with more than three-quarters jointly authored. Most authors are from U.S., Canada, and China. Social media and information behavior are the top-researched areas. The top-cited journals are the Journal of the Association for Information Science & Technology, Information Processing and Management, and Library and Information Science Research. The findings affirm ASIS&T's move to an international association and point to the growing importance of collaborative work and social media. The study fills the gap in the analysis of ASIS&T conference proceedings and will help information professionals understand patterns in recent research. This should help guide them in their future research directions.

KEYWORDS

Bibliometrics; ASIS&T; conference proceedings; geography; distribution; visualization.

INTRODUCTION

In the field of information science and technology, the annual meeting of the Association for Information Science & Technology (ASIS&T), an 84-year old association, is a premier conference, bringing in researchers and practitioners from various countries across the world. Held largely in North America since 1950, the conference has expanded to global venues such as Europe and Australia in the last few years. Being international and multi-disciplinary, the proceedings cater to various areas of information science and technology, as characterized by the Special Interest Groups (SIGs) of ASIS&T. These areas include information behavior, arts and humanities, classification, digital libraries, education, health informatics, history, learning sciences, ethics and policy, international issues, organizational information, and knowledge management, metrics, scientific and technical information, social informatics, social media, visualization, and artificial intelligence (ASIS&T, 2021). An important avenue for library and information science (LIS) researchers, practitioners, and students, the ASIS&T proceedings are peer-reviewed and indexed by SCOPUS (ASIS&T Proceedings, 2020).

There are a number of bibliometric studies of journals in information science (Gurikar, Hadagali, & Mulimani, 2018; Agarwal & Islam, 2020) or in the broader LIS area e.g., Tsay & Shu (2011), Ahmad, Sheikh, & Rafi (2019), and Jokić (2020). Agarwal & Islam (2020) carried out a bibliometric study of the Journal of the Association for Information Science & Technology. In a few studies, researchers have also analyzed conference proceedings in different fields related to LIS e.g., Doraswamy & Janakiramaiah (2013) and Shukla & Lalithlengliana (2019). Kim (2008) carried out a citation flow analysis of ASIS&T proceedings using pathfinder network analysis. Apart from Kim's citation analysis more than a decade ago, we found no systematic bibliometric study that has analyzed the proceedings of the ASIS&T annual meetings. The objective of the study is to investigate the research and publication trends in the articles published in the ASIS&T conference proceedings since the year 2000.

METHODOLOGY

This study uses two bibliometric procedures applied to the publications in the ASIS&T conference proceedings— 1) a bibliometrics analysis and 2) a scientific mapping analysis. For the first part, we used three data sources—Scopus, ASIS&T proceedings website (2020), and Scimago journal ranking (2019). In Scopus, we did not find any bibliographic data of 2005, and data for 2020 is not updated yet in the database. Gathering the data, when available, for these two missing years from the ASIS&T proceedings website (ASIS&T Proceedings, 2020), our study covers the proceedings from 2000 to 2020. Where the data is missing, we mention it as “excluding 2005” in our findings.

DATA ANALYSIS AND FINDINGS

In the twenty-one-year period from 2000 to 2020, we found that ASIS&T proceedings have more than three thousand publications (3129) in 21 volumes. We analyzed the distribution of single-versus-joint-authorship to

understand the degree of author collaboration. Of the publications during this period, more than three quarters were jointly authored. In the year 2000, half the publications in the proceedings were single-authored. Now, 85-90% are jointly authored. This shows both the importance and the growing interest in collaborating for doing quality research work. Figure 1 shows the percentage of publications each year that have co-authors from different countries. The graph shows that international collaborations were highest in 2016 with more than a quarter of collaborative publications, with a decline in 2017 and a pickup in 2018 above the high 2006 levels.

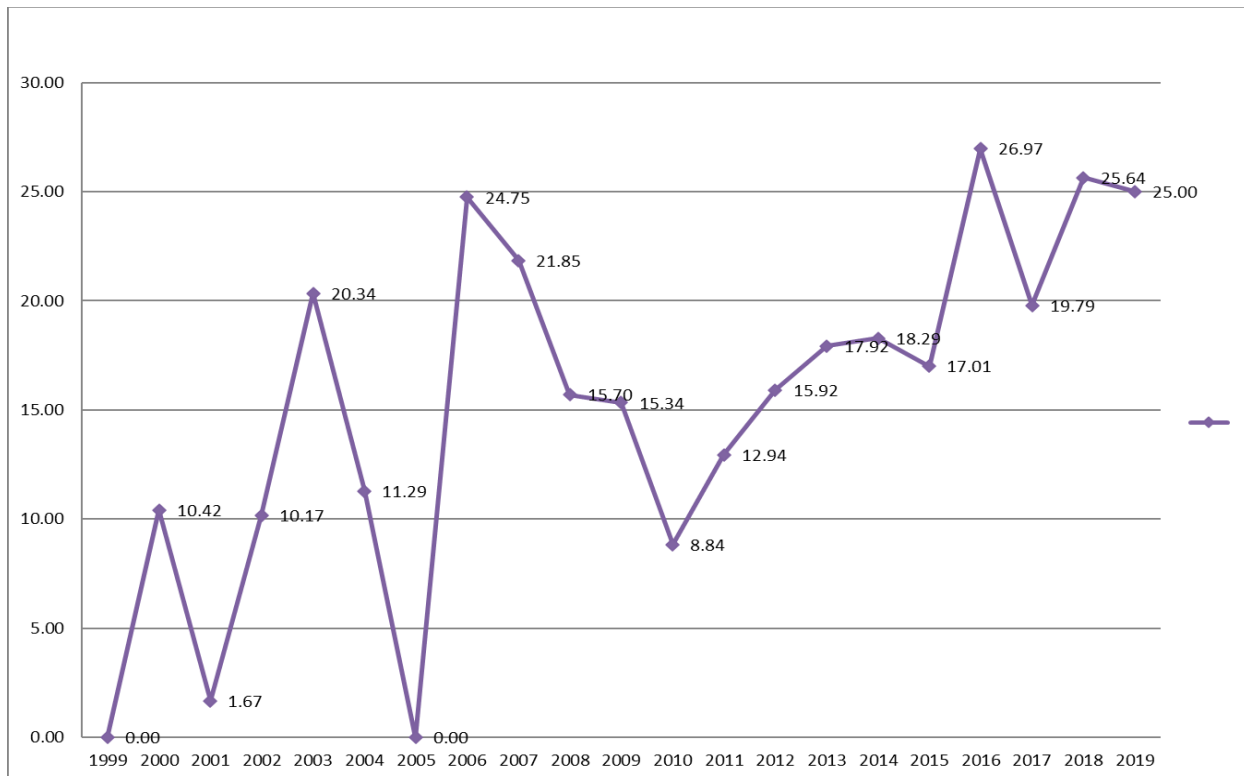


Figure 1. International collaboration among authors (1999-2019)

Analyzing the citation pattern and top-cited publications, we found that Kules & Capra (2010) is the most cited with 131 citations in 11 years. In contrast, Hsiao & Chen (2019) is the most influential as it reached 127 citations in only 2 years since its publication in 2019. In the case of top authors and author-institution countries, we see that authors based in the USA published the most between 2000 and 2019, excluding 2005. They had 2,021 publications, while authors in Canada and China followed with 367 and 139 publications respectively. Shah C. is the most prolific author/co-author in the proceedings with 44 publications, followed by Zhang Y. and then Erdelez S. Under the major research topics, we wanted to see the frequency of all keywords in the ASIS&T proceedings, and their co-occurrences (or appearing together) with other keywords. We analyzed the 4,384 keywords that appeared in the proceedings from 2000-2019, excluding 2005. 'Social media' was the most frequent keyword, appearing 103 times, followed by 'information behavior' (97) and 'scholarly communication' (50).

DISCUSSION AND CONCLUSION

The study found that the number of papers in the ASIS&T proceedings is growing, and this growth reflects both the growing international membership, and the growth in the prestige of the ASIS&T annual meeting over time. International collaboration has had declining and ascending patterns over the years. This is an important focus for ASIS&T with its move from an American Society to an international Association. The two top-cited publications were cited more than 130 times each in two decades. The citation patterns showed that on average, each publication has been cited more than thrice. This points to the importance of ASIS&T proceedings as a publication outlet. The most prolific authors have high Google scholar citations and have also written books. The research climate in their work institutions is a reflection of their high research activity which often leads to research grants, Ph.D. supervision, and subsequently, increased research publications. The findings show the North American continues to be important in leading research, and China has been growing in importance in promoting research. The findings of this study should benefit the community of ASIS&T researchers and practitioners in their research.

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Management Software for Monitoring Related Versions of Cultural Heritage Artifacts for Libraries and Museums

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ABSTRACT

In cultural object conservation, tracking provenance has served as the foundational method of managing information for historical artifacts. To find data points, archivists identify related versions of an artifact at various time points. In this paper, we discuss four categories with versioned examples to display the importance of data points for identifying patterns over time through events in history, cultural heritage, performing arts, and fine arts. We describe our use of the Ashurbanipal diristry to document scholarly research regarding library tools and technologies for the preservation of cultural objects as well as the implementation of PORTAL-DOORS Project (PDP) utilities for tracing provenance and distribution of cultural objects and interoperability with bibliographic formats such as BIBFRAME and MARC from existing archival methods.

KEYWORDS

PORTAL-DOORS Project; time points; cultural heritage; archiving; artifact conservation.

INNOVATIONS IN INFRASTRUCTURE

With the creation of cities, our definition of design principles has continuously changed to fit innovations of infrastructure in numerous fields of study. Buetow (2005) describes how biomedical database infrastructure, a fundamental archiving system, could improve the cross disciplinary transfer of knowledge between various communities. Similarly, infrastructure takes on many terms, from biomedical database infrastructure to civil engineering infrastructure which actively serves communities. During the Great Plague of London, without a plan to salvage the European sewage system, lack of maintenance led to the decline of the quality of city life (Bramanti *et al.*, 2019). Following the plague, Bazalgette, the chief engineer of the Metropolitan Board of Works in London, proposed developing a system of collectors to drain sewage that overflowed from the River Thames (De Feo *et al.*, 2014). These design principles have served as the basis for sewage infrastructure for decades, building on the foundations of basic infrastructure to iterate more effective forms of design in the future. Universally, the creation of infrastructure can be attributed to design principles that inform its use, meaning, and underlying features. Design principles are subject to iterations, changes, or improvements that in select cases create different versions of the same entity, or a form or variant of a type or original (Gançarski & Jomier, 1994). To evaluate the changes between key iterations of an object between various points in time, we examine sequential points in time and their comparable versions in a variety of fields: cultural heritage, events in history, fine arts, and performing arts.

IDENTIFYING PATTERNS OVER TIME

Each domain-specific field uses its own defined methods of tracking related versions of historical artifacts. We explore four fields of study that aid in identifying trends in history, including events in history, cultural heritage, performing arts, and fine arts.

Events in History Historians identify events in history either through time points or across space (countries, cities, regions); these time points are then used to track economic, political, and social trends among centuries (Allison, 1984). While history is often tracked and recorded based on the sources and evidence of the era, when there's a lack or destruction of regional evidence, certain important persons and events often get lost in history. Hatshepsut is known as the Lost Pharaoh of Egypt and is regarded as one of the most successful pharaohs of Egypt. Following her death, her figure was chiseled off statues and stone walls and records of her existence in obelisks were smashed and destroyed and records listing her name were destroyed. With the hypothesis of the "Hatshepsut Problem" and misalignment between pronouns and the ruler at the time, her name was reinstated into history (Roehrig, Dreyfus, & Keller 2005).

Cultural Heritage In cultural heritage, information archives, e.g. Library of Congress, are developed through museums and libraries to preserve objects over time for "information literacy" regarding social life and the identities of groups (Baker, 2013). The Mayas were known in A.D. 900 for their impressive constructions that plummeted

following colonization, intense drought, and military conflict. Archaeologist Takeshi Inomata helped discover thousands of structures through radiocarbon dates at Ceibal, a center for chronologically tracking the exact population size of a civilization (Haug *et al.*, 2003). Collecting data points for each cultural object or event in history centers around the creation of a timeline for such event through past archaeological discoveries, and a variety of primary, secondary, and tertiary sources (Chen & Tu, 2007).

Performing Arts In performing arts, two pieces can be compared at a single point in time in the piece although played in different location; if one examines their comparable attributes, they can be deemed similar or related. If an opera is performed once in one location and another time in another location by the same cast, each point in time in the musical can be considered related or versioned performances (Tsai *et al.*, 2008). Versions of performances can be compared between differences in casting, a performer, composer, or even alterations to a plotline.

Fine Arts Fine Arts is used to represent aesthetics and beauty relating to works of poetry, sculpture, or various types of paintings and techniques. Many versions of paintings are displayed, either through alteration from restoration, or versions created by the original artists themselves. A single artist may either iterate through different steps in the painting process on different canvases or paint different iterations of the same painting on the same canvas (Orozco, 2019). Figure 1 references *La Taureau* by Pablo Picasso, a series of paintings he completed to display the aesthetic of a minimalist bull and show the iterative process to create related versions of the painting.

	Cultural Heritage	Events in History	Performing Arts	Fine Arts
Version 1	 Bernardo Bellotto's Dresden Market with the Frauenkirche (1749)	 Papyrus Hegankhi's Letter (1961 B.C.)	 Charles Strouse's Annie (1992)	 Pablo Picasso's Le Taureau (1945)
Version 2	 The Frauenkirche Church (February 1945) Bombing of Dresden WWII	 Amata Huertzinoo Code (1521)	 Charles Strouse's Annie (1999)	 Pablo Picasso's Le Taureau (1945)
Version 3	 The Frauenkirche Church (Present 2021) Dresden, Germany	 Letter/Paper Modern-Day (1980s - Present)	 Greg Kurstin's Annie (2014)	 Pablo Picasso's Le Taureau (1945)

Figure 1. Comparing Sequential Versions

CULTURAL ARTIFACT ARCHIVES

The PORTAL-DOORS Project can be described as an *archiving system* that, as part of the implementation measures to track related versions of cultural objects, is able to store metadata relating to the provenance of associated scholarly research and cultural artifacts (Taswell, 2010). Bibliographic formats currently used by the Library of Congress include MARC (Machine Readable Cataloging) and BIBFRAME in a modern transition to semantic web technologies (Xu, Hess, & Ackerman, 2018). To accommodate software management of related versions, we have continued development of the Nexus-PORTAL-DOORS-Scribe (NPDS) Cyberinfrastructure in conjunction with the PORTAL-DOORS Project to include import features for mapping current bibliographic formats to the NPDS format. This method includes storing information related to resource provenance and distribution, based on which initial import format is preferable to curators accessing PDP diristries (Taswell, 2008). Provenance can vary based on the discovered history of the object or a transfer between various libraries, museums, and archives. Time features and metadata stored in NPDS infosubsets can be mapped to existing bibliographic formats of MARC or BIBFRAME through the import feature without the curator having prior knowledge of system use. When discussing the provenance of a cultural artifact, e.g. a historical bust, one might track from the discovered history of the artifact and through its archivists, including the archaeologist, restorer, preservationist, and cataloguer (Patel *et al.*, 2005). We have developed the Ashurbanipal diristry as a catalog for documenting library tools, technologies, and multimedia about the preservation, restoration, and curation of cultural artifacts. Its contents includes a range of scholarly literature that details cataloguing techniques for cultural heritage objects including methods in painting restoration or repairing water damaged artifacts in an effort to track documentation relating to the preservation of cultural heritage.

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A Comparison of Search Functionalities in Several Tools Used for Searching within Digital Text Collections

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ABSTRACT

The search functionalities that a search tool for a digital text collection offer, will determine how a user can interact with and search in such a collection. This poster considers the search functionalities in four tools that are used to search within digital text collections. Search functionalities that are well known in information science, namely basic word searching, phrase searching, wildcards, Boolean operators, proximity searching, field searching, case sensitive searching, filtering, as well as linguistic search functions will be considered. Knowledge about search functionalities can inform and improve the design of tools for digital text collections.

KEYWORDS

Digital humanities; searching; search functionalities; digital text collections; retrieval.

INTRODUCTION

Digital text collections or corpora are becoming more prevalent and more important for researchers, especially in the digital humanities (e.g. Meyer & Eccles, 2016). Some large digital text collections have been created by several large-scale digitization projects. For example, Google Books, HathiTrust Digital Library and the Internet Archive. The availability of textual data in digital form has opened up new opportunities for scholars, particularly for scholars in the humanities (e.g. Nicholson, 2013; Viiri, 2014).

Some efforts have been made to open up digital text collections for searching; for example, the Google Books Ngram Viewer is a tool which allows users to discover the relative frequency of words across specified years (Google Books Ngram Viewer Info, 2020). Despite some concerns over the use of the tool, it has captured the attention of researchers and “has begun to seep into our methodological toolbox” (Pettit, 2016). Other tools have also been developed.

The tools that are used to search in and explore digital text collections, and the functionalities that these tools offer, will have an impact on the way users can interact with digital text collections. Hardie (2012) argues that better software to work with corpora should be developed. Some tools exclude general researchers as they require specialist knowledge (Welsh, 2014). Terras et al. (2017) investigated the use of large-scale digital collections in the arts and humanities and found that most of the information humanities researchers were looking for were represented by a main set of queries, namely, searching for variants of a word, observing trends of the use of words, eliminating words from a query, searching for words close to other words, and selecting to search in image metadata. There also seems to be a need to search in more fine-grained sections than the volume, for example to search in a chapter, poem or page (Fenlon et al., 2014).

Much has been written about effective searching in the field of information and library science; consider for example, the numerous documents and websites that give guidance about searching, particularly for searching in databases. It could be helpful to review the search functionalities in some of the tools used to search in text collections from an information science perspective, in order to make recommendations for future designs.

The purpose of this poster is to consider the search functionalities available in several tools. This poster forms part of a larger study that examined the extent to which retrieval in text collections can be improved by using detailed metadata (Ball, 2020). Several tools that are used to search in digital text collections were identified and evaluated in a heuristic evaluation. The criteria in the evaluation were: interface design, metadata, search options, filtering, search results, complexity of use, help files and corpus design (where applicable). These heuristic evaluations have been reported (Ball, 2020; Ball & Bothma, 2020). Though search options and filtering offered by these tools were discussed in the heuristic evaluations, the discussion was general, and a more focused discussion of search functionalities will be useful and can inform the design of future platforms.

METHODOLOGY

This poster will present the findings of a heuristic evaluation of the search functionalities of four tools, namely, Google Books Ngram Viewer (<https://books.google.com/ngrams>), HathiTrust+Bookworm (<https://bookworm.httrc.illinois.edu/develop/>), BNCweb (CQP-Edition) (<http://bncweb.lancs.ac.uk/>) and the English-corpora.org platform (<https://www.english-corpora.org/corpora.asp>). The tools were selected based on their use in research projects. The search functionalities (heuristics) that will be considered in this poster are basic word searching, phrase searching, wildcards, Boolean operators, proximity searching, field searching, case sensitive searching, filtering and linguistic search functions.

COMPARISON OF SEARCH FUNCTIONALITIES

		Google Books Ngram Viewer	HathiTrust+Bookworm	BNCweb	English-Corpora.org (COCA)
Single word		Yes	Yes	Yes	Yes
Phrases		Yes	No	Yes	Yes
Wildcards	Substitute word	Yes	No	Yes	Yes
	Substitute characters	No	No	Yes	Yes
Boolean operator	AND	No	No	No	No
	OR	Yes	No	Yes	Yes
	NOT	No	No	No	Yes
Proximity searching		Limited	No	Yes	Yes
Field searching		No	No	Limited (through tags)	No
Case		Yes	Yes	Yes	No
Filtering		Limited	Yes	Yes	Limited
Linguistic search options	Morphological	Yes	No	Yes	Yes
	Syntactic	Yes	No	No	No

Table 1. Comparison of search functionalities in tools used to search in digital text collections

RECOMMENDATIONS

It seems that general search tools (e.g. Google Books Ngram Viewer) are easier to use but have more limited search functionalities. Tools from the field of linguistics (e.g. BNCweb) offer more advanced search options but rely more on commands and codes and will therefore have a steeper learning curve. To prevent users without specialist knowledge from being excluded, the design and development of user-friendly interfaces should be considered. Filtering a large set of data to create a subset is not well supported but could greatly enhance searching in a digital text collection, specifically if filtering on a fine-grained level is supported, for example, filtering according to sections in a book.

CONCLUSION

Digital text collections, and the use of such collections, are becoming increasingly important. The design and development of tools used to explore such collections are essential, as they will affect the way researchers and general users can engage with these collections. In particular, the search functionalities that these tools offer will influence the effective and efficient retrieval of needed information from such collections. Enhancing the search functionalities in search tools for digital text collections can improve the way in which users interact with such collections and allow users to retrieve relevant information.

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Actionable Approaches to Promote Ethical AI in Libraries

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ABSTRACT

The widespread use of artificial intelligence (AI) in many domains has revealed numerous ethical issues from data and design to deployment. In response, countless broad principles and guidelines for ethical AI have been published, and following those, specific approaches have been proposed for how to encourage ethical outcomes of AI. Meanwhile, library and information services too are seeing an increase in the use of AI-powered and machine learning-powered information systems, but no practical guidance currently exists for libraries to plan for, evaluate, or audit the ethics of intended or deployed AI. We therefore report on several promising approaches for promoting ethical AI that can be adapted from other contexts to AI-powered information services and in different stages of the software lifecycle.

KEYWORDS

artificial intelligence; information ethics; library and information science.

INTRODUCTION AND METHOD

As in most domains of the information society, artificial intelligence (AI) has begun entering libraries, for example in tools for collection and catalogue analysis, systems that recommend items to patrons, and robotic greeters (Feng, 2021; Massis, 2018). However, such systems must be developed, implemented, and maintained carefully to minimise the numerous ethical issues they entail, small and large, from data and design to deployment, including issues with bias, fairness, accountability, transparency, responsibility, environmental impact, and more (Bender *et al.*, 2021; Slavkovik, 2020). Scholarly and public responses to address such issues have ranged from general principles and broad guidelines to specific recommendations and even development-to-deployment auditing approaches. Such approaches cannot guarantee ethical outcomes, but rather aim to increase their chances (i.e. promote them). Yet to our knowledge, no analogous guidance exists for libraries, so it is unclear how a library considering implementing AI, or already using it, might act on the above concerns to, for example, audit the ethics of their systems, or identify and communicate their ethical requirements to software vendors. And such action may become not only ethically but legally necessary, for example if public institutions are required to show their AI systems' ethics have been audited or have certification (Cihon *et al.*, 2021; Naudé & Dimitri, 2021).

As part of a systematic review of AI research in other domains we collected over two hundred publications about AI ethics and closely related topics (e.g. data ethics). For the present study we identified among those publications fifty-one that, at face value, contain actionable content for promoting ethical outcomes of AI, such as usable guidelines, proposed methods like auditing frameworks, and lessons learned. Such publications come primarily from the fields of computer science, philosophy, and applied (e.g. medical or business) ethics, whereas none are from library and information science (LIS) research. Though none of the publications were explicitly about libraries or related institutions, we read and discussed each more deeply to draw out any implicit relevance, potential applicability to, or usefulness for libraries. Below we discuss the few examples we find the most notable, grouped by theme and ordered according to when in the software lifecycle they could be used (Lauesen, 2002).

RESULTS AND DISCUSSION

Consult AI ethics guidelines (before and during requirements analysis)—States, organisations, human rights defenders, and other groups have produced countless guidelines for ethical AI that may be relevant to a library given their geographic location, mission, patrons' demographics, or the kind of AI in question. One useful starting point for considering which guidelines may be applicable or useful to a library is the searchable inventory of guidelines maintained by *AlgorithmWatch* (<https://inventory.algorithmwatch.org/>), which includes guidelines for/by particular regions and domains. Further, there are systematic reviews and syntheses of many guidelines from different perspectives, which can help give a useful overview, understand their uses and limitations (Hagendorff, 2020), and quickly establish which are relevant to an institution based on (a) their concerns (Ryan & Stahl, 2020) or (b) their commitment to the different principles motivating most guidelines (e.g. transparency, justice and fairness, non-

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maleficence, responsibility, privacy; Jobin *et al.*, 2019). We particularly recommend libraries consider which guidelines are important to them as early as possible so that they can be used in software selection and communicated to the vendor during functional requirements specification.

Address bias (before and during design)—Bias is a problem that plagues AI in several forms (Mehrabani *et al.*, 2019), and there are many technical and non-technical approaches to address bias before and during the design of AI systems. We recommend relevant staff review all kinds of bias via a broad and generalised review (e.g. Ntoutsis *et al.*, 2020), and talk to vendors about if and how they audit their systems and training data for bias. For example, libraries might request developers use an auditing framework and questionnaire designed to uncover bias and “facilitate communication with non-technical stakeholders” (Lee & Singh, 2021). To further identify and address possible *non-technical* bias, libraries could organise events that draw on the perspectives of trustees, IT staff, LIS researchers, and the AI system’s developers; consensus-building methods like ethical foresight analysis are generally designed for larger scales of AI, but could be useful in a library-AI context as well (Floridi & Strait, 2020).

Audit the systems, development process, and data (throughout the software lifecycle)—Auditing is an aspect of evaluating and monitoring AI systems once they are implemented to ensure they are performing in an ethical manner, for example by systematically considering myriad possible unintended consequences. For an overview of issues that auditing can identify and address, we recommend a recent report by Koshiyama *et al.* (2021). However, because issues of AI can stem from its design and be hard to identify until after deployment, several auditing strategies, called end-to-end approaches, have been proposed to be put in place from the moment of identifying the perceived need for a system, *through* its development, to deployment and ongoing monitoring.

Notably, the SMACTR framework (Raji *et al.*, 2020) provides a promising guide to particular auditing steps (Scoping, Mapping, Artefact Collection, Testing, Reflection, and post-audit) and the necessary documents (e.g. list of principles, cases, checklists, data sheets, risk analyses, reports...) to conduct a thorough end-to-end algorithmic audit. We suspect it is sufficiently generic and thorough to be applicable and useful in libraries, but this should be validated. Though less generic and containing some examples that will not translate, there is also promise in an approach developed for auditing applications of machine learning to health care (Char *et al.*, 2020), because it is a very practical high-level guide to systematically identifying issues, with illuminating examples. If these solutions are too onerous given the scale of some system or the resources available for an audit, the Glass-Box Approach (Tubella *et al.*, 2019) may be a better fit; it is essentially a thoughtful adaptation of careful requirements specification and system verification to AI systems, consisting of (a) translating ethical values into design requirements and then (b) observing the deployed AI to see if the requirements are being met. Finally, though the previous frameworks do not ignore the importance of data (e.g. training data) in ethical AI, data-intensive cases like applications of AI to research data management may call for a framework that specifically considers the key data-ethical aspects. One such framework maps ethical themes and particular issues to five phases of data projects: business understanding, data preparation, modelling, evaluation, and deployment (Saltz & Dewar, 2019). Approaches like these are so far only *proposed*, rather than validated, but appear *prima facie* promising starting points for auditing libraries’ AI systems.

CONCLUSION

AI is, with all its potential for good and bad, entering libraries today. Libraries therefore have an opportunity to evaluate and minimise ethical issues of their AI-powered systems, and in that process can be leaders of ethical AI in the public sphere. Though LIS-specific research on how to do this does not currently exist, we suggest the above approaches, taken from non-library contexts but adaptable into several stages of the software lifecycle, could be useful starting points. However, we also recommend that LIS research starts to explore *library-specific strategies* for ensuring ethical outcomes of AI, especially end-to-end approaches and with particular attention to making them feasible for practitioners to implement (Morley *et al.*, 2019).

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Systematic Comparison of Data Models used in Mapping Knowledge Organization Systems

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ABSTRACT

This study explores six projects in mapping Knowledge Organization Systems (schemas, taxonomies, ontologies), and examines the data models used in these projects. We discuss (1) the two most common data models presented in these projects, namely tabular model, and tree model; (2) the implicit and explicit information shown in the data models; and (3) the information gains and losses of each model. We found that though the tree model maintains the hierarchical structure of the KOS while a tabular model flattens out the structure, both models can potentially obscure the information of the original KOS. This makes it problematic if we want to reconstruct a mapping project based on the outcomes manifested in either model. Our findings contribute to the Knowledge Organization literature by showing how choices of data models can impact the results in mapping schemas, taxonomies, and ontologies.

KEYWORDS

Data models; Metadata interoperability; Knowledge Organization Systems; Taxonomies; Ontologies.

INTRODUCTION

Data models are abstract models used in the context of designing Knowledge Organization Systems (KOS) such as metadata schemas, taxonomies, and ontologies. Prior literature has extensively explored how different choices of data models can impact the effectiveness of a KOS design (Van Hooland & Verborgh, 2014). In the context of mapping KOS, however, the impact of these choices have not been explicitly discussed. Efforts have been made to examine various mapping methods (Chan & Zeng, 2006; Shvaiko, & Euzenat, 2005), or evaluate the effectiveness of these methods (Avesani, Giunchiglia, & Yatskevich, 2005; Euzenat et al., 2001). We extend this literature by comparing the impact of different data models used in the process of mapping KOS. We recognize that the definition of data models varies across disciplines, but the commonality is that they represent raw data in a structured manner. Here we follow Van Hooland & Verborgh's (2014) definition that is specific to metadata research: data model "embodies the meaning of the data in its most essential and stripped down form". Established data models includes tabular model, tree model, relational model, and RDF model (Van Hooland & Verborg, 2014).

In this exploratory study, we examine six KOS mapping projects and the data models used in their studies. The six different projects are selected to represent a diverse set of KOS: two projects are mapping metadata schemas (Harping et al., 2000; Library of Congress, 2008), two projects are mapping taxonomies (Franz et al., 2016; Cheng & Ludäscher, 2020), and two projects are mapping ontologies (Raunich & Rahm, 2014; Jung, 2008). The purpose of this study is to compare the data models used across mapping projects and ask the following research questions:

- What kinds of information are made explicit/implicit in the data model used in these projects?
- What are the potential information gains/losses from the data model used in these projects?

This study is part of a larger research project aiming at evaluating KOS mapping methods. We hope the questions asked in this study can contribute to future mapping projects in the Information Science community and aid the researchers to choose the optimal data models fitting their goals.

DIFFERENT DATA MODELS IN INTEROPERABILITY PROJECTS

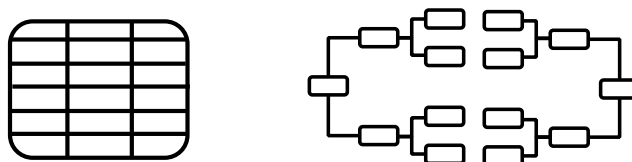


Figure 1. Tabular model (left). Tree model (right).

Two most common data models used in mapping projects are tabular model and tree model (Figure 1). Tabular models are used in the Getty Research Institute project to crosswalk 15 different art-related metadata standards (Harping et al., 2000), Library of Congress's MARC to Dublin Core Crosswalk (Library of Congress, 2008) and Franz et al. (2016)'s study on aligning 11 biological taxonomies of *Andropogon* complex across 126 years. Tree models are used in Raunich & Rahm (2014)'s ATOM project, Cheng & Ludäscher (2020)'s Indigenous Taiwan project, and Jung (2008)'s Virtual Organization project. Below we discuss the differences between the models that are discovered by inductive qualitative analysis.

Tabular Model

Using tables is a direct and effective way to map different schemas or taxonomies, especially when there are numerous KOS being compared. The information gain following this is tabular model's ability to aggregate and explicitly present all related standards and taxonomies about the same subject in one place. Oftentimes, it is assumed in a tabular model that the side-by-side representation of elements in columns suggest two elements are equivalent, whereas in reality, they may be overlapping, one subsuming the other, or near-equivalent. Also implicitly stated in a tabular model with more than two schemas is whether it is (1) a pair-wise comparison between schemas of adjacent columns; or (2) a comparison between the main schema in the first column versus the rest.

Further, like the name tabular suggests, using such model flattens out the information of these mapping projects, so the information is either lost in the mapping process, or not easily seen in the table. For example, in the Getty crosswalk (Harping et al., 2000), the sub-elements (or children nodes) of the original schemas and the nested elements are not shown directly on the crosswalking table, they have to include further markings (bolded fonts, numbered bullet points, shades on the tables, etc) to indicate the hierarchy of the schemas. It is also apparent that when mapping a more granular schema (e.g., CDWA) to a more general schema (e.g., Dublin Core), redundancies would occur in the table where multiple elements are mapped to one same element. Hence, it may be harder to reconstruct the study based on a tabular representation of the standards.

Tree Model

Tree models present taxonomies (or schemas, ontologies) in either hierarchies or directed acyclic graphs (DAGs). In KOS mapping projects, it is often the practice to place hierarchies beside each other and connect the links between the two hierarchies to depict the 'before-merging' view (input) of the project. This view has made explicit (1) how many levels of nodes there are in each taxonomy; (2) the root node, parent nodes, sibling nodes, and children nodes; (3) which level of nodes are we comparing in the two taxonomies; (4) the correctness and completeness of the relations between the two taxonomies. The 'after-merging' view (output) of two taxonomies are usually presented in one final hierarchy or a DAG (a node having more than one parent). This final merged solution view clearly shows which nodes in either taxonomy are congruent, and which nodes should be included in another.

Using the tree model to present mapping projects implies that the two taxonomies will be symmetrically mapped. In other words, there are no source or target taxonomies unless further specified using labels. In the input graphs, having two hierarchies also suggests implicitly that the nodes and edges of each taxonomy should be of the same type. For instance, all the edges (lines) within both taxonomies in Raunich & Rahm (2014)'s ATOM project implied they are is-a (parent-child) relations (e.g. a sedan 'is-a' an automobile), though none of the edges are marked with any labels. Moreover, in the output graphs, there could potentially be information loss because the merged tree can blur what the two original taxonomies are – so it would be difficult to trace back how the input graphs look like.

DISCUSSION AND CONCLUSION

The choice of using a certain data model over another in KOS mapping project may not be a random act, but one could choose it without realizing the implicit and explicit information a data model can signify. Though the tree model maintains the hierarchical structure of the KOS while a tabular model flattens out the structure, both models can potentially obscure the information of the original KOS. This makes it problematic if we want to reconstruct a mapping project based on the outcomes manifested in either model. We discuss the two most prevalently used data models when mapping schemas, taxonomies, or ontologies, but the list of data models is not exhaustive. Other alternative data models such as relational model or semantic model may exist in other mapping projects. Even with examining only two data models in mapping projects, there are already many embedded assumptions. Information losses can be amplified if more than one data model is used to represent diagrams in a mapping project, or if we are comparing more data models. Finally, we ought to understand that data models are abstractions of real-world entities, so they may not represent what the actual mapping tools look like, but rather a way to help us conceptualize how two or more KOS relate to each other.

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Challenges of Ovarian Cancer Patient and Caregiver Online Health Information Seeking

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ABSTRACT

Ovarian cancer (OvCa) patients and caregivers have constant and evolving information needs. To meet their needs, they seek information from various resources, including online health information. Although about 60% of cancer patients are now using the Internet to meet their information needs, little is known about online health information seeking (OHIS) among OvCa patients and caregivers. To address this gap, we interviewed 18 OvCa patients and 2 family caregivers of OvCa patients and conducted content analysis on the transcribed data. We identified three challenges of OHIS: (1) lack of OvCa-related knowledge, (2) poor quality of online information, and (3) inherent characteristics of OvCa, such as the high complexity and aggressive progression of the disease. The findings deepen the understanding of OvCa patients and caregivers and provide insights to better support their OHIS experience.

KEYWORDS

Online Health Information Seeking; Ovarian Cancer; Challenges; Qualitative Study.

INTRODUCTION

Ovarian cancer (OvCa, hereafter) is listed as rare cancer by the National Institutes of Health (NIH, n.d.). Managing OvCa can be very stressful because of its complexity and often aggressive progression (Hagan & Donovan, 2013). Due to limitations in early detection, OvCa is usually detected at late stages when the possibility for cure is unlikely. It is the most common cause of death for women with gynecologic cancers in the US (Siegel, Miller & Jemal, 2020).

About 60% of cancer patients use the Internet as a resource to manage their health (Chua, Tan & Gandhi, 2018). The OvCa community could benefit from an extensive online resource, however, the online health information seeking (OHIS, hereafter) of OvCa patients and caregivers has been understudied. Given the fact that patients' OHIS can vary across cancer types (Nagler et al., 2010), we aimed to understand the OHIS of individuals who suffer from OvCa. Specifically, *what are OvCa patients' and caregivers' perceived challenges in OHIS?* Identifying challenges may help researchers and clinicians to design interventions to assist this unique population's future OHIS experience.

METHOD

This study was conducted as part of an ongoing research project, Health E-Librarian with Personalized Recommendations (HELPeR) (R01 LM013038), which has an overarching goal to build and implement a personalized health recommendation system for OvCa patients and caregivers. In order to understand potential users' OHIS challenges, we conducted in-depth interviews with OvCa patients and caregivers. Our inclusion criteria were: (1) patients with a diagnosis of ovarian, fallopian, or primary peritoneal cancer (any stage of OvCa) and any time after initial diagnosis, including recurrence) OR family caregivers of patients diagnosed with ovarian, fallopian, or primary peritoneal cancer, (2) 18 years or older, (3) ability to read and write in English, and (4) access to computer (or mobile device) and Internet. The study design was approved by the IRB of the University of Pittsburgh.

We conducted interview sessions between May and November 2020. A faculty facilitator and two doctoral students conducted interviews with semi-structured, open-ended questions on participants' OHIS experience, and their perspectives of the online information they found. Each interview lasted approximately one hour and was recorded with permission. All recorded interviews were transcribed by a third-party vendor and anonymized with pseudonyms.

After the interview, three coders conducted content analysis on the transcribed data (Hsieh & Shannon, 2005). A codebook was developed using a combination of interview protocol (deductive) and open coding (inductive). Then,

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three coders independently analyzed the transcribed data to identify categories using NVivo (NVivo 11, n.d.). NVivo allows coders to highlight any length of text in the transcript and assign one or multiple codes from the pre-defined codebook. The whole coding process lasted approximately 3 months, during which the research team met on a weekly or bi-weekly basis to discuss disagreements and come to resolutions.

RESULTS AND DISCUSSION

A total of 20 individuals (18 OvCa patients, 2 family caregivers of OvCa patients) were interviewed over Zoom due to COVID-19 restrictions. The average age of participants was 58, and 60% of participants (n=14) were diagnosed at stage III or IV. All but one had received chemotherapy, and half of the participants had finished initial treatment. Three themes related to challenges of OHIS emerged: knowledge-related, quality-related, and disease-related. Our Cohen's kappa of 0.717 indicated substantial agreement between the three coders.

First, **lack of OvCa-related knowledge** was a challenge reported by participants, and it could engender extremely negative feelings such as hopelessness, fear, and frustration when the OvCa patients and caregivers conducted OHIS. For example, S13 told us, *"If it gets too complicated, then I get frustrated, and then I get more confused, and then I have to look up more words. And by the time I'm done, I'm getting totally upset."*

This can be explained that OvCa is, by nature, a complicated disease that requires a high degree of information and knowledge to be understood. For example, Donovan, Hartenbach, and Method (2005) found that women with OvCa under treatment suffer from 12 concurrent symptoms on average. OvCa patients and caregivers were required to search and learn a lot to manage their complex symptoms. In a recent study, Reid et al. (2021) found that 69% of the surveyed OvCa patients had not heard of or knew nothing about OvCa before their diagnosis. Lack of disease awareness makes the learning process extremely difficult and causes negative feelings toward OHIS process.

However, learning through OHIS is an independent and unassisted process unlike consulting a doctor. S12 described her challenges when she tried to search and learn the medical terms on the Internet: *"that was overwhelming because a lot of it was-- it just seemed like doom and gloom. And you really don't have someone there to turn to and say, 'How is this?' And you're just reading something. It's not interactive. So, it was frustrating."*

Second, the **poor quality of some online information** caused a sense of frustration among participants. As stated in the literature (Chi, He & Jeng, 2020), the quality of online health information is highly variable. Due to the low prevalence of OvCa, the online information on OvCa is generally scarcer and the quality was less validated. S11 said, *"what I initially read online was really frightening and wasn't necessarily true."* Worse yet, some participants were not confident in evaluating the quality of the online information that they searched. S17 stated that *"I'm a little leery about reading things -- it's hard to tell sometimes what's drug-pushed articles and what's actual medical exam articles. And I get nervous about not knowing whether or not this relates to my specific process in my journey."*

Third, the **inherent characteristics of the OvCa** led to feelings of fear, depression, anxiety, and hopelessness about OHIS for the participants. Women with OvCa experience high rates of recurrence, high symptom burden, and high intensity of treatment (Hagan & Donovan, 2013). In addition, most OvCa patients are diagnosed in advanced stages. A population-based study found one in four women with advanced OvCa die within 3 months of diagnosis (Urban et al., 2016). The majority of our participants were diagnosed with advanced stages. Thus, knowing the complexity and the prognosis of disease can be very stressful to patients and family caregivers, regardless of the source of information.

Our participants described that information provided by reputable cancer organizations did not ease their anxiety on poor prognosis of OvCa. S13 told us her feeling toward the information from the American Cancer Society, an authoritative cancer resource: *"Everything's negative on there. It says you have a very low chance of living. Ovarian cancer is one of the worst. They give you absolutely no hope. It scares me. That site is one of the main reasons why I stopped looking stuff up"*. S13 was not the only one who stopped seeking information after being scared by the information. S15 quit OHIS because *"I find I get depressed and more anxious if I read the bad [from the Internet]."*

CONCLUSION AND FUTURE WORK

The preliminary results presented in this paper highlighted three challenges of OvCa patients' and family caregivers' OHIS, which were resulted from complexity and aggressive prognosis of OvCa. We provide guidance on the support and information needs of an understudied population, women with OvCa. A better understanding of OvCa patients' and caregivers' challenges through the lens of their self-reported OHIS stories can provide potential implications for designing personalized recommendation systems. In the future, we will further reveal other aspects of the participants' OHIS experience and their perceptions about the recommendation system in development.

ACKNOWLEDGMENTS

This study was funded through National Library of Medicine (R01 LM013038).

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Discovery of a Hidden Pattern in Social Discussion

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ABSTRACT

This study investigates whether socially discussed book reviews would help understand the characteristics and features of books in selecting books for children. The study identifies users' interests in discussing books by analyzing the frequency of words used in their book reviews on a social networking site. This study also examines whether the patterns of word frequency would help understand the features of books. The findings of this study identify the aspects of a book that users are concerned about in reviewing the books. The results also reveal that online book reviews help us understand the specific features of books and user behavior in discussing books on a social networking site. This study has implications for providing practical insights into the intrinsic values of users' book reviews in discovering a pattern of social discussion.

KEYWORDS

Online reviews; social media; social networking; text analysis; children's books.

INTRODUCTION

Book reviews have been long used as a selection tool for collection building and book purchase (Jenkins, 1996) and have been identified as significant determinants in the library acquisitions process (Jenkins, 1999). However, the number of printed book reviews has been reduced, while online book reviews have been increasing (Hartley, 2018). The importance of online book reviews has been recognized as it forms a new type of book culture (Driscoll & Sedo, 2019). Researchers analyzed online book reviews to investigate the helpfulness of online reviews on sales of books (Chevalier & Mayzlin, 2006; Mudambi & Schuff, 2010). However, there have been a few studies done on online book reviews for selecting children's books (Choi, 2019a; Choi, 2019b). Selecting appropriate books for children is an essential factor that influences children's reading interests. Therefore, this study aims to investigate whether socially discussed book reviews would help understand the characteristics and features of books in selecting books for children. This study identifies users' interests in discussing children's books by analyzing the frequency of words used in their book reviews. This study also examines whether the frequency patterns of the words used in the reviews would reflect the characteristics and features of books. This study, therefore, addresses the following research questions:

RQ 1. Which aspects of books are frequently mentioned in book reviews on a social networking site?

RQ 2. Do the frequency patterns of words used in book reviews reflect the characteristics and features of books?

METHODOLOGY

For the analysis of book reviews, this study selected sample books from the American Library Association (ALA) Newbery Medal and Honor Books list. From the list, this study randomly selected 20 books and collected reviews of the books from Goodreads, which is a social networking site for book reviews and recommendations. This study collected Goodreads reviews randomly listed by default order, which is not sorted by date or length. A total of 3,062 reviews (55,856 words) was collected during the period from November 2017 to June 2018, and the collected reviews cover the period from 2006 to 2018. The data pre-processing was conducted for the collected reviews to exclude reviews that included non-English languages. This study analyzed the frequency of words that users used in their book reviews. For the word frequency analysis, the study employed the categorical topics of review words developed from our previous study (Choi & Joo, 2020) identifying the core categories of the features of book reviews: Physical Description, Genre, Award Note, Audience, Emotions, Series, and Evaluation category. Those seven categories were identified by using Latent Dirichlet allocation (LDA) topic modeling. From the topic generation using LDA, 57 exemplary words applied to those categories were also identified. An in-depth discussion of topic extraction using LDA topic modeling is beyond the scope of this short paper, so the key points are as follows. For identifying the aspects of a book frequently mentioned in online book reviews (RQ 1.), this study conducted the frequency analysis of the 57 terms based on the identified seven categories. For investigating the frequency patterns of words used in the book reviews (RQ 2.), this study further examined reviews by conducting a content analysis on review texts.

RESULTS AND DISCUSSION

The analysis of term frequency revealed that the most frequently addressed terms in book reviews were related to evaluative comments (37.3 percent), which are followed by “emotion” (20.1 percent) and “audience” (19.8 percent) (Figure 1). The word frequency of the Evaluation category demonstrated user behavior in reviewing books. That is, users tend to express their opinions by evaluating books with words such as “good,” “bad,” “complex,” “funny,” or “perfect.” The results also discovered that users are likely to specify the level of the audience by considering age groups or grade levels while recommending or arguing about the books. For example, words such as “age,” “grade,” and “students” were also frequently found in the reviews.

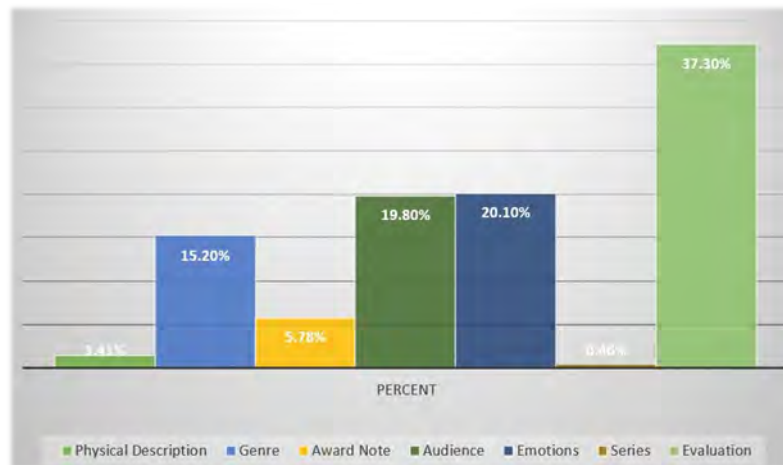


Figure 1. Frequency Analysis of Terms Used in the Online Book Reviews

The patterns of word frequency showed interesting points which reflect the characteristics and features of books. The results revealed that the comments on the time travel elements or poem form frequently appeared in the reviews of books. In the reviews about the book titled “*When You Reach Me*,” the words applied to the “Genre” category showed higher frequencies than other books. The story of this book has time travel elements with complex mystery characters. The study also discovered that the reviews address the unique style of writing (written in verse). The book titled “*The Crossover*” is a story about basketball, family, and life rules, and it is written as poems.

Another interesting fact about online book reviews is that users tend to indicate the series information about a book. The series information helps understand a book by serving as an important feature of the book. The high level of word frequency in the “Series” category indicated that a book is one series. For example, in the reviews about three books, such as “*Giver*,” “*Julie of the Wolves*,” and “*Sarah, Plain and Tall*,” the frequency of the word “series” was relatively higher than that of other books. The book titled “*Giver*” is about the memory of human life. This book is one of the series on the *Giver Quartet*, consisting of four books like *The Giver*, *Gathering Blue*, *Messenger*, and *Son*. The book titled “*Julie of the Wolves*” is about an Eskimo girl who had to survive in the Alaskan tundra. This book has two prequels: “*Julie*” and “*Julie’s Wolf Pack*” which makes this book the third in the series. The book titled “*Sarah, Plain and Tall*” is about a woman named Sarah who answered a widower’s advertisement for a new wife. This book also has sequels, including *Skylark*, *Caleb’s Story*, *More Perfect than the Moon*, and *Grandfather’s Dance*. These results showed that series information about a book is one of the essential aspects for users when reviewing books.

CONCLUSION

This study discovered the aspects that users are most interested in when reading a book or recommending a book to others. The results of word frequency by category uncovered that most words appearing in the reviews were related to emotional and evaluative comments on the books except the subject of the books, which this study excluded for the analysis. The findings also demonstrated that the words used in the reviews tend to show patterns that reflect the characteristics and features of books, such as the audience level, unique formats (such as time travel or poem), and the series information of books. To further investigate the patterns of word frequency in online book reviews, the study will perform a hierarchical cluster analysis on the selected books to identify homogeneous groups of cases (books) based on selected characteristics (word frequencies). This study has implications for providing practical insights into the intrinsic values of users’ book reviews in discovering a pattern of social discussion.

ACKNOWLEDGMENTS

The author is deeply grateful for Dr. Soohyung Joo, Associate Professor at the University of Kentucky, for his valuable contribution to data analysis.

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Analyzing Readers' Responses to Fake News on Facebook

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ABSTRACT

This paper investigates how different framings of fake news on social protests are related to readers' responses on Facebook. A 2 (news standpoint: pro-protest vs. pro-establishment) \times 2 (violence description: protesters' violence vs. police' violence) within-participants web-based experimental survey (N=90) was used to study readers' intention to like, share, and comment on Facebook. Results suggested that exposure to different framings of fake news led readers to respond differently on Facebook. Moreover, the intention to click "Like" did not necessarily translate to the intention to click "Share" or "Comment" and vice versa. This paper concludes with theoretical implications, practical implications, and limitations.

KEYWORDS

Fake news; News framing; Facebook; Social media; Social protest.

INTRODUCTION

Facebook is currently one of the dominant sources for users to consume online news (Lazer et al., 2018). Unfortunately, it has also been used as a conduit to spread misinformation and disinformation. For instance, during the 2019-2020 Hong Kong protests, fake news from both sides of the political divide emerged on Facebook to manipulate public opinions. Research has found that some users were willing to read and share these pieces despite knowing they were false (Guess, Nyhan, & Reifler, 2020). While there is a growing body of literature on users' responses to fake news, works dealing with the theme of social protests in a non-western context remain limited.

In the context of a social protest, news coverages are typically framed from two aspects. The first involves the news standpoint, classified as pro-protest and pro-establishment (McLeod & Detenber, 1999). The second is the depiction of violence associated with the protest, emphasizing either protesters' violence or police's violence (McLeod & Detenber, 1999). Given the news presentation format on Facebook (Kim, Moravec, & Dennis, 2019), news standpoints and violent depiction are reflected in the headline and captioned image. Facebook users may respond to each news clip in three distinct ways, namely, by clicking the "Like" button to signal their affirmation, clicking the "Share" button to share the piece with their contacts and clicking on the "Comment" button to express a qualitative opinion (Kim & Dennis, 2019).

However, the relation between different framings of such fake news and Facebook users' responses has not been empirically investigated. For this reason, this paper proposes the following research question: *How are different combinations between the standpoint of a news headline (pro-protest vs. pro-establishment) and the violent depiction of its captioned image (protesters' violence vs. police's violence) related to Facebook users' response in terms of the intention to click "Like," "Share" and "Comment"?*

METHODS

A sample of 90 students in a public university in Southeast Asia volunteered for this study. All of them met the two eligibility criteria: They were regular Facebook users and were aware of the Hong Kong protests but had no attitude inclinations towards either camp. A 2 (news standpoint: pro-protest vs. pro-establishment) \times 2 (violence depiction: protesters' violence vs. police' violence) within-participants web-based experimental survey was employed to study users' responses to fake news on Facebook. Participants were exposed to four experimental stimuli, which followed a Latin Square design embedded as Facebook posts on a pseudo-user account. For Fake News A, the headline was "Hong Kong protesters: We have the right to demand democracy," and captioned image showed that protesters walked in front of a burning barricade during clashes with police. Fake News B's headline was "Violence returns to HK as police tried to clear protests," and captioned image showed that several policemen hit a protester in a street. For Fake News C, the headline was "New violence erupts in HK after protesters march in defiance of police ban," and captioned image showed that protesters were breaking the glass outside the legislative council building. Fake News D's headline was "HK police fight back to rioters in streets," and captioned image showed that policemen addressed chaos and violence raised by protesters. Participants could see that these posts had been marked as false

news by Facebook's fact-checking board (Kim et al., 2019). After exposure to such false news, their intentions to share, like, and comment were captured using 7-point Likert scales adapted from Kim and Dennis (2019).

RESULTS

Figure 1 shows the readers' responses to different framings of fake news on Facebook. Specifically, exposure to Fake News A and Fake News D attracted higher intentions to like (Mean \pm S.D: 4.45 \pm 0.87; 4.38 \pm 0.92). Next, exposure to Fake News B and Fake News D drew higher intentions to share (Mean \pm S.D: 4.58 \pm 0.95; 4.61 \pm 0.76). Finally, exposure to Fake News B and Fake News C attracted higher intention to comment (Mean \pm S.D: 4.56 \pm 0.93; 4.42 \pm 0.89). After ensuring that the data satisfied the statistical assumptions of ANOVA, SPSS was used to confirm that exposure to different framings of fake news drew significant differences on the intention to like ($F(3, 86) = 12.95, p < 0.001$), intention to share ($F(3, 86) = 20.76, p < 0.001$) and intention to comment ($F(3, 86) = 15.28, p < 0.001$).

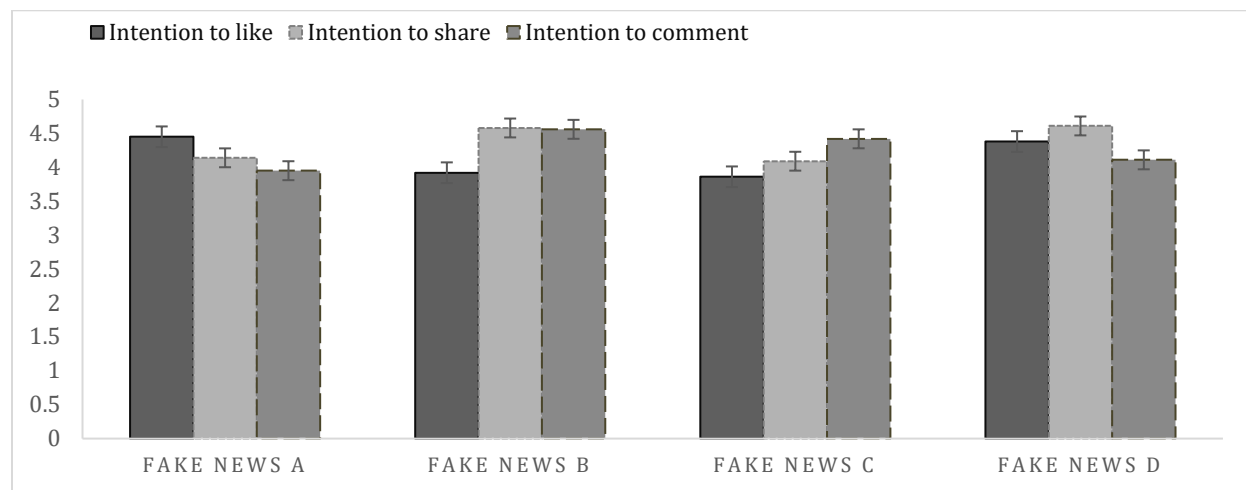


Figure 1. Readers' responses to different framings of fake news

Note: Fake News A (pro-protest + protesters' violence); Fake News B (pro-protest+ police's violence); Fake News C (pro-establishment + protester's violence); and Fake News D (pro-establishment + police's violence). Error bars reflect 90 percent confidence intervals.

CONCLUSION

Three major findings are gleaned. First, when there is alignment between headlines and the captions of the accompanying images (e.g., pro-protest headline + protesters' violence depiction or pro-establishment headline + police's violence), users are more likely to click "Like." Second, captioned images showing police's violence are more likely to lead users to "Share." Third, when there is misalignment between headlines and the captions of the accompanying images (e.g., pro-protest headline + police's violence or pro-establishment headline + protesters' violence depiction), users are more likely to click "Comment."

This paper is significant on two counts. Theoretically, it contributes to the existing literature by shedding light on how different framings shaped readers' responses to fake news on social media. In brief, the intention to click "Like" did not necessarily translate to the intention to click "Share" or "Comment" and vice versa. These need to be treated as distinct and independent social media metrics. Practically, it has implications for social media providers. They are encouraged to focus on the relationship between exposure to different framings of fake news and users' respective responses on social media.

Two major limitations must be acknowledged. First, since participants were selected using convenience sampling, it is important to exercise caution in generalizing the results. In particular, individual differences such as information processing preferences were not taken into account. Second, this study has not investigated why readers were willing to share, like, or comment on these posts even though they knew the posts were marked as false. Future research could uncover the reasons by augmenting the data collection procedure with one-to-one interviews.

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Boundary Crossing in Online Community of Practice: “Between Art and Quarantine”

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ABSTRACT

“Between art and quarantine” became a popular social media challenge during the COVID 19 lockdown. Thousands of users posted art recreations and formed several online communities of practice (CoPs) around this common interest. The boundaries of some of these CoPs are more permeable than others and they all utilize Instagram visual affordances to cross language barriers. We aim to gain a better understanding of the unique boundaries within and between these CoPs and their boundary crossing processes. Initial analysis of 1,555 posts reveals patterns of overlap and the roles of boundary brokers and boundary objects; yet, further in-depth analysis is still needed, to gain a better understanding of the visual and cross language boundary crossing that is at play within and between these CoPs.

KEYWORDS

Community of Practice; Boundary crossing; Social media challenges; “Between art and quarantine”.

INTRODUCTION AND BACKGROUND

The lockdown during the COVID-19 pandemic brought with it a host of social media challenges. One of these challenges is “between art and quarantine,” which invited people to post a recreation of a work of art with resources they had at home (Waldorf & Stephen, 2020). As a result, many social media users posted their creations, tagging museums or using hashtags such as #tussenkunstenquarantaine in Dutch, #изоизоляция in Russian, and #gettymuseumchallenge or #betweenartandquarantine in English. Figure 1 provides an example of an art recreation from the challenge posted on Instagram. We approach this challenge as an online community of practice (CoP), bounded by the hashtags. We examine the boundaries and overlap of these four CoPs, focusing on users that act as “boundary brokers,” and on “boundary objects” that are shared within and across CoPs (Wenger, 1998).

Online CoPs are composed of members that share common interests and interact with each other to discuss topics, exchange ideas and seek support. The “between art and quarantine” challenge is a social activity that involves people with a shared interest in art recreation on social media platforms, who utilize the platforms’ unique affordances (e.g., hashtag and following). One of the building blocks of online CoPs is their boundary maintenance, upheld by boundary crossing and boundary brokers (Wenger, 1998). Often boundary objects are the technology that connect CoPs members—Instagram hashtags, in our case—which facilitate boundary crossing among different CoP, while enforcing the boundaries of each CoP. Boundary brokers are members of more than one CoP, and can make effective connections between them (Brown & Duguid, 1998). Wenger (1998, p. 109) describes the broker’s role in the following way: “It requires the ability to link practices by facilitating transactions between them and to cause learning by introducing into a practice, elements of another.” In our case, these are users who utilize multiple hashtags and post their recreation regularly and typically engage with the CoP more frequently than others, by posting, commenting, liking, and following. CoPs’ boundary maintenance processes have received some scholarly attention, but scholars call for the need for further research on boundary crossing (Hara & Fichman, 2014). When language barriers between communities are evident, unpacking the role of boundary brokers and boundary objects is necessary; it is particularly critical to understand the boundary crossing that occurs on Instagram’s CoPs, given the platform’s visual affordances.

METHOD

Using Phantombuster’s Instagram Hashtag Collector, we collected all March 2021 Instagram posts with the hashtags: #betweenartandquarantine (689 posts in total, 22 posts in average per day), #tussenkunstenquarantaine (779, 25), #gettymuseumchallenge (647, 21), and #изоизоляция (383, 12). We first conducted descriptive data analysis to examine the boundaries and overlap between the four CoPs, which we report here. Then, to gain a better understanding of the boundary crossing processes, we developed a codebook for qualitative content analysis, which is not included in this paper, due to space limitations.



Figure 1. Example of an Instagram post (<https://www.instagram.com/p/CASOsC7oXxj/>).

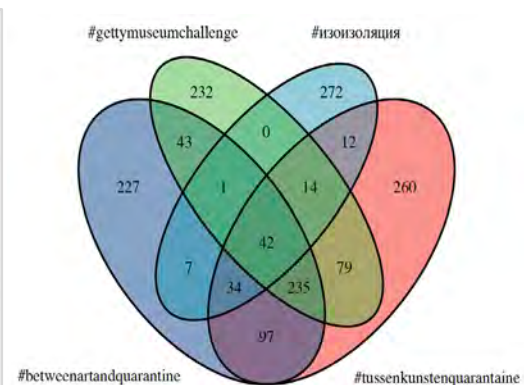


Figure 2. The Venn diagram of posts in “Between art and quarantine” challenge in each hashtag.

FINDINGS AND DISCUSSION

A Venn diagram of the four hashtags shows that there are many overlapping posts across the four CoPs, as participants posted their recreation using more than one hashtag (Figure 2). Three of the hashtags (#betweenartandquarantine, #tussenkunstnquarantaine, and #gettymuseumchallenge) are frequently used with each other, with two thirds of posts overlapping, while the Russian hashtag is used less frequently with the other three hashtags, with only one third of posts overlapping. The boundaries between the first three CoPs are permeable, unlike the Russian CoP. It is possible that the four CoPs differ in other ways, therefore an in-depth examination of posts content could further increase our understanding of the boundary crossing processes that are at play here.

We examined and compared the attributes of the posts and participants who have employed multiple hashtags, to those who used a single hashtag (Table 1). Nine participants posted almost every day, posting more than 20 times in a month, but the majority of the participants (88%) posted only up to five times; still, half of the posts (50%) came from those who posted up to five times. Participants who posted more frequently tended to use more hashtags, as can be seen through the average number of hashtags. Using multiple hashtags facilitated the boundary crossing processes, and was more frequently seen with boundary brokers, who crossed the boundaries between the four CoPs. Surprisingly, the “like” and “comment” counts had nothing to do with the number of hashtags associated with the posts, despite their exposure to wider audiences; future examination of posts’ content may shed light on the reason behind this discrepancy.

	>20 times	20-11 times	10-6 times	5-2 times	1 time	Total
Participants count	9	15	32	140	275	471
Post count	326	214	238	401	376	1,555
Average hashtags	2	1.6	1.5	1.4	1.3	1.6
Average like count	160	472	126	242	188	226
Average comment count	7	25	8	13	9	12

Table 1. The distribution of all kinds of characteristics of posts on different participation frequency

CONCLUSIONS AND FUTURE RESEARCH DIRECTIONS

We report initial findings from our examination of boundary crossing processes in four Instagram CoPs that had a significant overlap. Variations and overlap between the CoPs may be a direct result of the actions of boundary brokers and function of boundary objects. Further content analysis of comments and posts (text and art recreation images) will facilitate a better understanding of boundary processes in these CoPs, as community members navigate their participation and identities across communities on the platform. It is important to do so because this challenge utilizes Instagram’s visual affordances on one hand, and textual affordances, on the other; boundary processes use them both, within and across CoPs.

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A Peek into the US Informal STEM Landscape through Theconnectory.org

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ABSTRACT

It's well-known that informal STEM learning is a critical component of STEM education. However, there is not a comprehensive directory, at the state or national level, listing informal STEM programs offered in the US. This makes it difficult to assess the national landscape of informal STEM programs. Theconnectory.org is by far the most comprehensive listing that aims to connect learners and volunteers to informal STEM learning opportunities. In this poster, we present the results from a data analytics project using the informal STEM program information collected through theconnectory.org API to sketch a preliminary picture of what kind of programs are offered and what audiences are targeted. Theconnectory.org has the potential to become a primary resource for STEM learners, educators, and policymakers. There are ways the ASIST community (faculty and students) can help enrich this resource.

KEYWORDS

Informal STEM programs; STEM education; online directory; data analytics; Theconnectory.org.

INTRODUCTION

Numerous studies have shown the unequal representation of different populations in the STEM career (e.g., Dasgupta & Stout, 2014; Saw et al. 2018). Many funding agencies in US, for example, the Department of Education and the National Science Foundation, have been offering various programs to improve STEM education in the past decade or longer. Some of these funding opportunities are exclusively targeted at underrepresented populations, for example, NSF's INCLUDES program. Many informal STEM programs have been funded for girls, the disabled, low-income people, and different age groups ranging from elementary school students to junior faculty (<https://www.nsf.gov/awardsearch/>).

However, there is not a comprehensive directory in the US, at the state or national level, listing informal STEM programs offered. This makes it difficult for learners to find a program that is 'right' for them and for educators and policymakers to assess the national landscape of informal STEM programs: are there STEM programs in terms of quality, quantity, STEM areas, and accessibility to serve various underrepresented groups? Learning during the COVID pandemic adds additional evidence on the importance of informal STEM learning as studies have shown that COVID-related school closure had less effect on students' reading abilities than on their math skills (e.g., Kuhfeld et al. 2020).

We searched far and wide on the Web for a comprehensive directory for information STEM programs and with an insider's tip, we found theconnectory.org. This is by our assessment the most comprehensive service, developed by the National Girls Collaborative Project, to connect the learners and volunteers to informal STEM learning opportunities. As the MS Capstone project of the first author, informal STEM learning programs registered on theconnectory.org were analyzed to provide a preliminary landscape of such programs in the US. With more programs registered on theconnectory.org, the picture will be refined and become a more and more accurate reflection of reality. We would also encourage the ASIST community to contribute the further development of theconnectory.org as a valuable resource for learners, educators, volunteers, and policymakers.

METHOD

The API provided on the theconnectory.org site was used in a python script to collect all metadata about informal STEM programs registered on the site. A total of 843 programs were collected at the end of March (up from 647 collected in Jan 2021) with 45 attributes. Additional attributes, for example, school enrollment, poverty rate, and population by US counties were scraped from indexmundi.com.

Through feature selection and data transformation (one-hot encoding, binning, etc.), data were shaped for analysis. Exploratory analysis, association rule mining, and clustering analysis were performed on the clean data.

RESULTS

Due to the page limit, we can only include selected findings in this paper.

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STEM areas covered: In the descending order of the frequency of STEM areas covered by the 843 programs are technology, general science, computer science, coding/programming, engineering, space, biology, arts, environmental science, robotics, making DIY, math, invention education, architecture and design, natural history, humanities, entrepreneurship, citizen science, and biological engineering. **Languages used:** English is used in 662 programs and 24 programs use Spanish. Other languages used in less than 3 programs. **Target audience served:** Around 400 programs include boys, girls, and gifted/talented students as their target audience, and less than 100 programs include students with disabilities or students at risk of dropping out of schools as their target audience.

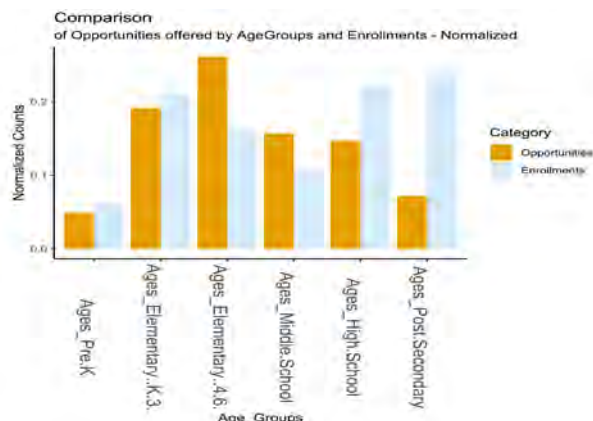


Figure 1. Comparison of opportunities offered by age groups to school enrollments



Figure 2. Geographical distribution of informal STEM programs in Theconnectory.org

Age of audience served: Most programs are for elementary students or younger. Putting in the context of enrollment numbers for PreK to post-secondary education, the data shows an overproportioned number of programs for 4th grade up to middle school, and the difference between school enrollments and available programs reverses for high school and post-secondary students. **Cost of the programs:** Over 300 programs are free. The majority of the fee-based program has a fee between \$100 and \$500, with a few charge over \$1000. Over 200 programs offer scholarships and these scholarships are almost exclusively distributed among programs costing \$100 - \$500. A vast majority of the programs costing \$100 - \$500 are summer programs. **Duration of the programs:** Half of the programs indicated the duration for their programs. Programs with a duration of four to seven days are about three times the programs with a duration of under 1 hour, under one day, or over 14 days. **Geographic distribution of the programs:** Theconnectory.org database holds programs across the US, with most of the programs distributed on the east coast and in large cities. In North Carolina, we observed a negative correlation between the county poverty rate and the number of programs.

Some interesting association rules were mined using the R arules package. Several clustering algorithms were attempted but did not turn up easy-to-explain clusters.

CONCLUSION

To our knowledge, this is the first informal STEM program review based on real data. The results suggest that the data collected by theconnectory.org are valuable in identifying gaps in terms of STEM areas, language used, geographic distribution, cost, and targeted audiences of informal STEM programs, however, more programs need to be registered in theconnectory.org to provide more an accurate picture. Through the platform of the ASIST meeting, we hope to bring theconnectory.org to our attention and encourage ASIST communities to contribute to the building of this valuable resource. Important functionalities currently missing include learner evaluation of the programs they attended. With more programs registered on theconnectory.org, learners, especially underrepresented learners, will be able to find suitable programs more easily, educators will be able to collaborate and learn about other programs, and volunteers and programs will also be better connected.

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Teaching with Color: Calling in White Faculty to Address Whiteness in the LIS Curriculum

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ABSTRACT

Diversity, equity, inclusion, and justice (DEIJ) issues underlie the systemic problems affecting our society, including the critical lack of inclusion within the field of librarianship. All LIS faculty must prepare students to work with diverse populations of both patrons and colleagues and should aim to strengthen students' cultural competence by incorporating DEIJ issues and concepts into the curriculum. However, in a field that is overwhelmingly white, there are sure to be missteps as white faculty develop their own cultural competency through research, teaching, and interpersonal interaction. In this poster, we argue for increased transparency amongst white LIS faculty who seek to incorporate DEIJ concepts into their courses. We additionally encourage faculty to prioritize student involvement and feedback while integrating DEIJ-related theory and topics into the LIS curriculum. Finally, we argue that open discussion between white faculty and students of color is necessary for the field's ongoing progress towards equity.

KEYWORDS

LIS Curricula; Diversity, Equity, Inclusion, and Social Justice; Critical Race Theory; Pedagogy; Cultural Competence.

INTRODUCTION AND MOTIVATION

Despite significant efforts over the past two decades to increase diversity within librarianship (Kung et al., 2020), the field continues to struggle with a "whiteness" problem (Brown et al., 2018), particularly (but not only) in the U.S. Among other issues, the lack of a diversified workforce results in Library and Information Studies (LIS) professionals of color disproportionately carrying the burden of demonstrating cultural competency when serving patrons from underserved groups (Mehra, 2019). At the same time, professionals of color frequently suffer micro-aggressions and more from both patrons and staff (Sweeney & Cooke, 2018). While research shows that there is a dire need to recruit and retain diverse students into LIS programs in order to support a more inclusive workforce (Croxtton et al., 2016; Kim & Sin, 2008), LIS programs continue to struggle with this goal (Jaeger et al., 2011; Mehra, 2019).

One significant cause of such inequities within the field is the continued lack of emphasis on diversity, equity, inclusion, and justice (DEIJ) issues within LIS curricula (Pawley, 2006). This lack of coverage not only leaves students ill-equipped to serve diverse patrons (Jaeger et al., 2013), but also contributes to the lack of support for professionals of color within their workplace (Mehra, 2019). Furthermore, a failure to address and incorporate DEIJ topics into the LIS curriculum may dissuade students of color from entering the field (Jones, 2020).

While all LIS faculty should accordingly prepare students to work with diverse populations of both patrons and colleagues, the work of incorporating DEIJ issues and concepts into the curriculum has disproportionately been taken up by LIS faculty of color—often with little reward or positive recognition (Mehra, 2019). In order to truly address whiteness within the LIS curriculum, the field must also "call in" (e.g., Arroyo-Ramirez et al., 2018) white faculty to better incorporate DEIJ issues into their courses and their pedagogical approaches.

PREVIOUS WORK

LIS educators have discussed their efforts to integrate DEIJ topics and theories in a number of areas within the curriculum. Focusing on the existing core courses of LIS curricula, researchers have identified areas where social justice content naturally connects to topic "levers" of multiple courses (Kumasi & Manlove, 2015) and have discussed how DEIJ theories may be incorporated across courses to help students understand that race and ethnicity affect the politics of the classification and circulation of information (Adler & Harper, 2018). Others have considered successful approaches to teaching information literacy skills within a social justice framework (Rioux, 2017).

Beyond focusing on specific courses, other efforts promote change more broadly within LIS education. One approach developed an informal reading group to support critical discussion of race, racism, and white privilege across the institution (Cooke et al., 2016). Other methodological routes encourage pedagogies that can resist the normalization of white cultural practices in LIS education to support a climate of equity (Barnett & Witenstein, 2020), including: adopting Indigenous (Roy, 2015) or radical (Cooke, 2019) pedagogies, or using social justice

frameworks as both curricular topic and pedagogical tool (Cooke et al., 2016; Cooke & Sweeney, 2017). Such reframings can disrupt mainstream methods of educating that often perpetuate systemic injustices and exclude students of color (Roy, 2015).

As attempts to integrate DEIJ into curricula progress, so do the analyses of such efforts. One study of cultural competence within a cohort of LIS students found that their gained knowledge concerning DEIJ-related issues ranged only from low to moderate levels of learning, confirming a continued need for evaluation of DEIJ integration attempts (Kumasi & Hill, 2011). Another such analysis involved instructor-student collaboration to evaluate syllabi across their school's curriculum and collect DEIJ resources that can be infused into LIS curricula (Cooke & Jacobs, 2018).

Involving students in both course analysis and course development is crucial, as LIS students notice the lack of social justice theories addressed in LIS curriculum and may become disenchanted with the profession—especially students of color (Gómez, 2013). LIS students realize the need for more prominent discussion of and pedagogy that supports critical thinking on issues of social justice (Helkenberg et al., 2018). LIS students can help transform their institutions and profession at large, beginning with student-led initiatives (Oxley, 2013) or student-based groups that engage with DEIJ topics and apply skills to real-world situations (Jardine & Zerhusen, 2015). In particular, student-faculty partnerships can foster supportive participation in addressing DEIJ within curricula (Mercer-Mapstone et al., 2021).

CALLING IN WHITE LIS FACULTY TO WORK WITH STUDENTS AND FACULTY OF COLOR

We support the ongoing overhaul of both course content and pedagogy that have not sufficiently prepared LIS students to be culturally competent professionals. In a field that is still overwhelmingly white (Mehra & Gray, 2020), however, there will inevitably be missteps as white faculty develop their own cultural competency through research, teaching, and interpersonal interaction. Many white faculty members are hesitant to address DEIJ issues in the curriculum for a number of reasons, including: a perceived lack of knowledge or personal experience (Quaye & Harper, 2007), feeling unprepared to moderate difficult conversations that arise when discussing these issues in class (Deepak et al., 2015), or simply not seeing this work as a priority either personally or within their institution (Mayhew & Grunwald, 2006).

To address these concerns, we argue for increased transparency amongst white LIS faculty who seek to incorporate DEIJ concepts and frameworks into their courses. Rather than avoiding this work altogether or working independently, we argue that white LIS faculty members should call each other in by openly discussing their efforts—particularly including their own missteps—and by engaging in discussion and collaboration with each other. White faculty should additionally support colleagues and students of color in sharing their perspectives and engaging in “counter-storytelling” to redress the whiteness of LIS and of academia in general (e.g., Arday, 2018; Cooke, 2017; Doharty et al., 2021). We particularly encourage white faculty to build on previous efforts to prioritize student involvement and feedback—especially from students of color—throughout the entire process of addressing DEIJ issues within the LIS curriculum. Finally, while engaging with peers and colleagues of color is important, white faculty must also work to advance their own knowledge in frameworks such as Critical Race Theory to truly address equity in the curriculum.

CONCLUSION AND FUTURE WORK

While missteps are inevitable, white faculty must take responsibility for better addressing DEIJ in the LIS Curriculum. Humble approaches and increased transparency with students and colleagues regarding this journey allow white LIS faculty room for growth and ownership concerning their own DEIJ knowledge. Developed through discussion between students of color and white LIS faculty, this poster represents the beginning of such a collaborative project. Future work could ask: How might critical analysis and revamping of current LIS curricula lead to the creation of new frameworks for faculty to address whiteness in the field? How might white LIS faculty better support marginalized students—especially students of color—through student collaboration in addressing DEIJ in the curriculum? Sharing such research amongst colleagues across the field could potentially inform efforts both in the U.S. and in other regions.

Potential approaches to this work could include: conducting quantitative and/or qualitative methods analyses of DEIJ coverage in existing curricula by soliciting feedback from faculty and students of color; incorporating meaningful student-faculty collaboration into both the assessment and creation of curriculum; acknowledging and openly discussing experiences of marginalized groups in order to disrupt mainstream, white pedagogical practices; creating specific spaces for white faculty to discuss their own DEIJ journey; and encouraging white faculty to be open about their missteps in order to normalize an ongoing process and to “call in” other white faculty. The burden of improving DEIJ and combating whiteness in the LIS curriculum should not wholly fall onto the shoulders of faculty or students of color; it is imperative to call in white faculty to this work. Together, we can learn to teach with color.

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Information Organization and Information Retrieval in the LIS Curriculum

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ABSTRACT

Within LIS programs, information organization (IO) and information retrieval (IR) serve as foundational topics of instruction. While traditionally represented by required, dedicated courses in LIS curricula, they may now appear as a combined course or in combination with other topics across required courses. The present analysis of 58 IO/IR-related course syllabi is part of a larger project examining the interrelation of IO and IR instruction across current ALA-accredited LIS curricula. Preliminary results presented here show significant IO and IR coverage in a range of course types, as well as the heavily applied nature of IR instruction and the movement of IO instruction toward more emergent topics.

KEYWORDS

information organization; information retrieval; LIS education.

INTRODUCTION & BACKGROUND

Within LIS programs, both information organization (IO) and information retrieval (IR) serve as foundational, longstanding topics of instruction. IO focuses on the development and use of tools and systems to organize information and information resources, such as catalogs and classification systems, while IR is concerned with selecting and retrieving information relevant to a user's needs. Together, these topics address a common goal of access (Hjørland, 2021) and have been described as the cornerstone of LIS education (Bawden, 2007, 135).

As LIS curricula continue to change in response to quickly changing areas of information work and important emergent topics, however, many programs are featuring a smaller core of required courses, supplemented by an expanded offering of electives (ur Rehman & Alajmi, 2017, 98). While IO and IR may have once been represented by their own required courses, they may now be combined into one course (Joudrey & McGinnis, 2014, 524), distributed across several courses covering other combinations of LIS topics, or offered as electives.

Most examinations of IO and IR in LIS curricula have considered these topics separately, focusing on the presence and nature of dedicated courses (for example, Salaba, 2020). The combined teaching of IO and IR, as well as their disbursement across core, required courses, remain relatively unexplored. The present study is part of a larger project examining the interrelation of IO and IR across LIS core courses in ALA-accredited programs. The current work presents preliminary findings on the type and content of required LIS courses that cover some aspect of IO and/or IR. These initial findings offer insight into the changing ways in which IO and IR are being taught.

METHOD

Using the ALA program directory, researchers identified accredited LIS programs in North America. Publicly available data on each program's website was reviewed to determine the required courses in their graduate programs. Researchers recorded information about any required course referencing information organization or information retrieval in its title or description. For each identified course, one syllabus from calendar year 2019 was collected from the school, program, or instructor website. For syllabi not available online, researchers contacted programs and/or instructors to request a copy.

In analyzing the syllabi, researchers first used the title and description to code the course into a general type. Further analysis focused on two common syllabus sections: course description and schedule of topics. Researchers conducted keyword extraction on these sections for all syllabi, recording any terms or phrases that identified an information concept as a topic of instruction (e.g., "classification," "database design," "reference services"). The entire process was conducted separately by two researchers. A third researcher reviewed their results and oversaw a reconciliation process to address and resolve any inconsistencies between the two.

RESULTS

A total of 58 syllabi were collected from 41 ALA-accredited programs. Researchers divided these courses into five types, based on purpose and general content, as follows: information organization (17), information retrieval (7), combined (9), general foundations (11), and reference and information services (14).

A total of 3,080 keywords (1,918 unique) were extracted from the syllabi, with an average of 53 keywords per syllabus. Table 1 shows the 10 most frequently occurring keywords along with their number of occurrences within all the syllabi for each course type.

	IO	IR	Combined	Foundations	Reference
1	metadata (20)	access (6)	classification (7)	information (10)	reference interview (13)
2	classification (15)	databases (5)	information (7)	libraries (6)	reference services (12)
3	authority control (12)	information literacy (4)	metadata (7)	metadata (5)	information literacy (11)
4	linked data (11)	information services (4)	authority control (6)	users (5)	information services (10)
5	information organization (10)	searching (4)	information organization (6)	create and manage information systems (4)	libraries (10)
6	subject analysis (10)	Boolean logic (3)	information retrieval (6)	information services (4)	reference (8)
7	RDA (8)	design, querying, and evaluation of information retrieval systems (3)	indexing (5)	internet (4)	dictionaries (7)
8	Semantic Web (8)	evaluation (3)	information organization and retrieval practices and methods (4)	library and information science (4)	encyclopedias (7)
9	categorization (7)	information seeking (3)	information retrieval systems (4)	systems (4)	ethics (6)
10	controlled vocabularies (7)	reference interview (3)	organizing information (4)	classification (3)	information centers (6)

Table 1. Most frequently occurring instruction topic keywords per course type

IMPLICATIONS & CONCLUSION

Within the 58 courses examined, IO and/or IR topics were prominent in a variety of course types. Most common were the dedicated IO courses, a finding that echoes Salaba's (2020) recent observation that a majority of ALA-accredited programs contain a core IO course. Surprisingly, dedicated IR courses were the least common type noted within the present study, with combined IO/IR courses or reference courses appearing as more common sources of IR coverage. The disappearance of the required IR course, as well as IR's prominence within reference and information services courses, are trends that have been noted for some time (Nicholson, 2005; Chu, 2006).

As shown in Table 1, free keywords extracted from the syllabi reflect a range of instructional topics within required courses. Broad, general topics such as "information" and "libraries" are understandably common within the entire dataset, though one of the most frequently occurring keywords, "metadata" is typically associated with IO education. Other IO-associated keywords, such as "classification" and "indexing," also occurred across course types, indicating the foundational nature of some IO topics. Within specific course types, IR-related keywords appeared commonly within IR and reference and information services courses. In both cases, the more commonly occurring keywords such as "reference interview" and "information services" show the heavily applied nature of IR instruction. In contrast, the more theoretical IR terms "precision" and "recall" occurred only once each within the entire dataset. Within IO courses, "classification," "authority control," and "subject analysis" occurred frequently. "Semantic Web" and "linked data" occurred more frequently than "cataloging," however, showing some shift away from traditional IO applications toward more emerging practices.

Overall, these preliminary findings show that IO and IR topics are not just limited to dedicated courses, but occur prominently across core courses within contemporary LIS curricula. To fully understand their role in LIS programs, we must take a broader view of how these topics are being taught, moving beyond the examination of dedicated courses to a more holistic examination of their presence within both core and elective courses of all types. Future work stemming from the larger, ongoing project will be aimed at identifying specific IO and IR topics within the curriculum, as well as understanding areas of frequent crossover between the two.

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Street Art as Visual Information: Mixed Methods Approach to Analyzing Community Spaces

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ABSTRACT

This paper uses a mixed method approach to analyze how a community space can be perceived by a visual information via physical spaces. In this analysis, Street Art images are considered as a type of visual information that can represent a specific perception of a community as a member of a community space. While understanding community attributes through perceptual tools we can use social network analysis methodology to understand how different neighborhoods are connected and how they might differ. The results show that specific neighborhood traits, urban, population, culture contribute to stronger ties within the Street Art community network.

KEYWORDS

Social Network Analysis; Visual Information; Mixed Methods; Street Art; Community Spaces.

INTRODUCTION

The importance of visual information in a community, for example street signs, store fronts, logos, legal information, community events, etc. is crucial to the structure and sustainability of that community. Visual information takes on an even more evocative role for the outsider attempting to understand a community and imposes an analytical representation of events to help preserve the social structure (Rose, 2016). By focusing on one specific type of visual information a community can be perceived from its components. The question this poster tries to answer is how a community can be perceived by a visual image via physical spaces? Street Art will be seen as a type of visual information, including examples in the Tucson, Arizona metropolitan area spanning a 70-mile radius. Street Art will be considered as any non-institutional art created for the local community, legally or illegally. These art forms include graffiti and murals contracted by community leaders, groups, or independent artists.

Community spaces are specific demographic areas within a city, town, or region that represent the surrounding community. Culture, history, activities, and resources represent the space, along with a communal atmosphere that is indicative of its members, where members are usually geographically located in the vicinity of the community space. Street art that represents a community space can be considered as a membership to a particular group. By using social network analysis as a form of linking actors to other actors or groups within a network, quantitative forms of analysis can help review how street art represents a community space. Social network analysis methods for this research include by-dynamic line graphs as well as dualistic forms of methodology that show the relational ties between members and communities and the shared relationships within the network.

DATA

The data describing the Street Art pieces was created into a custom map (Figure 1) that was pulled from a Google Map of almost 100 Tucson Street-Art Murals created by Tucson.com (Tucson.com, 2021), along with artist and organization websites to compile a dataset that includes the area, location, artist, address, name, style, latitude and longitude of 92 pieces. The community data was gathered from the United States Census website, the DataUSA website, and the statistical atlas, where economic, race, and education demographics were found for neighborhood, zip code, and representative boundaries. These data were joined by zip codes and other boundary descriptions. The community and Street Art datasets were joined by zip codes to create the network dataset based on location, community, demographics, artist, and Street Art piece.

METHOD - DUALITY AND BI-DYNAMIC LINE GRAPHS

The network is composed of two sets for analysis, Street Art and community spaces. Street Art can belong to a group of Street Art practice but can also belong to a community space such as a neighborhood, and visa versa. Understanding the value of connections within and between particular sets can help understand how a Street Art image might be perceived as belonging to a particular community space. To understand these connections, Breiger's (1974) duality measures consider the value of ties between a set of individuals and a set of groups (Breiger, 1974). In this case Street Art can be understood as individuals and community spaces as groups (Breiger, 1974). Breiger's (1974) axioms help describe the ties between Street Art images and community spaces and describe how Street Art nodes and community space nodes can be related by similar connecting ties, and the destination of reflexivity where

belonging to a group is relatable and groups relate to their individual members. But what does this mean for Street Art and their communities?

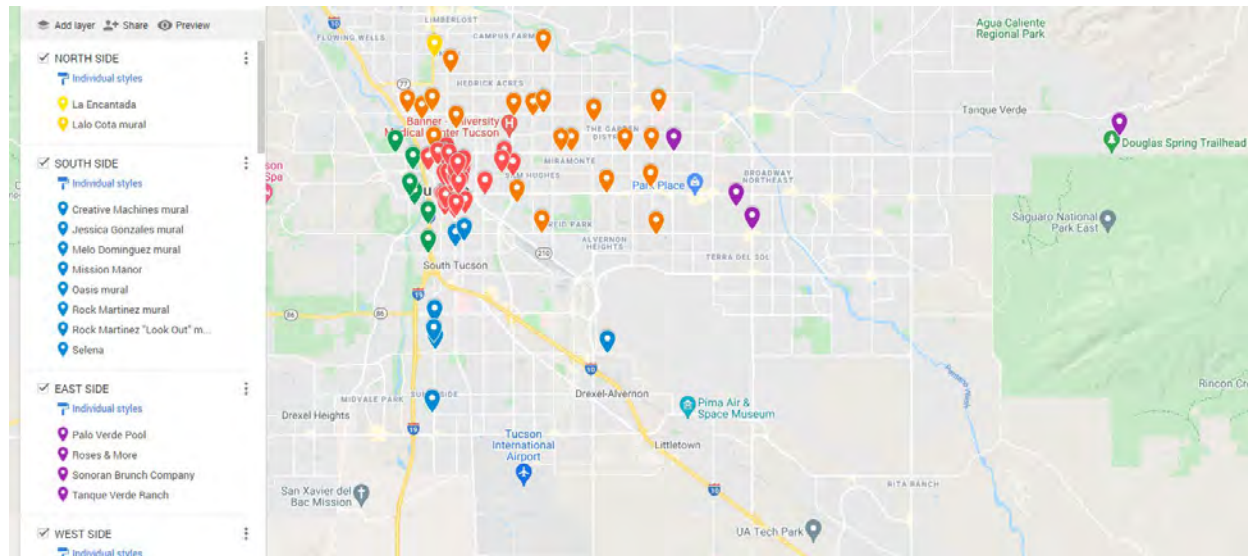


Figure 1. Custom Tucson Street Art Map

As Street Art is perceived within a community space, we can look further into the notion of duality by using a bipartite network to consider the intersection of these two sets. In their work on temporal dynamics of bipartite networks, Broccatelli, Everett, and Koskinen (2016) use bipartite networks with a temporal aspect of modes for covert networks that intersect actors and events across time (Broccatelli, et al., 2016). They implemented three steps, 1) an affiliation matrix of the two sets, 2) they generate a line graph projection where edges between individuals are transformed to nodes while excluding redundant ties, and 3) they further reduce the ties to contain only the edges that connect the individual nodes to the group nodes (Broccatelli, et al., 2016). Community space to community space ties within Street Art sets show how some community spaces are more prone to Street Art as representatives. These are reciprocal ties that connect the two node types (community to community) that interact with each other. There are seven main community to community clusters within the Street Art set while eight other sets are connected outside of the clusters. Street Art to Street Art ties within Community spaces show a different behavior than their Street Art to Street Art counterpart where most Street Art does not affiliate with each other showing distant parts, and little if any connections to other dissimilar Street Art. This is an interesting outcome because it shows how Street Art within community spaces is somewhat independent of itself, instead of being connected to other art. The comparison of community space to community space within a Street Art cluster is also interesting because it shows how community spaces are connected.

CONCLUSION

The components of perception for visual information in the form of Street Art provide a qualitative analysis to how community spaces are perceived through street art images. Network analysis methods quantitatively show how Street Art images are connected to their community spaces and how they might represent that community in the overall network of Street Art images. Considering interpretations of surface and practices of viewing, Street Art images can provide a perception of urban, cultural, and specialized community spaces that make up a network of connections in a metro area.

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Information Flow and Social Organization in a Bitcoin Discussion Network on Twitter

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ABSTRACT

This study investigates the information flow and social organization in a Bitcoin discussion network on Twitter (BDN), using social network analysis to examine user-user interactions. Results suggest that BDN presents a heterogeneous degree distribution, where most users have few interactions. A myriad of weakly defined but well-connected subcommunities enables efficient information flow in the network. BDN emanates a small-world effect, without the dominance of a few influential users. 'Star-power agents,' such as Elon Musk, are popular references among users, but the network is driven bottom-up by smaller 'two-sided' users. This explorative study demonstrates how the classification of different users can be used in analyzing online communities. Future research could compare the network structure of BDN with other networks and utilize sentiment analysis to analyze the quality of information.

KEYWORDS

Network analysis; Twitter; Bitcoin discussion network; Community analysis; Cryptocurrency.

INTRODUCTION

Surging past 60,000 USD (BBC News, 2021), the most popular cryptocurrency Bitcoin has been riding a wave of enthusiasm in recent decades. As Twitter is a popular platform among Bitcoin enthusiasts, existing studies often utilize Twitter sentiment analysis to predict Bitcoin's market performance (Abraham et al., 2018; Choi, 2021; Colianni et al., 2015; Kinderis et al., 2018; Lamon et al., 2017; Mai et al., 2015; Matta et al., 2015; Philippas et al., 2019; Shen et al., 2019; Stenqvist & Lönnö, 2017). In particular, influential Twitter accounts (Öztürk & Bilgiç, 2021), such as Elon Musk (Ante, 2021), were identified as key drivers and predictors of Bitcoin returns. However, little attention has been paid to the dynamics of the Bitcoin community on Twitter. To our knowledge, this study is the first to investigate a Bitcoin discussion network on Twitter (BDN) using social network analysis. The research questions are: 1) What are the structural characteristics of BDN? 2) Who are influential users? 3) What characterizes the subcommunities within the network?

This study used the number of followers as a simple proxy to estimate users' social capital and labeled the users with most followers as 'star-power agents.' Social capital is given by one's connections, and through these connections, individuals can further affect, influence, and mobilize other agents in a network (Lin, 2017). Moreover, we introduce the concepts 'two-sided users' and 'one-sided users,' based on reciprocity in online interactions. Two-sided users reciprocally interact with others. In contrast, one-sided users do not interact with others at all or only interact with others unilaterally. Many one-sided users are bots, giveaway sites, and advertising companies. Our categorization of users provides insights into what roles different users play in information diffusion.

METHODS

We collected 82,799 tweets using the Twitter streaming API in April 2021, with the keywords 'Bitcoin' and 'BTC' (the acronym for Bitcoin). Thereof, 58,471 unique users were identified. Excluding users with no interactions ($n=7,093$), we constructed a directed user-interaction network based on Twitter's *retweet*, *reply*, and *mention* interactions among 44,675 unique users in the dataset. Data analysis was done corresponding to each research question. The structural characteristics are examined by analyzing the degree distribution and a number of network-level measures. We calculated betweenness centrality, closeness centrality, and reciprocity to identify influential users. In-degree and out-degree was used to identify two-way users (in-degree and out-degree ≥ 1) and one-sided users (in-degree or out-degree = 0). We used the number of followers to identify star-power agents. Lastly, modularity and the number of subcommunities were calculated. We used Stochastic block modeling (SBM) to visualize the structure of the subcommunities (Abbe, 2017).

RESULTS

The total number of edges in the network is 125,433, with the majority of interactions being *mentions* ($n=63,790$), closely followed by *retweets* ($n=48,043$) and then *replies* ($n=13,240$). The graph density is ~ 0.0000448 , and the

average degree is 5.238. The total number of isolated nodes is 7,093 out of 58,471, approximately 12.131%. The largest component contains 40,464 nodes, which suggests that BDN has some level of connectivity. The average clustering coefficient is 0.055, which shows that nodes are relatively dispersed. Alternatively, nodes' neighbors are not necessarily connected. The network's diameter is 16, and the average shortest path length is 2.986, indicating that, on average, information would have to go through about three users to reach a new user. The power-law distribution (Figure 1B) shows a heterogeneous degree distribution where a large number of nodes have a low degree, which suggests a small-world effect (Watts & Strogatz, 1998). Thus, the network may be relatively sparse, and most users have relatively few interactions, but it is still well-connected. In terms of users' social influence, Figure 1A illustrates that nodes with a high in-degree tend to have an out-degree close to zero and vice versa, which is reflected in the low reciprocity (~ 0.0114). For better visualization, we have limited the Figure 1A's x-axis to 80 and the y-axis to 100. Both two-sided users ($n=2,684$) and one-sided users ($n=48,694$) exist in the network, and one-sided users include bots, giveaway sites, and star-power agents. When identifying the top 10 star-power agents in the network, we see that these are regularly interacted with by other BDN nodes, but all have an out-degree of 0. In other words, these accounts, such as major newspapers, are popular references among the Bitcoin community, and the most notable one is Elon Musk's account. However, they do not themselves interact with others and, thereby, drive the community. Thus, the nodes that efficiently connect the network and transfer information are the dispersed two-way users. This indicates that the community is created and organized bottom-up. Concerning the social organizations in BDN, there are 3,351 subcommunities and high modularity of 0.858. It indicates that BDN has a well-defined modular structure. Moreover, we can infer from a relatively low clustering coefficient (0.055) and figure 1C that subcommunities are not well-defined, structurally polarized, or independent. Instead, there are many small and intertwined subcommunities. Theoretically, information would reach the majority of nodes but have to travel a long path to do so.

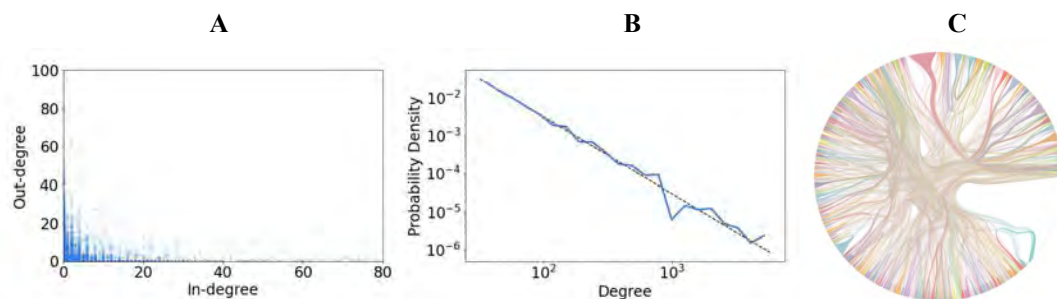


Figure 1. A) In-degree vs. out-degree distribution. B) Power-law distribution. C) Stochastic block model.

CONCLUSION

Our snapshot of BDN shows that it is a dispersed yet well-connected and non-polarized network. It is driven bottom-up, and multiple weakly defined and interconnected subcommunities facilitate widely spread information. Our study applied social network analysis to explore the social dynamics of the Bitcoin community on Twitter, contributing to the knowledge of online community formation and information diffusion. While previous studies found that influential users on social media, what we deemed 'star-power agents', are key drivers for Bitcoin's market performance, we found that they do not dominate the social organization of the Bitcoin community on Twitter. Instead, the online community was driven bottom-up by non-star-power agents. Moreover, our study demonstrated how the classification of different users (i.e., 'star-power agents,' 'one-sided,' and 'two-sided' users) is relevant to analyze online communities. Given the explorative nature of our study, the representativeness of such a Bitcoin discussion network is limited. The following steps are to collect data over a more extended period and use sentiment analysis to examine the quality of information disseminated by different users. The network structure of the Bitcoin community could be compared with other regular networks to see how the information patterns differ and its implication. These future directions may enable a better understanding of the social dynamics of online communities.

ACKNOWLEDGMENTS

This poster would not have been possible without the guidance and support of Dr. Shihui Feng. The three authors contributed equally and thank each other for a fruitful collaboration.

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Cross-Cultural Analysis of Trolling Behaviors

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ABSTRACT

The online disinhibition effect allows trolling to spread widely. As it is possible that trolling behaviors are more frequent in some countries than others, this paper compares the extent and type of trolling in India and the USA. Through a comparative content analysis of 3,000 Twitter posts, we found that trolling varies significantly between the two countries. Specifically, we found that individuals in the USA were trolled significantly more frequently than individuals from India. Almost all trolling behaviors have been at least three times more common in the USA. We argue that the variations in trolling can be attributed to socio-cultural differences between the two countries, as trolling is more acceptable in low power distance countries.

KEYWORDS

Twitter; Trolling; Cultural Diversity.

INTRODUCTION AND BACKGROUND

Twitter announced new ways to combat trolling (Brandon, 2020), due to its omnipresence on the platform. More than 500 million tweets are posted daily, spreading disinformation and trolling. Online trolling is multidimensional and context dependent, and it varies from one setting to another (Sanfilippo et al., 2018). It is possible that targets of trolling in different countries will have different experiences because “according to the theory of cultural relativity, every culture and subculture has its own standards about what is acceptable and unacceptable behavior” (Suler & Phillips, 1998, p. 276). Indeed, online disinhibition is partially enabled by reduced status, power, and authority, compared to face-to-face interactions (Suler, 2004). Power dynamics may shift online (Suler, 2004) or may be unnoticeable (Suler & Phillips, 1998). At the same time, power differences may be as prominent online or even more noticeable as they are offline.

Hofstede’s cultural dimensions framework (Hofstede et al., 2010) has been treated as a paradigm in cross-cultural studies. While there has been a lot of criticism of this framework, it is perhaps the most popular one when it comes to cross-cultural research. The framework includes six cultural values: power distance, individualism-collectivism, masculinity-femininity, uncertainty avoidance, long term-short term orientation, and indulgence-restraint (Hofstede et al., 2010). Power distance is defined as “the extent to which the less powerful members of organizations and institutions (like the family) accept and expect that power is distributed unequally” (Hofstede et al., 2010, p. 80). We examine if there is a difference between trolled individuals from high power distance (India) countries and trolled individuals in low power distance (USA) countries. Given India’s higher rank on the power distance index, compared to the USA, we expect Americans to be trolled more frequently on Twitter than Indians.

METHOD

Using ExportComments.com, we collected data from Twitter on February 9-23, 2020, utilizing a Twitter account created for this purpose. We collected 200 tweets from eight Twitter accounts of celebrities from the two countries (Abhishek Bachchan, Alexandria Ocasio-Cortez, Anushka Sharma, Donald Trump, Kevin Spacey, Lindsay Lohan, Mamata Banerjee, and Narendra Modi), 25 tweets per account, and all of their respective comments. We randomly sampled 15 comments from each of the 200 tweets, with a total of 375 comments per account, for a total of 3,000 comments. We uploaded the comments into NVivo12, a software for qualitative data analysis, to facilitate content analysis. Next, we developed a codebook with eight trolling behaviors (Table 1) through an iterative process of coding and discussion among the authors, and tested it on a sample of our data. We then coded the data at the individual post level; each of the 3,000 posts was coded with all the relevant codes. Inter-coder reliability was 85% simple agreement.

FINDINGS

We found that some trolling behaviors were more common than others, with derailment, insulting, provocation, personal attacks, and pseudo-sincere as the most frequent trolling techniques (Table 1). As expected frequencies of trolling varied by country; we found significantly more trolling comments in the USA than in India (Table 2). As can be seen in Table 2, derailment was the most frequent trolling tactic overall, and it was almost as frequent in both countries. Yet, the other seven trolling behaviors have been at least times more common in the USA than in India

(hyperbole, ideological misalignments, ideologically extermizing language, insulting, personal attacks, provocation, and pseudo sincere). The most common trolling behaviors in the USA include personal attacks and pseudo sincere.

Trolling Tactic	Definition	Frequency
Derailment (P)	Purposefully leading a conversation off track.	354
Hyperbole (H)	Exaggerating one's strengths or another's weaknesses.	87
Ideological Misalignment (IM)	Comments/remarks made because of a difference in political opinions.	152
Ideologically Extremizing Language (IEL)	Contains extremist language used to critically describe a subject/ their behavior (e.g., an implicit slur).	96
Insulting, Mocking, Name Calling, & Swearing (I)	Statement meant to insult an individual or group of people.	197
Personal Attacks (PA)	Statement meant to target an individual.	195
Provocation (P)	Statement intended to elicit a specific reaction.	284
Pseudo Sincere (PS)	Providing the impression of particular motivations while actually being driven by other motivations.	346
Total		1,711

Table 1. Trolling behaviors and their frequencies

Country	D	H	IM	IEL	I	PA	P	PS	Total
India	167	20	23	16	40	42	63	95	466
USA	187	67	129	80	157	153	221	251	1,245

Table 2. Frequency of trolling behaviors by country

DISCUSSION AND CONCLUSION

While satire political trolling differed only slightly between 60 countries (Fichman, 2020), we found that trolling is context-dependent, and varies significantly between countries. We demonstrate that tweets by American celebrities are subject to more trolling than tweets by Indian celebrities. The variations might be due to socio-cultural differences, as there are significant variations in cultural values between the two nations (Hofstede et al., 2010). The USA is a society with low power distance which might be more accepting of trolling than India. However, differences in political regimes might account for the variations, as India is authoritarian, where trolling may be less frequent because of censorship or self-censorship. It is likewise possible that other socio-cultural factors are at play here, or that our sample is not representative of trolling in the two countries. Future research could examine trolling in other countries to support or refute our findings.

We conclude that trolling is more nuanced than previously understood, not only because it simply varies from one setting to another, but also because perpetrators troll certain individuals more often than others. Even though people behave online in less socially desirable ways in general, due to online disinhibition, they may be pushing the boundaries of unacceptable online behaviors further in countries that tolerate deviations. What count as an acceptable behavior in one country may not be acceptable in another, and trolling pushes these boundaries in context. Future research may examine if online disinhibition is sensitive to cultural variations.

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Knowledge Work in the Library

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ABSTRACT

Library staff are knowledge workers (KWs), but it is not entirely clear what this work looks like, how it is allocated, what outcomes are associated with it, or how the pandemic influenced this work. This poster outlines an agenda to study the KW of paraprofessional and professional library staff. Learning more about the form, context, and authority of KW in the library—as well as the personal and task outcomes of this work—will better position LIS to prepare future librarians and guide the development of equitable workplaces that support the needs of library staff.

KEYWORDS

Knowledge work; tacit knowledge; embodied knowledge; canonical knowledge; library management.

INTRODUCTION

The 21st century came with promises of transforming the way people work. Machlup (1962) showed that, in a *Knowledge Economy*, the relevant stock of knowledge in any society was not what is recorded in books but rather “what living people know” (p. 167). Drucker (1999) suggested that the *knowledge workers* (KWs) who fueled the success of this new economy would bring their own knowledge to their work rather than the knowledge of someone else. Yet, definitions of KW remain contested (Pyöriä, 2005), and the extent to which workers engage in this work is unclear. For instance, the gig economy failed to fulfill its promise of a new wave of KW (Hasija & Rampal, 2020). And, although companies continue to hire for knowledge-intensive jobs, this work is overly standardized around rigid job titles and predictable outputs (Martin, 2013). Librarians are KWs (Materska, 2004; Asogwa, 2012). Yet, it is unclear what this looks like, how it influences personal and task outcomes, or how paraprofessional and professional library staff prepare for this work. This poster outlines a research agenda within LIS to study the KW of library staff.

Understanding more about the KW of library staff has significant implications for library management practice. First, to the extent that KW enables variety, choice, and independence, it should also increase job satisfaction (Leysen & Boydston, 2009; Srivastava, Bartol, & Locke, 2006). Libraries should strive, then, to allocate this work equitably. Yet, KW has historically been assigned according to occupational classifications (Machlup, 1962) or formal education (Drucker, 1993; Choi & Varney, 1995). Freeburg (2018) found that some library management allocate KW to those deemed to be the *creatives*. This restriction of KW is problematic given that educational progress (de Brey et al., 2019) and assumptions about someone’s creativity (Schuster et al., 2020) tend to differ according to race, ethnicity, and gender. Second, KW in the library has been associated with a library’s competitive advantage and success (Islam & Kedia, 2014; Sheng & Sun, 2007). Yet, the budget cuts faced by some libraries during the pandemic may lead to the adoption of more rigid standardization and efficiency practices that might hinder this work. It is important to learn how this shift in approach influences the mission and goals of a library.

A RESEARCH AGENDA

What is Knowledge Work?

Though it may seem obvious that KWs use knowledge, there have been several—often competing—attempts to articulate exactly what this means (Pyöriä, 2005; Palvalin, 2019). It has been used synonymously with “white collar” work (Okkenen, 2004), associated with highly qualified and talented individuals (Costas & Karreman, 2016), and used as a catch-all term for the future of work. KW has been defined as *skilled mental labor* (Reyt & Wiesenfeld, 2015) that uses ideas as raw materials (Heerwagen et al., 2004), uses information to make decisions (Jacobs, 2017), and uses theoretical concepts to produce results (Bosch-Sijtsema et al., 2011). Yet, these and similar definitions are not entirely helpful to the study of library work. For one thing, a focus on individualized knowledge tends to leave out the situated nature of KW. For another, these definitions do not add much clarity to what KW *looks like*. As a means of narrowing the focus of KW research in the library, while accounting for socio-cultural elements of this work, this poster defines the KW of library staff by focusing on three components of this work: form, context, and authority. The KW of library staff is defined as any activity situated in and mediated through the context of library practice that involves tacit, explicit, canonical, or noncanonical knowledge.

Form. KWs in the library use knowledge in several forms, and researchers often distinguish among tacit and explicit forms. Though this distinction is helpful, library staff are unlikely to work with knowledge in pure explicit or tacit

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form. Rather, these forms represent the opposite ends of a continuum (Panahi et al., 2016), and most knowledge includes a “tacit-explicit mix” (Jasimuddin et al., 2005). Knowledge that has more *tacitness*, then, is difficult to codify and share (Hau et al., 2013) and tends to be *sticky* (von Hippel, 1994). It is subjective, informal, and internalized (Kabir, 2013). It includes intuition, skills, insight, know-how, beliefs, mental models, and practical intelligence (McAdam et al., 2007). And people are generally not aware that they are using this knowledge. When driving a nail, for instance, one may be aware of the hammer, but their explicit focus is on the nail (Oğuz & Şengün, 2011). LIS researchers have recognized the value of tacit knowledge to the library, looking at how it is shared (Burnette, 2017) and captured (Wijetunge, 2012; Stover, 2004). Additional research is suggested into how staff create and apply tacit knowledge during their workday. Explicit knowledge, on the other hand, has a more formal shape than tacit knowledge and, as a result, is easier to communicate and share (Nonaka & Takeuchi, 1995). It is transmittable through language and typically refers to knowledge that either is or can easily be codified (Dhanaraj et al., 2004). The codified forms of explicit knowledge can be studied as information, and researchers in LIS have long been concerned with information behavior in the workplace (Widén et al., 2014). Yet, while some research has looked into the information behavior of library staff—e.g., their use of technology (Maceli & Burke, 2016) and workplace information literacy (McDonald et al., 2015)—much of this research focuses on how library staff can support the literacy efforts of *visitors* to the library. Additional research is suggested into how library staff, themselves, create, find, and use explicit knowledge to help them complete work tasks and make sense of their lives at work.

Context. KW in the library occurs within the defined practice of librarianship. It includes the “situated practices of ordinary daily work” (Cook & Brown, 1999, p. 80) that are “negotiated, emergent, and embedded” (Gherardi, 2009, p. 357) and “materially and historically mediated” (Nicolini et al., 2003, p. 26). The KW of library staff is evident, then, not just in what staff know, but in what they do together. Any study of KW in the library, then, should consider the socio-cultural context of the library as a workplace. This extends what is considered to be KW. For instance, because KW is materially mediated, it includes how workers take in and use information and knowledge processed through the five senses (Lloyd, 2010). Kuuru and Närvänen (2020) noted, for instance, the physicality of service workers as they read physical signs from customers and adapted body language to account for customer actions. In addition, because the knowledge used by these workers includes shared understandings and language, i.e., encultured and encoded knowledge (Blackler, 1995), it also includes how workers navigate their place within complex social systems. For instance, Rydzik & Ellis-Vowles (2019) considered how women in the male-dominated brewing industry manage stereotypes in these masculine spaces by what they say and how they appear. As library staff take in knowledge about how they are perceived and modify their behavior and appearance to influence these perceptions, they are engaging in KW. Additional research is suggested into how library staff use knowledge to navigate the situated and material realities of the library workplace and how this influences job satisfaction and task outcomes.

Authority. KW also includes *official* knowledge and staff-driven workarounds, what Brown and Duguid (1991) referred to as canonical and noncanonical knowledge. The canon of librarianship represents knowledge that has been blessed, so to speak, by authority and management. This is the *manual* of librarianship, including formal processes, procedures, standards, and policies. The canon plays a controlling function as it establishes the *right* way to do things, and it is typically the focus of LIS education. Yet, just like repair technicians following support documentation (Orr, 1990), problems arise that this canon cannot solve. Working together, library staff discuss these problems and develop new noncanonical knowledge about how to get things done. Thus, while the canon is developed outside of the specific context in which it is applied, noncanonical knowledge emerges from the context of library work. This means that, while canonical knowledge is abstract, logical, alienating, and individualizing, noncanonical knowledge is situated, loosely structured, collective, and collaborative (Cox, 2005). Since Frederick Taylor’s (2003/1911) *Scientific Management*, the focus of American business has been on holding workers accountable to these canons as a means of increasing efficiency. Additional research is suggested into how library staff follow and develop this knowledge and—given that Taylor’s approach was adopted by many libraries (Kipp, 1954)—the extent to which staff are allowed to deviate from the canon and how this influences job satisfaction and task outcomes.

CONCLUSION

This poster described a research agenda for the study of KW in the library, including conceptualizations of KW and suggestions for future research. It asks LIS researchers to consider not only how librarians can use their skills to support “equity, diversity, inclusion, justice, and relevance” (ASIS&T, 2021) in broader society but also how the library as a workplace can support this for its own staff.

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Is Gamification Effortful? A Study in the Crowdsourcing Context

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ABSTRACT

Researchers have claimed that gamification adds to the workload of users, potentially influencing their perceptions of effort and performance expectancy negatively. Through an experimental study which compared a gamified and a non-gamified mobile app for crowdsourcing restaurant reviews, we found participants had similar perceptions of effort and performance expectancy, contrary to expectations. Interestingly, participants perceived reviews in the gamified application to be more accurate. There were also more reviews made in the gamified application.

KEYWORDS

Gamification; crowdsourcing; performance expectancy; effort expectancy; user study.

INTRODUCTION

The use of game-like experiences in non-game contexts to motivate people towards beneficial outcomes is commonly known as gamification (Deterding et al., 2011). While there is much literature on its usefulness (e.g. Seaborn & Fels, 2015), there is also increasing recognition of gamification's inadvertent side effects (e.g. Diefenbach & Müssig, 2019). In particular, gamification features may add to users' workloads because they now have to attend to them plus contend with social comparison and competition with other users (Hanus & Fox, 2015). This may impact users' perceptions of the gamified application, and subsequently, their usage performance.

The present study thus investigates whether the use of gamification influences users' effort and performance expectancy in a crowdsourcing context. Crowdsourcing was chosen as it is one of the areas where gamification has often been employed to motivate participation (Goh, Pe-Than, & Lee, 2017). Briefly, effort expectancy refers to the level of ease associated with the use of a technology (Ventatesh et al., 2012) while performance expectancy is defined as the extent to which using a technology will provide benefit to people, and lead to performance gains (Chong, 2013). Complementing these two constructs, we further investigated whether gamification influences perceptions of accuracy of crowdsourced contributions, and the number of contributions made.

METHODOLOGY

To address these objectives, an experiment involving restaurant reviewing was conducted using the Google Maps mobile app. The app was chosen because it offered both gamified and non-gamified modes for crowdsourcing reviews. Further, the gamification features are the only differences between the two modes, allowing for consistency in the experiment. The non-gamified mode provides the usual features for reviewing including commenting and rating. The gamified mode layers gamification components upon these features. Users earn points for different types of reviewing activities such as writing a review, rating reviews, and contributing photos. Users level up based on the number of points earned, which is depicted as a progress bar on their profile pages. Finally, users earn badges by performing review-oriented tasks such as reviewing 25 places or contributing three photos. Note that in the Google Maps app, reviews can be of any location, but in our study, we restricted these locations to restaurants.

A total of 60 participants, comprising 25 males and 35 females were recruited through convenience and snowball sampling. The average age was about 25 years. About 60% of the participants worked in the information technology sector. Twenty-seven participants reported giving online reviews using platforms such as Google Maps and online shopping sites. Participants were randomly assigned to use the gamified and non-gamified modes of the Google Maps app, with 30 in each experimental group. Each participant was given a Google account. In both groups, participants were asked to install the app on their mobile phones, use it for one week, and review at least 12 restaurants. They were told to create reviews that were truthful, informative and helpful to others. In the gamified group, participants were further informed of the gamification features, and asked to earn points and badges.

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At the end of the one-week period, the number of reviews created by each participant was recorded. Participants completed an online questionnaire comprising: (1) Demographic questions including age, gender, and employment sector; (2) Experience with online reviewing; (3) Effort expectancy, referring to the ease of using Google Maps to create reviews; (4) Performance expectancy, referring to the effectiveness and usefulness of Google Maps to create reviews; (5) Accuracy of reviews, which measures perceptions of the correctness of the crowdsourced reviews (Goh, Pe-Than, & Lee, 2017); and, (6) Intention to use, which asks whether participants would continue using the app for reviewing in the future (Rodrigues, Oliveira, & Costa, 2016). These constructs were the dependent variables of the experimental study, with the application type (gamified versus non-gamified) as the independent variable.

RESULTS

The independent sample t-test was used to compare the dependent variables across application type. Table 1 summarizes the results. Interestingly, only effort expectancy and performance expectancy yielded statistically non-significant results. Tests of the remaining independent variables were statistically significant. When compared against the non-gamified mode, participants in the gamified mode reported they would continue to use it more, perceived that it provided more accurate information, and actually created more reviews.

Construct	Non-Gamified Mode Mean (SD)	Gamified Mode Mean (SD)	T	p-value
Effort expectancy	3.43 (2.95)	3.88 (3.65)	-1.834	0.072
Performance expectancy	3.88 (3.16)	4.12 (3.13)	-1.273	0.208
Accuracy	3.76 (3.63)	4.17 (2.32)	-2.074	0.043*
Intention to use	3.14 (3.19)	3.76 (2.77)	-2.378	0.021*
Number of reviews	11.27 (6.03)	12.53 (0.51)	-2.173	0.038*
* statistically significant differences at $p < 0.05$				

Table 1. T-Test Results

DISCUSSION AND CONCLUSION

Our effort expectancy results indicate that the ease of creating restaurant reviews was perceived by participants to be similar between Google Maps' gamified and non-gamified modes. This suggests that the additional workload (Turan et al., 2016) required of the gamification features did not appear to distract participants or add to their burden of restaurant reviewing. Perhaps the engagement and immersion (Lumsden et al., 2017) afforded by gamification had a positive influence on effort expectancy. This could also explain the higher ratings for intention to use the gamified mode. Next, gamification did not influence performance expectancy, but it interestingly influenced perceptions of accuracy and the number of reviews contributed. This meant that although participants did not feel that Google Maps' gamified mode was more useful or effective than the non-gamified mode for restaurant reviewing, the former did actually result in better outcomes since more reviews were made, and participants perceived that the reviews were more accurate. One possibility is that the Google Maps' gamification and reviewing features were seamlessly integrated such that restaurant reviewing and gaming were intertwined (Goh, Lee, & Low, 2012). Consequently, participants were less aware that they were in a gamified environment but were still positively influenced by it.

The present study suggests that although there could be disadvantages to gamification as reported in the literature (e.g. van Roy & Zaman, 2017), careful design can create a viable gamified application that motivates participation in crowdsourcing tasks. In particular, the use of gamification should not lead to users' perceptions of an increase in workload. This may be accomplished through the judicious selection of gamification features as well as adoption of design strategies that make the resulting gamified task engaging and immersive.

Although our results have led to potentially useful insights, there are limitations that may be addressed in future work. First, data was collected from one application and in one crowdsourcing task of restaurant reviewing. It is conceivable that Google Maps' features and task type could have influenced our findings. Second, accuracy of reviews were measured through participants' perceptions. The actual reviews were not analyzed. Future work could investigate other gamified applications as well as crowdsourcing tasks. As well, replicating this study with more diverse participant profiles will help ascertain the generalizability of our results.

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Radical Empathy in the University Archives: Examining Archival Representations of Chinese Students from 1906 to 1920

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ABSTRACT

With the increase in Anti-Asian hate crimes in the United States in 2020, it is essential for information institutions to reflect on how they are confronting the oppression of Asian communities. Guided by the concept of radical empathy, we conducted an analysis on how historical Chinese students at the University of Illinois were documented and described in the university's archives. Relevant archival materials, descriptive metadata, and additional archives-generated materials were examined to identify potential representation issues. The preliminary findings include: (1) Chinese students are mostly visible in registers and yearbooks, with some well-known alumni also appearing in newspapers and correspondence; (2) Some culturally insensitive terms occasionally appeared in historical student newspaper articles; (3) Name variations related to Chinese "courtesy names" and hyphenations can lead to challenges in creating descriptive metadata and affect the discoverability of Chinese students in the archives.

KEYWORDS

University archives; radical empathy; Chinese students; archival representation; cultural sensitivity.

INTRODUCTION

Since 2020, there has been a growing surge of discrimination against Asians in the United States (US) inflamed by the Coronavirus Disease 2019 (COVID-19) pandemic. As Chinese students pursuing a Library and Information Science (LIS) degree at a US university, it was evident to us that reflecting critically on how information institutions are confronting the oppression of Asian communities is painfully urgent at this moment. Therefore, we are conducting a case study to examine how Chinese university students are represented in the University of Illinois (U or I) Archives. The U of I has a long history of enrolling Chinese students (De Sando, 2018) and continues to host a large Chinese student population (Tea Leaf Nation Staff, 2016).

RELATED WORK

A growing body of LIS work has reflected on how underrepresented communities can be further marginalized in cultural institutions. First, library and archival collections often lack materials that sufficiently represent marginalized communities, such as Black communities in the US (Mastley, 2020) and Asian communities in Australia (White & Woods, 2021). Second, knowledge representation systems used in libraries and archives can be culturally insensitive to marginalized groups, such as library classification systems (e.g., Hajibayova & Buente, 2017; Ragaller & Rafferty, 2012), subject headings (e.g., Buente et al., 2020). Therefore, underrepresented communities can be less visible, misrepresented, or even depreciated in the cultural record (Adler et al., 2017; Dobreski, Qin & Resnick, 2019).

LIS studies that focus on representation issues of Chinese cultures in American cultural institutions remain scarce. For instance, Chen (2018) examined three finding aids of historical collections related to Chinese in America and revealed how they are shaped by individual and institutional worldviews. Diao and Cao (2016) studied how the Library of Congress Classification system introduced cultural bias and ambiguity into the organization of Chinese archaeological materials that impacts discoverability. To date, we have not found any studies on how Chinese students are represented in university archives. To begin to bridge this gap, this study locates and examines materials from the U of I University Archives in which Chinese U of I students appear as record creators or record subjects and analyzes the organization, description, and general presentation of these materials to identify potential representation issues.

Our analysis is guided by the concept of radical empathy proposed by Caswell and Cifor (2016). Empathy is "the ability and willingness to place oneself in the perceptions and viewpoints of others" and it is radical if it "critically and consciously shifts existing power relations in favor to those who are marginalized" (Brilmyer, Caswell, &

Cifor, 2021). Radically-empathetic archivists value affective responsibilities in their archival decisions and are guided by an ethics of care (Caswell & Cifor, 2016). Thus, our examination is consciously oriented towards considering whether the archival representations of Chinese U of I students appear to be radically empathetic that strives for social justice. Based on the findings, we aim to provide suggestions on how university archival collections could be constructed in ways that place more emphasis on an ethics of care.

RESEARCH DESIGN

This project focuses on Chinese U of I students who were on campus during University President Edmund James's administration (1904 to 1920). This period was selected because it witnessed the first phase of notable and steady growth in Chinese student enrollment in the university's history (Huang, 2001).

The scope of information that was searched and analyzed included archival materials, their descriptive metadata, and additional archives-generated resources (e.g., blog posts, exhibition information). To best locate relevant materials, the search process was divided into two parts after consulting with the university archives. For the first part, we searched for keywords such as "China" and "Chinese." For the second part, we searched for individual student names. The names were drawn from the Illini Everywhere blog posts by the U of I Student Life and Culture Archives. These posts provided narratives about the experiences of Chinese U of I students from 1906 to 1948.

At this stage, we analyzed: (1) the types, forms, and content of the archival materials to study where and how Chinese students were historically recorded; (2) the descriptive metadata and other narratives created by the archival institution to understand if Chinese students were represented in accurate and culturally respective ways.

Because representation issues of Chinese students in the US remain largely understudied, we selected an analytical process that facilitates open discovery. We conducted a qualitative analysis of the data using a general inductive approach, which allows findings to emerge from frequent or significant themes inherent in raw data (Thomas, 2006). While our analysis was inductive and open, radical empathy served as a guiding philosophy that "sensitized" us to identify representation issues that may cause harm to various stakeholders (e.g., record creators, record subjects). Radical empathy will also be more prominent in our future recommendations for university archives.

PRELIMINARY FINDINGS

Regarding the types and forms of the archival materials, most students can be found in the U of I Annual Registers and the Illio Yearbooks. However, only general student information such as name, major, and hometown was recorded. Some students who were active in student affairs and activities while on campus or became well-known alumni can also be found in the Daily Illini (the student-run university newspaper) and faculty correspondence. These findings may be at least partly true for the general student body and not necessarily unique to Chinese students.

We also identified some issues related to language usage and cultural conventions across the data. The first issue is some terms that are deemed culturally insensitive today occasionally appeared in Daily Illini articles relevant to Chinese students. For instance, the "church notices" from December 1, 1917, included "Talks by oriental students" on page 3. These students were not necessarily Chinese, but "oriental students" was likely used as a label that included them. Using "oriental" to refer to Asian people is now considered outdated and offensive (American Heritage Dictionaries, 2016). Since encountering these materials could be harmful to today's users, this is where archival descriptions could be created in more radically empathetic ways to mediate users' interactions with historical materials.

The second issue is Chinese "courtesy names" and inconsistent hyphen usage may lead to challenges in creating descriptive metadata and affect the discoverability of Chinese students in the archives. In the 1900s, well-educated Chinese males often had a courtesy name in addition to their given name. We noticed that this Chinese convention may cause confusion in archival processing. For example, for student Wenfu Yiko Hu, "Wenfu" was his courtesy name and "Yiko" was his given name. However, his name was processed as "Wenfu Y. Hu" in an Illini Everywhere post: the given name was treated as middle initials following customs for Western names. Additionally, the inconsistent usage of hyphens in Chinese names creates name variations for the same student. One instance is the U of I Register 1909-1910 presents student Ching Chun Wang's name as "Wang, Ching Chun" on page 420 and "Ching-Chun Wang" on page 558. These variations may create barriers for future users in identifying Chinese students, affecting their discoverability in the archives. We argue that an awareness of Chinese name conventions and romanization issues will help archivists to process Chinese student related materials in more radically empathetic ways.

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Clusters, Stars, and Hashtags: Understanding Librarians' Professional Online Networks

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ABSTRACT

Twitter serves as a platform for librarians to connect with each other and discuss, debate, and find consensus around professional issues. Using Social Network Analysis and participant interviews, the Twitter conversations that coalesced around the hashtags #NoHateALA and #IStandWithALA, with particular attention to the role of central actors, are examined. Findings reveal that five Twitter accounts were responsible for 75.5% of all posts under these hashtags out of 1693 posters. In interviews, some of the central actors indicated that their centrality in these networks was deliberate and part of a larger activist agenda. Understanding the depth and breadth of the online network, alongside an understanding of how and why the central actors took on such important roles in the network sheds light on how librarians use online tools to connect and debate professional issues and effect important professional changes.

KEYWORDS

Twitter; Social network analysis; Professional communities; Librarians.

INTRODUCTION

In 2018, Twitter served as a platform for librarians to publicly debate the profession's core values, particularly diversity and intellectual freedom, and how the American Library Association (ALA) is supporting, or not supporting, these core values in its policies and interpretations. The Twitter conversations that are the focus of this investigation resulted from an update to the ALA's meeting rooms policy, "Meeting Rooms: An Interpretation of the Library Bill of Rights". The main point of contention was the decision to include hate groups among those welcome to use library meeting spaces. The revision was completed by a working group of the IFC in February 2018 and presented to the ALA membership for comment, before being formally presented to the ALA Council Forum in June 2018. Although there was some limited debate about the inclusion of hate groups during the Council Forum (see LaRue, 2018 for a full timeline of events), most of the public debate that surrounded the revision occurred on Twitter after the revision had been approved by Council, with the conversations coalescing around the hashtags #NoHateALA and #IStandWithALA. In August 2018, the ALA Council voted to rescind the revised interpretation and sent the draft back to the IFC for further review ("ALA Council Rescinds," 2018). There is some evidence that the Twitter discussions and debates played an important role in the rescinding of the interpretation (Peet & Yorio, 2018).

Although not the first time the ALA membership has come together to rescind an unpopular policy, these recent events illustrate how quickly social media facilitates information diffusion and open dialogue within a professional community, as the interpretation was passed and then rescinded within approximately six weeks. This incident provides an excellent way to examine how social media applications influence and shape how librarians build community online. Research into how librarians use social media is limited, but there is a clear expectation in the practitioner literature that librarians should be using Twitter for connecting with other librarians and keeping "tabs on developing issues" (McLaughlin, 2018, p. 57). Research focusing on allied professions has demonstrated that Twitter provides an online space for community development and relationship building among professionals (Gruzd, Takhteyev, & Wellman, 2011). Using a mixed-methods approach, this poster will present research guided by the following research questions:

RQ1: What were the features and characteristics of the social networks that developed around the hashtags #NoHateALA and #IStandWithALA?

RQ2: How did central actors in the networks leverage, or not, the affordances of Twitter to facilitate information diffusion and open dialogue?

METHODS

Two data collection and analysis techniques were used for this study. First, using Twitter's Historical PowerTrack, tweets using the hashtags #NoHateALA and #IStandWithALA between June 25, 2018 and October 31, 2018 were collected. Historical PowerTrack provides access to Twitter's entire historical archive of publicly available tweets.

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The hashtags were selected for the search based on media reports of the conversation (e.g., Pete & Yorio, 2018) and observations of the discussions as they were occurring. The date range was selected because it represents the day the ALA passed the changes to its interpretation of the meeting rooms policy during its annual conference and a two week period after a new version of the interpretation was proposed to the membership, ensuring that initial reactions were captured in the data set. Observation of the hashtag's use between November 2018 and February 2019, after the second revision of the Interpretation was passed at the 2019 ALA midwinter meeting with little debate (Revised Library Bill, 2019), showed that use of the hashtags in relation to the meeting room interpretation dropped off significantly.

A total of 4783 messages from 1693 unique posters, including both original tweets and retweets, were collected. Using Netlytic.org (Gruzd, 2016), a name network analysis was performed on the data. The cluster analysis indicated that there were five primary clusters in the network (further details below). The central actors in each cluster were then identified. For four of the five clusters, the central actor was an individual librarian. To get a better understanding of how Twitter was used by librarians during this event, 3 of the 5 individual central actors were interviewed. All interviews were conducted over Zoom and recorded. Interview transcripts were then thematically coded using inductive analysis. Ethical approval for this project was granted by the San Jose State University's Institutional Review Board.

FINDINGS

The overall network properties of the indicate that the network that formed around these tweets was fairly small with a low density and limited reciprocation. A diameter of 35 provides an indication of the network's size, specifically that the longest distance between two actors is 35 nodes (or twitter accounts in this network). The low density measure (0.001399) suggests that the participants within this network are not very close to each other. Only a few within the network are connected to each other. The similarly low reciprocity measure (0.031370) suggests that the majority of the conversations occurring within the network are one-way in nature. The measures for centralization (0.121600) and modularity (0.423500) indicate that information flows fairly freely and there is overlap between the clusters of actors within the network. In other words, the network that arose out of these Twitter discussions occurred among a small group of disconnected people, often in a one-sided way. This facilitated the sharing of information among overlapping groups of actors. The most frequently used word in the network was #nohateala (which was used 1550 times), followed by hate (1005), meeting (884), library (691), and groups (687).

There were five primary clusters within the network. A cluster is a group of actors that is more likely to communicate with one another than with those outside the cluster. The largest cluster focused on the ALA's primary Twitter account, @alalibrary. It had a total degree of 430. All @alalibrary's connections were indegree connections, meaning that all links to the account were incoming and there were no outgoing connections. The remainder of the five most prominent clusters focused on Twitter accounts representing individuals (i.e., accounts run for and by the actor for personal and/or professional reasons, not on behalf of an organization). The largest of these clusters focused on the account @aprilhathcock (total degree 366; indegree 364; outdegree 2), followed by @lenagluck (total degree 332; indegree 312; outdegree 20), @beastlibrarian (total degree 320; indegree 277; outdegree 43), and @jessamyn (total degree 152; indegree 150; outdegree 2).

Interviews with four of the five central actors were conducted. Preliminary analysis indicates that Twitter played an important role in the broadcasting of information related to the revision of the Meeting Rooms Interpretation. The central actors often intentionally acted as an unofficial spokesperson for responses that were collectively authored off Twitter. Google Docs, Slack, and private direct messages were used to develop Tweet threads, letters of support, petitions, and other advocacy tools that the central actors would tweet out to their followers. Members of the collective would then retweet the central actor's tweet. This was a deliberate harnessing of Twitter's broadcasting abilities to spread specific and intentionally crafted messages. Full analysis of the interviews will be presented in the final poster.

CONCLUSION

This study contributes to the growing body of literature that examines information professionals' use of social media to build and sustain community online. It illustrates the complexity of these networks and highlights the need to bring multiple methods to the study of online professional communities to understand their full complexity.

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What Does Channel Say? Understanding How Social Media Social Capital Facilitates COVID-19-Related Information-Seeking and Opinion-Expression on Two Types of Platforms: User-oriented versus Content-oriented

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ABSTRACT

Social capital (i.e., resources obtained from social relationships) facilitates informational use of media, yet how in detail the mechanism functions in a multi-platform social media environment remains underexplored. Taking an affordance approach, this study aimed to investigate the differentiated effects of social media social capital on COVID-19-related information behaviors on user-oriented and content-oriented social media (USM&CSM). It was hypothesized that information exposure on USM mediates the relationship between social capital and information-seeking intention, whereas exposure on CSM was expected to mediate the relationship between social capital and opinion expression. Web-based survey data collected among Chinese social media users (N=256) supported the hypotheses, and in-depth interviews (N=15) further revealed how people explored the affordances of different platforms to enjoy the information resources. Implications were discussed.

KEYWORDS

Social capital, social media, information-seeking, channel choice, affordance.

INTRODUCTION

Previous literature in information and communication has revealed that bridging social capital (i.e., resources derived from loosely-knitted social networks: Putman, 2000) generated through Internet use (Ellison et al., 2007) can bring information resources, facilitating risk information-seeking (Hovick et al., 2014; Johnson, 2004; Junaidi et al., 2020; Wen, 2020) and social media expression (Skoric et al., 2009; Wen & Wei, 2018). Yet, how in detail the mechanism functions in a multi-platform media environment remains rather underexplored. According to the modality switching perspective (Ramirez & Zhang, 2007), which was proposed to understand the effects of channel choice on computer-mediated information processing, people navigate between social media channels with different affordances (e.g., privacy and network association) to find the one that best serves the interests of their social relationships, which leads to differentiated impacts of social media use (McEwan, 2021).

Mainstream social media platforms can be categorized into either user- or content-oriented. User-oriented social media is characterized by relationships between family, friends, and other types of strong-ties, on which the diffusion of more credited information is largely based, whereas user-oriented social media is known for the prevalence of weak-ties and diversified information (Tufekci, 2014). In previous literature, Facebook was usually seen as typical user-oriented social media, and Twitter and YouTube more of the content-oriented type (e.g., Yoo et al., 2018).

Chinese has its own social media ecology, yet the social media map also shares similarities with the one in the Western context, with WeChat largely being the Chinese Facebook, and Weibo the Chinese Twitter (Kantar, 2019). On WeChat, information is circulated largely depending on individual's personal networks with people they know in real life (Wu & Wall, 2019). By contrast, Weibo is more like a virtual square for public deliberations (Chan et al., 2012). Different as they are, both are mainstream platforms that enjoy frequent informational use by the Chinese public during the COVID-19 pandemic, where the first wave of outbreaks took place (Han et al., 2020; Zhong et al., 2020).

The study aimed to explore the differentiated effects of online bridging social capital on information behaviors on two types of platforms during the COVID-19 pandemic: user-oriented and content-oriented social media. By providing the information resources through individual's social media social capital, the two types of platforms may facilitate distinctive information practices. On the one hand, interpersonal influence mediates the relationship between media use and attitudinal change (Katz, 1957), which makes WeChat—on which credited information is proliferated among strong-ties (Wu & Wall, 2019)—a more powerful vehicle for attitudinal change and subsequent information-seeking. On the other, information is more diversified and abundant while norms and social surveillance

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are weaker in weakly-knitted social networks (Putman, 2000; Williams, 2006), making Weibo a better platform to make personal expression about the issue. A recent research showed that news recommended by strong-ties on social media motivated news-seeking, but that by weak-ties did not (Kaiser et al., 2018). Taken together, it was hypothesized that:

H1: Bridging social capital is positively related to (a) information-seeking intention and (b) social media expression;

H2: Information exposure on user-oriented social media mediates the relationship mentioned in H1a;

H3: Information exposure on content-oriented social media mediates the relationship mentioned in H1b.

METHOD

First, web-based survey data (administrated on Wenjuanxing.com) was collected from January 25 to 28, 2020 among Chinese social media users (N=256). Participants were recruited on WeChat and Weibo. Most people were 18-30 years old (74.6%; n=191). 52.3% of them were female (n=134). For measures, we referred to previous studies (e.g., Ellison et al., 2007; Wen, 2020; Yoo et al., 2018, and Kantar, 2019). In addition, 15 in-depth phone-interviews were conducted with social media users recruited in the same way as survey from March to April, 2020 (M=22.27, SD=1.62; Among the 15 informants, seven were female), so as to further interpret the quantitative findings.

RESULTS

Quantitatively, most of the variables of interests were related, and Cronbach's α were all larger than .70. CFA and path analysis using Cohen & Cohen's (1979) residualization procedure for controlling the effects of age, gender, education, income, health status (for which, the model fit was good: Chi-square=2.587, df=3, p=.460, CFI=1.00, NFI=.99, RMSEA<.001) using AMOS 22.0 showed that the data supported all of the three hypotheses (Figure 1).

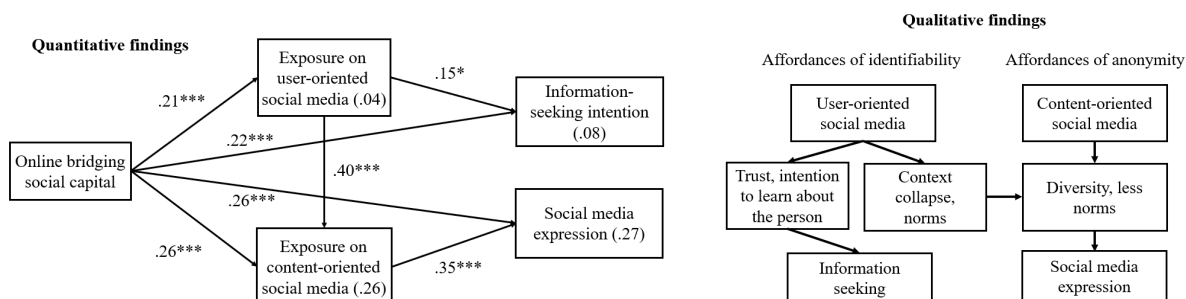


Figure 1. Path Analysis

Qualitatively, most participants did not take it seriously when they saw risk information on content-oriented social media (i.e., Weibo) at first until relevant posts were circulated by family and friends on user-oriented social media (i.e., WeChat) with a greater *affordance of identifiability* (Fox & McEwan, 2017), which prompted them to seek more information on Weibo. By contrast, because of context collapse (Marwick & boyd, 2011) that occurred on WeChat and the diversified views circulated on Weibo with a greater *affordance of anonymity* (Fox & McEwan, 2017) that made them feel “capable of opinion-expression”, many informants preferred Weibo as the platform to voice out.

DISCUSSION

One and a half decades since Ellison et al. (2007) demonstrated that Internet use can also generate social capital, we have now understood more about how online social capital in turn facilitates informational use of social media in times of crisis (e.g., Chang & Chuang, 2011). Yet, how do people weave their way into the information sea deserves more scholarly attention, as most of them do not solely rely on one platform, but navigate between many. Taking an affordance approach, the study found that channel choice may influence people's information behaviors in the context of covid-19 pandemic. The suppressing effect of context collapse on expression on certain platform and the opposing effect on another can be also applied to understand the spread of malicious contents and misinformation. Taken together, the findings call for more information studies that employ a channel choice perspective.

ACKNOWLEDGMENTS

I thank Prof. Nainan Wen and two anonymous reviewers for providing helpful comments on previous versions of this manuscript. I also thank Mr. Shijie Song for his advice on choosing the conference for submission. My thanks also go to the participants for their trust in and help with the study.

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A Critical Discourse Analysis of the Hashtag #WeAreAllIsraaGhrayeb on Twitter: An Exploration of Honor Killing Crimes in Palestine

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ABSTRACT

This research investigates a crucial social justice concern “honor killing” that are affecting women worldwide especially in Palestine. Feminist theory and critical theory provide a lens to explore issues of gender inequality, patriarchy, and oppression. The researcher utilized qualitative research method based on critical discourse analysis of the Twitter hashtag #WeAreAllIsraaGhrayeb between August 22 – September 22, 2019. Analyzing the tweets identified three themes: tweeters’ anger and frustration against the killing of Israa Ghrayeb, the impact of honor killing crimes within the Palestinian community, and an urgent call for justice by action. The author is a participatory action researcher (PAR) who gained an experiential understanding and deeper insights of cultural relevance to address contemporary issues and to contextualize a cultural reality to benefit stakeholders (i.e., entities or individuals who witnessed the horrors of honor killing) by developing a strategic action plan that can bring social change leading to a just society.

KEYWORDS

honor killing; #WeAreAllIsraaGhrayeb; critical discourse analysis; critical and feminist theories; Palestine.

INTRODUCTION

In the Palestinian community as it is in many Arab countries, honor killing crimes continue to occur even in the 21st century. The United Nations Office on Drugs and Crime’s (UNODC, 2018) global statistics revealed that in 2017, a total of 87,000 women were premeditatedly killed worldwide (UNODC, 2018). In Palestine, the Independent Commission for Human Rights and women’s organizations statistics showed that 28 women were victims of honor killing in 2013, compared to 12 in 2012 and 8 in 2011 (UN Women Palestine, n. d.). The increasing prevalence of honor killing in Palestine over recent years calls urgent attention to a devastating reality within the Palestinian community (UN Women Palestine, n. d.). It highlights an immediate human rights’ need for various stakeholders to stop these horrific acts of patriarchal violence and gender abuse (Abramowitz & Moran, 2012; Merry, 2006).

LITERATURE REVIEW

In the Middle East and in the Arab countries, the gender construction is distinguished by “patriarchy, patrilineal orientation”, hegemony, domination, misogyny, and inequality against women. Many women are living with different constraints and fear from the male; husband, brother, or father (Abu Odeh, 2010; Eisner & Ghuneim, 2013; Esherick, 2004, p. 59; Mojab, 2002, para. 5). This research drew on intersections of feminist theory and critical theory (Macdonald & Allen, 2015). Feminist theory challenges patriarchal norms privileging men and subordinating women and their concerns (Ferber & Nelson, 2009; Lewis, 2019; Tong, 2001) and empowering and enhancing the lives of women. Critical theory critiques oppression, exploitation, and dispute; challenges social injustice and inequality; aims to liberate people from all conditions that dominate and enslave them; and helps to establish a superior life and society, freedom and power for all human beings to bring social change (Bates & Talbot, 2016; Bohman, 2005; Datta, 2009; Rehbein, 2018). This study explored honor killing crimes against women in Palestine based on a critical discourse analysis of public posts relating to the hashtag #WeAreAllIsraaGhrayeb on Twitter (Rosen, 2017). This hashtag trended soon after Israa Ghrayeb, a 21-year-old Palestinian woman was killed by three male family members in the name of honor (AFP, 2019; Independent, 2019) on August 22, 2019. After her death, social media outburst with several hashtags "Israa Ghrayeb", "No honour in honour crimes" and "We are all Israa Ghrayeb" (Bateman, 2019). Many tweets advocated for justice for Israa, and lots of women shared their fear and personal narratives about violent incidents they encountered (Bateman, 2019).

RESEARCH METHODS

As a participatory action researcher (PAR), I continue to advocate for oppressed women who were experiencing honor killing or other forms of gender violence and oppression within the Palestinian society and around the world. As a “paradigm in linguistics” (Hodes, 2018, p. 74), critical discourse analysis (CDA) provided me a valuable tool in qualitative research (Bloor & Bloor, 2007; Chen, 2018; Guba & Lincoln, 1994; Locke, 2004; Weiss & Wodak,

2003), it is an interdisciplinary approach, which connects the theories of language to the theories of society. Scholars study society via discourse, contextualize, and understand this discourse by analyzing its' historical, socio-political, and cultural basis (Flowerdew & Richardson, 2018). I collected a representative dataset by performing an advanced search to seek information about users' responses to the hashtag #WeAreAllIsraaGhrayeb and its' sub-hashtags in English and Arabic. A total of nine hundred and eighty tweets during the period between August 22, 2019 - September 22, 2019 were manually compiled and analyzed in this research. In the process of applying CDA to analyze the tweets, the author created multiple categories representing various stakeholders, analyzed what direct and/or implied messages were communicated via the posts, and whether these posts were supporting or opposing honor killing crimes. In doing so, I created a codebook and validated it through intra-coder reliability (Wrench, Thomas-Maddox, Richmond, & McCroskey, 2016). I utilized thematic content analysis by applying grounded theory principles of open, axial, and collective coding. These coding practices then helped decide what was considered a theme by focusing on the words and emotions (that appeared in the statements tweeted by various stakeholders). If various reactions appeared two or more times, it was considered a theme. Three different themes have been presented: tweeters anger and frustration against the honor killing of Israa Ghayeb, the impact of honor killing crimes within the Palestinian community, and an urgent call for justice by action.

FINDINGS

In response to the hashtag #WeareallIsraaGhrayeb and its' versions in English and Arabic, the three themes depicted the reactions from different individual and institutional stakeholders in Palestine and abroad. The first theme stated that various male and female feminists and human rights activists in Palestine and abroad expressed their sadness, sympathy, anger and frustration towards the devastating experiences. An Iraqi woman who tweeted on September 1, 2019 that many women in the Middle East like Israa Ghayeb are voiceless, lack media outrage, and they lack health system or police protection. The second theme explained how institutional stakeholders including representatives from human and women rights organizations, mass and social media outlets, academic institutions, the government, and other affiliated agencies referred to the effect of honor killing among the Palestinian community. On September 1, 2019, a female writer from Yemen published an article depicting Israa Ghayeb's incident, Arabs' perceptions about honor killing, and the outdated Palestinian laws and regulations. The third theme encouraged different individual and organizational representatives in Palestine and abroad to emphasize the importance of an immediate call for justice by action. A female activist tweeted on September 4, 2019, representing her support to women victims and emphasized punishing criminals.

DISCUSSION

This article provides illustrative examples for three themes representing the reactions of various stakeholders to honor killing crimes on Twitter as presented in the hashtag case study. Action-based initiatives in the strategic plan represent a holistic overview of the possibilities that different stakeholders (i.e., families, Schools, universities, libraries, governmental organizations, judicial institutions, and religious agencies) can collaboratively operationalize. The research findings offer the potential to support women in the Middle East to empower them to work towards changing their current disenfranchising, traumatic, and abusive circumstances; and allow different stakeholders to implement the strategic action plan to enhance their responsibilities cooperatively to develop a community that values women as independent, not as a second-class human beings; treat them equitably; respect and accept gender and sex differences, and offer social justice classes to students and the citizens within the society. Further, this research reinforces the need for different stakeholders to push towards altering the outdated and biased laws and regulations that enable the guilty to escape scot free.

CONCLUSION

This research places responsibility on the sexist social construction of gender roles in the Palestinian society as the main contributor to honor killing crimes, which is empowered by male patriarchy; dominance; and oppression among others. As a PAR, the researcher was able to provide a glimpse about one of the many cases that happened in Palestine and in many other countries around the world about the honor killing of Israa Ghayeb; the researcher analyzed the hashtag #WeAreAllIsraaGhrayeb and its' subversions in English and Arabic, utilized thematic analysis that contributed to establishing three major themes with illustrative examples, which helped the researcher to develop a strategic action plan that different stakeholders can adopt to overcome the brutal effects of honor killing to promote social justice within the Palestinian society and among the communities world-wide. Future directions involve applying other related methods such as critical participatory action research (CPAR) (Coles-Ritchie, Eggington, & Valdez, 2019) through conducting in-depth interviews with victimized women who seek refuge at the human and women rights institutions. Implementing CPAR will allow oppressed women to participate in discussions with others to express their voices by taking actions to make their lives better. Possible efforts can also involve studies about honor killing crimes in the Eastern and Western cultures beyond Palestine. A related project of value must look at all types of discrimination and oppression against women including domestic violence.

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Seeking Health Information in Wikipedia and Readers' Satisfaction

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ABSTRACT

This current paper describes the results of our study on users' health information seeking in Wikipedia and on their subsequent satisfaction as an indicator of future Wikipedia usage for health information needs. We examine six factors associated with user' satisfaction. Based on multiple regression analysis of 322 responses, the paper identifies information quality factors associated with continued use of Wikipedia as a health information source. The results show that trustworthiness, reliability, topic coverage, and information presentation significantly affect user' satisfaction with Wikipedia health information. Among these factors, information presentation and trustworthiness were most influential on user' satisfaction.

KEYWORDS

Wikipedia; Information quality; Health information; Wiki reader satisfaction.

INTRODUCTION

Wikipedia is a Web-based multilingual user-generated knowledge base that features information from scholarly content to celebrity news. Since its inception in 2001, Wikipedia has become one of the most popular platforms for online activity in the USA. Wikipedia's community includes over 6 million articles, more than 39 million registered users, and more than 4 billion of site visits from the USA (Wikimedia, 2020). As an online health information source, Wikipedia has been steadily gaining popularity. In fact, its usage is comprised not only of the general public but also health care professionals and students (Heilman et al., 2011; Hughes et al, 2009; Okoli et al, 2014). Furthermore, Wikipedia is perceived as a reliable health source due to its citations from reliable sources (Schafee et al., 2017). Readership of Wikipedia has been investigated in various aspects such as content quality, reader perception of credibility, and content reliability, but few studies have attempted to explore reader satisfaction with Wikipedia health information quality. The purpose of the current study is to explore how Wikipedia readers perceive the health-related information's quality and which information quality attributes influence their information satisfaction, leading to continued use of Wikipedia for health information needs.

RELATED LITERATURE AND RESEARCH MODEL

Prior research indicates that information users' satisfaction with selected online sources is based on 3 criteria: information quality, information presentation, and perceived usefulness (Koo et al., 2011). Our proposed research model consists of information quality related six research constructs drawn from the previous studies and adapted to the current study in order to examine the extent of their influences on reader satisfaction: accuracy, trustworthiness, currency, and reliability are from an online consumer health information quality model proposed by from Stivilia et al (2009). Information presentation (Arazy & Kopak, 2011; Koo et al., 2011) is manifested as dimensions of logical and easy-to-read way of presentation of information in the current study; Topic coverage (Mesgari et al., 2015) is defined as completeness of the content of the source; Consumer satisfaction refers to users' perceived information quality presented on a Website (McKinney et al., 2002), and this characteristic is also drawn from Ghasemaghahi et al. (2015)'s study which examines the relationship between online information quality and consumer satisfaction.

RESEARCH METHOD

An online survey with 322 study participants was conducted in 2021. We used the Qualtrics Services Panel to recruit people who look for health related information in English Wikipedia articles and reside in the USA. We drew a purposive sample that includes Wikipedia readers whose BMI (Body Mass Index) is 25 or higher and might be interested in finding obesity related information on the Web. The questionnaire includes participants' demographic information, their experience levels with Wikipedia articles, and their perceived information quality in these articles. Among the 322 respondents, there were 140 male respondents (43.5%), 181 female respondents (56.4%), and 1 other. For age, the respondents are from diverse age groups ranging 18-29 (74, 22.98%), 30-39 (77, 23.91%), 40-49 (65, 20.19%), 50-59 (57, 17.70%), and 60 or older (49, 15.22%). Demographically, 44 respondents (13.63%) are Black; 42 (13.04%) Hispanic; 199 (61.80%) White; 18 (5.59 %) AAPI; 7 (2.17%) American Indian/Alaskan; and 12 (3.72%) other including multiracial.

DATA ANALYSIS AND PRELIMINARY RESULTS

In Table 1, the descriptive statistics show that mean values of six information quality factors were larger than 4 (the neutral position), implying that respondents positively evaluate health information in Wikipedia. Results also reveal that they are satisfied with health information in Wikipedia.

<i>Information quality factors</i>	<i>Mean</i>	<i>Standard deviation</i>	<i>N</i>
Accuracy	4.6398	1.47483	322
Trustworthiness	4.8385	1.37581	322
Reliability	4.7019	1.44621	322
Currency	5.0217	1.27136	322
Topic coverage	5.0093	1.37736	322
Information presentation	5.4658	1.28752	322
Satisfaction	5.3696	1.25430	322

Table 1. Results of Descriptive Statistics

Results of multiple regression analysis reveal that trustworthiness, reliability, topic coverage, and information presentation significantly affected user's satisfaction of health information in Wikipedia; accuracy and currency had no significant effect on their satisfaction. Among these factors, information presentation ($t = 6.644$, $p = .000$) and trustworthiness ($t = 4.727$, $p = .000$) were the most influential on users' satisfaction (Table 2).

	Unstandardization coeff.		Standardization coeff.	t	Sig. level	Collinearity Statistics	
	B	Stand. error	Beta			Collinearity	VIF
Constant	.926	.229		4.040	.000		
Accuracy	.050	.046	.058	1.074	.284	.445	2.248
Trustworthiness	.270	.057	.297	4.727	.000	.335	2.985
Reliability	.145	.042	.167	3.418	.001	.549	1.821
Currency	-.005	.051	-.005	-.098	.922	.503	1.989
Topic coverage	.142	.046	.156	3.108	.002	.523	1.913
Information presentation	.281	.042	.288	6.644	.000	.700	1.428

a. Dependent variable: Satisfaction

Table 2. Results of Multiple Regression Analysis

CONCLUSION

As the preliminary results above show, information quality factors including trustworthiness, reliability, topic coverage, and information presentation significantly affected Wikipedia readers' satisfaction, which might lead to users' decisions to continue using Wikipedia as a health information source. Our findings suggest that users largely have a positive evaluation of health information in Wikipedia. Additionally, it is demonstrated that while users' satisfaction with the information in Wikipedia is influenced by most sub-dimensions of information quality, accuracy and currency are irrelevant in their satisfaction. We can guess that users may find accurate and latest health information in other sources (e.g., WebMD, Medline Plus) rather than on Wikipedia. Actually, in our survey more than half of respondents chose WebMD as the most frequently used digital source for acquiring health information, and moreover 16 % of respondents mainly got health information on CDC website. Accordingly, the result discloses users' contingent information seeking behavior based on information quality. In other words, users generally use Wikipedia to get health information; they use different digital sources to access accurate and up-to-date information.

Our next step will be to extend our research model by incorporating additional factors such as confirmation and intention to continue using Wikipedia for health information. Thus, we will attempt to examine the extent of relationships among information quality factors and aforementioned factors. We hope that our research effort provides deeper understanding on perceptions of Wikipedia users on their information source selection and continuance of using it.

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Fixing for Change: Stories of Information and Aspiration in Community Repair

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ABSTRACT

Recent years have seen a grassroots resurgence in the repair of everyday technologies—community initiatives, cooperatives, websites, and how-to videos. While digital platforms have made do-it-yourself repair information more accessible and available, community initiatives—where people meet in person to repair devices and everyday items *together*—are nevertheless growing in numbers and popularity. This dissertation project explores the aspirations of citizens participating in local repair initiatives through a qualitative study with repair organizers and volunteers in Metro Vancouver, BC. Informed by the relational approaches of practice theory and socrionarratology, I explore how a storytelling lens might broaden conceptions of the information sources, systems, and stewardship engaged in climate adaptation. This poster presents preliminary reflections and contributions from the ongoing project.

KEYWORDS

Information technology repair; Narrative theory; Climate Crisis; Community information practice.

INTRODUCTION & CONTEXT

Many contemporary information practices, particularly in affluent parts of the world, are increasingly reliant on a range of digital devices. A fixation with what is new, novel, and not-yet pervades information technology scholarship, design, and marketing, and shapes present practices, where devices are expected to be replaced and upgraded often (Dourish & Bell, 2011; Dunne & Raby, 2013). In a world where the vision and design of technology tell us to aspire for the new and shiny, digital devices are increasingly made to be thrown away (Jackson, 2014; UNEP, 2009).

Scholars have adopted a range of alternative lenses through which to tell different stories of our relationships with technologies. Jackson (2014) asks, “what happens when we take erosion, breakdown, and decay, rather than novelty, growth, and progress, as our starting points in thinking through the nature, use, and effects of information technology and new media”? (p. 221). Vinsel and Russel (2020), of The Maintainers research group, encourage us to consider what “the world [would] look like if we focused more on fixing things instead of throwing them away; if we learned to rely on and respect the everyday technologies that we take for granted rather than worship the new” (p. 18). These provocations encourage new ways of theorizing our relationships with information tools and open space for doing new and different kinds of research.

This poster reports on an ongoing conceptual and empirical inquiry into the aspirations of citizens participating in community repair initiatives through an exploratory and qualitative study with repair organisers and volunteers in Metro Vancouver. Community repair initiatives are typically free community events where people come together to repair artefacts (e.g., digital electronics, household appliances, clothing), assisted by volunteers with skills, tools and expertise in different kinds of repair. Set against a backdrop of designed obsolescence, diminishing repair knowledge, climate emergency, and global pandemic, this project explores community repair initiatives as an example of citizens engaged in efforts to “imagine otherwise” (2018), answering the calls of Steven Jackson (2014), Lee Vinsel & Andrew Russell (2020) to tell different stories about how we can live well with technologies.

METHODOLOGY & APPROACH

Two primary theoretical traditions inform the conceptual grounding for this project. Firstly, Practice Theory informs my conceptualization of “information practice”, and the situated relations that this term connotes (Hui et al., 2017; Huizinga & Cavanagh, 2011). Secondly, I look to stories and storytelling as a methodological orientation to explore how people talk about their attempts to shift practices. A socio-narrative lens understands stories as situated knowledge practices that matter and participate in everyday life, influencing what people see as real, as possible and as worth doing or best avoided (Frank, 2010; King, 2003). In the spirit of the repair movement, rather than designing a new system or program, my project intentionally engages with initiatives that are already ongoing, in order to recognize, learn from, and sustainably support the work of communities developing local capacity to respond to long-term climate challenges.

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The study employs remote semi-structured interviews with approximately 20 organisers and volunteers of repair initiatives in Metro Vancouver. Participants were selected through a purposive sampling approach, based on their participation in local repair initiatives in Metro Vancouver. My approach to analysis employs both socio-narrative (De Fina & Georgakopoulou, 2008; Frank, 2010) and thematic (Braun & Clarke, 2006) analysis strategies. Whereas narrative analysis typically interprets patterns within a data item (e.g., an interview), thematic analysis provides scope to identify patterns and connections across the data set. Thus, I see these two approaches as complementary; in combining them I can produce a richer, deeper analysis and in comparing them I can reflect on what a focus on stories may hide, reveal, or confuse about information practice and aspiration.

PRELIMINARY REFLECTIONS

Systems have been developed to gather data at community repair events, measuring the numbers and types of items repaired, tons of waste diverted from landfill, and estimating carbon emissions (Charter & Keiller, 2018; “The Fixometer,” n.d.). When measured according to material outcomes, the impact of community repair initiatives might seem minimal; one UK repair cafe reported 1 ton of repaired materials over two years (Charter & Keiller, 2018). This figure is dwarfed by the 100+ million tons of toxic e-waste generated globally during this time (Platform for Accelerating the Circular Economy (PACE), 2019). These kinds of quantitative data provide a crucial role in monitoring and measuring waste reduction; however, rooted in the rationalism of scientific knowledge practices, they are less well-equipped to deal with other questions central to environmental issues, such as considerations of responsibility, justice, and values (Escobar, 2018; Rose et al., 2012). *What can an emphasis on stories, rather than measurable or generalizable forms of data, lend to ASIS&T scholarship in support of climate adaptation?*

Preliminary analysis reveals stories from interviewees that emphasize the social value of repair for them and their community, about the lessons of care that repair held in creating meaningful relationships with their things and with each other, and about building intergenerational connections by sharing skills and knowledge. For example, one repair organizer described combatting social isolation as a key goal of their repair work: “[T]hey are restoring value not just to objects, but also to people. [...] When people come to get something fixed, it might be one of the few social interactions that they have in their whole day”.

The importance of in-person gathering for community repair groups meant the COVID-19 pandemic had been a significant challenge. At a time when social infrastructure and the capacity to repair was needed more than ever (Wiens, 2020), many community repair initiatives were forced to adapt to pandemic restrictions preventing public gatherings. One participant reflected: “there [are] alternatives [...] like people dropping off their stuff for people to take home and fix, which is really not the same. [...] [T]he focus really is about the social interaction and the face-to-face and also the person learning more about repair rather than just getting something fixed, right? It's so much more than just that.” As organisers and volunteers considered ways to continue their repair work safely, their reflections gave insight into what they valued—and therefore felt necessary to sustain—in their practice, as well as the constraints imposed by different sociotechnical assemblages, such as hosting virtual repair events on Zoom. Concurrently, I grappled with similar challenges in my research practice, as I sought to engage participants safely in my study while maintaining a spirit of public scholarship. *How do we open spaces for community engagement, information sharing, and storytelling in a pandemic-bearing world?*

CONCLUSION & CONTRIBUTIONS

The ongoing environmental and social crises demand that information scholars take new, integrated and interdisciplinary approaches to scholarship that are able to place different knowledges in dialogue and to constructively imagine alternatives (Escobar, 2018; Haraway, 2016). This poster offers contributions in its theoretical and methodological framing and its engagement with the research context. The project broadens conceptions of the information sources, systems, and stewardship engaged in climate adaptation. The stories and outputs from the work contribute towards an articulation of the social value of repair cafés in ways that go beyond economic or quantitative terms (e.g., *x* tonnes of waste diverted from landfills). Tracing meanings and relationships in context through narrative presents new opportunities for understanding how community repair initiatives can and do foster a stronger ‘social infrastructure’, supporting the development of relationships and knowledge necessary to adapt to rapidly shifting local conditions (Klinenberg, 2018). The work to date, presented in this poster, offers stories, reflections, and questions for the ASIS&T community to open new possibilities for exploring repair work and climate contributions in information research.

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Appraising Research Data for Long-Term Preservation: An Analysis of Research Data Collection Policies

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ABSTRACT

Traditionally, research data has been managed independently by individual researchers and only shared at the discretion of the researcher upon request. Appraisal and selection of research data has become a major issue in recent years as the number of data types and volume of data have grown greatly, but little empirical study has been done regarding how academic libraries document their research data appraisal practices. This study surveyed academic libraries' research data collection policies, which govern the identification, appraisal, and selection of research data. A total of 17 academic libraries' research data collection policies were examined in this study.

KEYWORDS

Research Data, Value of Research Data, Research Data Curation, Appraisal, Selection, Collection Policy.

INTRODUCTION

Big data has created unprecedented challenges across industries and government agencies, resulting in active movements to find ways to unravel the challenges. Such data growth has fundamentally changed the landscape of scientific research as well. The recent increase in the number of data types and the volume of research data produced by researchers, combined with the technological advances that allow us to organize and use/reuse data in new ways, has led to a need to preserve research data available and usable in the longer term and provide services related to that purpose (Kim, Schuler, & Pechenina, 2018; Tenopir et al., 2020). Many academic libraries have expanded their institutional repository services into the realm of research data to meet the needs of researchers who want to ensure their data can be accessed and cited in the long term (Lee & Stvillia, 2017). However, keeping data in a usable form for the longer term takes effort and has a considerable cost. Therefore, both data creators and data curators should know that not all research data can or has to be kept indefinitely, and they will need to make decisions about which data is worthy of long-term curation.

The appraisal and selection of research data remains an evolving field, but several organizations have published guidelines (e.g., Morris, 2013, NOAA, 2008; Whyte & Wilson, 2010). Such guidelines are indeed helpful for libraries, archives, and research data centers to develop their own policies, but there is little empirical study done on research data collection policies of academic libraries. As such, this study is intended to report the current status of the research data appraisal of academic libraries by examining their research data collection policies.

METHODOLOGY

The sample population was chosen from Johnston and Coburn's (2020) study that identified a total of 50 academic libraries that have a dedicated data repository (either a standalone platform or a dedicated collection for data in the general IR) for showcasing the data shared by their institutions. We used the search phrase "research data (OR data) AND collection AND policy" on each institution's library domain. Different terms were also employed as collection development policy is often labeled using different names, such as "collecting policy," "collection development policy," "appraisal policy," and "acquisition policy."

It was found that in some academic libraries, their research data collection policy is part of a larger digital preservation policy that establishes a framework to support sustainable access to their digital collections, which includes various types of digital contents, such as e-journals and databases; we excluded such policies in this preliminary study. We only collected research data collection policies, which describe how an institution collects and manages research data through its institutional research data repository. As a result, a total of 17 policies were collected for inclusion in this study. Using QDA Miner, qualitative data analysis software, we proceeded with the content analysis. The content of the policy was coded based on the coding scheme identified in Marshall's (2002) study, adding new codes when needed.

RESULTS

Types of Programs Supported and Clientele Served by the Collection

An academic libraries' research data collection is intended to promote the management, dissemination, and preservation of research data generated by campus researchers in support of the university's mission to promote research and learning. A total of 14 policies (82%) include a paragraph-length statement describing the purpose of the policy and the audience it addresses. The purpose statement often incorporates the parent institution's mission. Three institutions' policies (18%) link to the purpose of complying with data-sharing mandates from funders and publishers as well as encouraging open science and research reproducibility; the best example can be seen in the University of Arizona's policy.

The intended audience includes not only the members of their institution, but also researchers external to their community. Six policies (35%) outline eligible data depositors; for instance, Texas Tech University lists faculty members, researchers, enrolled students, and university employees, whereas the University of Minnesota's policy states data must be authored by at least one researcher of its institution. Three policies (18%) list researchers affiliated with other institutions and/or are collaborating with their community members, independent scholars, and the public who want to make use of data as potential users outside of the institution. It was found that seven policies (41%) include or refer to their end-user access policy, acceptable use policy, and/or terms of use, which explains how people can access and use the research data collection for users.

Priorities and Limitation of the Collection

Out of 17 policies, three policies (18%) provide an explicit definition of research data. The University of Michigan's policy defines research data as "representations of observations, objects, or other entities used as evidence of phenomena for the purpose of research or scholarship." Although the statements included in most policies imply that an institution's research data repository accepts any research data that were created or generated by their community members, five policies (29%) emphasize that data should consist of unique data that cannot be easily reproduced or acquired elsewhere. Two (12%) specify only original data to which the depositor holds the copyright or has permission to deposit and that will not infringe upon anyone's intellectual property rights. Three policies (18%) list specific types of data that can be included in their collection; such data may take the form of notebooks, statistical or spatial data tables, audio or visual recordings, photographs, or models.

We also found three institutions (18%) that implement the priorities of their research data collection; for instance, Purdue University provides a three-level breakdown of priority in the scope section, from data sets associated with publications (Priority 1); stand-alone data publications (Priority 2a); data sets with high research/teaching value (Priority 2b); and other data files and materials (Priority 3). Out of 17 policies, nine policies (53%) clearly state that their collection only contain unrestricted and unclassified data; it does exclude data that contain sensitive or confidential information or legally protected information (i.e., personally identifiable information, protected health information, export-controlled information, etc.).

File Formats, File Size, and Documentation for the Collection

Five collection policies (30%) outline an open and nonproprietary file format as the preferred file format for long-term archiving. Three refer to a list of recommended formats available in their data management guide page or the Library of Congress Recommended Formats Statement. Nine policies (53%) define a maximum allowable file size; such file sizes span from 4GB to 150GB.

Six policies (35%) indicate that the research data collection should include not only data, but also its documentation, which could include reuse terms, a project description, and data dictionaries.

CONCLUSION

This study was an attempt to explore the current status of academic libraries' research data collection policies. Many institutions provide a good template for research data appraisal but still lack the details for how the appraisal work would be addressed. The findings of this study pose an important question for future studies: how does research data collection policy inform research data appraisal, selection, reappraisal, and deaccession practice?

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Synchronous Ideation Workshop with Rural Library Professionals to Envision Future Makerspaces

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ABSTRACT

Ideation can support the development of educational programs and services at public libraries. Prior studies on ideation workshops focus on face-to-face settings; less is known about synchronous ideation workshops with library professionals with limited design experience. This paper reports on the results of a reflective case study of an online ideation workshop with three rural library professionals to envision future makerspaces. Preliminary findings suggest design considerations for a synchronous ideation workshop around librarian experience, design space, and technology.

KEYWORDS

ideation, rural library, makerspace, synchronous workshop.

INTRODUCTION

Ideation—a collaborative approach in design thinking to brainstorm ideas—is increasingly recognized as a valuable tool to develop innovative products and services. Academic communities and public libraries used ideation to design new educational programs and services (Bowler, 2014; Carroll et al., 2010). While prior work exists on how to develop face-to-face ideation workshops; less is known about how synchronous online workshop can be conducted particularly with rural library professionals with limited design experience. Therefore, this study tested a prototype for a synchronous ideation workshop using Mural™—a digital workspace for visual collaboration with available frameworks—and conducted a reflective case study (Hamilton & Corbett-Whittier, 2012) to develop design considerations for conducting synchronous ideation workshop with library professionals.

RELATED WORK

A key challenge for an online ideation workshop is translating the process of idea divergence and convergence in which people organically share and adapt ideas in real-time at close proximity into a digitally-mediated setting (Hollan & Stornetta, 1992). The instant sharing of ideas and variety of interaction can be sacrificed in an online setting due to limited screen size and the limited capacity to share, categorize, and sort ideas. To explore the challenges involved in synchronous ideation workshop, this study adopted the framework developed by Walsh et al. (2013) and considered four dimensions: partner experience (how much design experience is needed before participation), need for accommodation (age and cognitive ability), design space (how specific the design is defined), and the level of technology. This study particularly focused on understanding how much design (or other) experience library professionals would need before participating in the ideation workshop, how specific the design space should be, and how participants experienced the technology in the online workshop.

METHODOLOGY

Three rural library professionals and two research team members participated in the workshop that lasted three hours. Participants (all females) were full-time library professionals in the youth services department with an average of 5 years of experience, serving a legal service area population less than 10,000. They had bachelor's degrees in education, but none obtained Master of Library and Information Science degrees. The ideation workshop included the following activities: 1) connecting activity, 2) introduction of the platform and rules of engagement, 3) define your goals, 4) ask five whys, 5) identify and map driving and restraining forces, 6) select your top priorities and ideate.

We collected a video record of the online workshop, participant-generated artifacts and fieldnotes taken by the researcher immediately after the workshop. The video record of the workshop was fully transcribed and the artifacts were digitized, which were analyzed to understand how the design space provided a productive direction for envisioning future maker programming ideas. Participants' debriefs and engagement were also analyzed to explore how the Mural platform supported or hindered them during ideation. Emergent themes were summarized through a reflective case study in which the first author iteratively refined the analytical memos prompted by the analysis based on the transcripts, artifacts and fieldnotes.

FINDINGS

Analysis findings highlighted that participants' narrow conceptualization of making—predominantly emphasizing STEM and technology—constrained the scope of their idea generation to be around STEM programming. 42.5% of the ideas in the last ideation activity had explicit connection to STEM and technology. Participants also expressed that their goals for establishing makerspaces were to follow the trend and offer STEM programs. During the *ask five whys* activity when participants were prompted to share why rural library professionals may find it challenging to create partnerships for maker programming, they immediately interpreted maker programming as STEM programming and described challenges related to creating partnerships with organizations in STEM domain. Findings demonstrated that participants' understanding of maker programming was heavily centered around STEM, which influenced the type of ideas they could generate. In this regard, findings emphasized the need to broaden the participants' perception of the design space to envision different ways to create maker programming beyond STEM.

Findings also highlighted the tension between the external push to offer STEM programming at public libraries and the library professionals' internal struggle as they experienced limited competencies in STEM. The underlying root cause for library professionals' lack of confidence in STEM and technology was related to current expectations to lead technologically-oriented STEM programs at libraries without prior training in STEM or technology. Participants expressed their roles to lead STEM programs as “one more iron in the fire” and “one more thing to try to figure out and master.” In addition, the three most unfavorable restraining forces that participants identified were “fear of trying new things,” “limited knowledge and ability in STEM,” and “minimal technological resources” at the libraries. As such, findings suggest that rural library professionals' current approach towards envisioning STEM maker programming will likely have challenges as they already feel overwhelmed in providing these programs.

The analysis of participants' debrief and their engagement during the online design thinking workshop illustrated that the Mural platform facilitated participants to generate ideas on digital post-its, support them to move and group ideas together, and select ideas by highlighting them in different colors. All three participants had no prior experience using the Mural platform. However, they expressed that it was easy to use and did not experience many challenges while utilizing new features in the platform.

DISCUSSION AND CONCLUSION

Preliminary findings from a reflective case study suggest considerations for future online ideation workshop with rural library professionals around librarian experience, design space, and technology. Walsh et al. (2013) have proposed to consider the participants' age and cognitive ability to determine how much design experience might be needed before participating in a design workshop and explore how specific the design space should be. This study illustrated the importance of first understanding library professionals' conceptualization of the ideation topic (in our case, makerspace) as it has direct influence over determining the design space. Practical design consideration for the future workshop is to understand the prior experience of the participating librarians and include a primer activity to broaden their conceptualization of making before participating in the workshop.

Design process is emergent. It is neither strictly bottom-up nor top-down. Design also involves the discovery of new goals. By conducting this prototype workshop, the new goals for the future ideation workshop were discovered: 1) support rural library professionals to find their strengths in making and use them as departures for envisioning future maker programming, 2) broaden their ideation approach informed by past endeavors and the interests of the rural community members, 3) prototype maker programming ideas. Barton, Tan, and Greenberg (2016) pointed out that the current conceptualization of making as providing access to digital fabrication tools and production process can marginalize populations that do not connect with the opportunities, needs, and goals afforded by these tools. While makerspaces at public schools, science centers, or museums may focus more heavily on STEM and technology, public library makerspaces are well-positioned to reconceptualize entry points and pathways toward making by leveraging different needs and interests in the community. In future, the research team will further investigate ways to develop context-relevant maker programming at small-town and rural libraries by implementing the study findings from our prototype workshop to prepare the future design thinking workshop.

ACKNOWLEDGMENTS

The project is supported by the IUPUI Arts and Humanities Institute.

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Out of the Past: The Challenges of B.C.E. Dates in Metadata

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ABSTRACT

While well-established standards for encoding date metadata exist, Before Common Era (BCE) dates, previously referred to as Before Christ (BC) dates, are a challenge. Libraries, archives, and museums have a rich variety of artifacts from this era. However, the lack of encoding or underuse of available standards hinders the ability to search and browse for this content. While several metadata standards support encoding of BCE dates, the full capability is often not exploited. By analyzing metadata in the Digital Public Library of America (DPLA, <https://dp.la/>), the authors examine the benefits and limitations of the Extended Date Time Format (EDTF) and related interoperability issues.

KEYWORDS

metadata; EDTF; ISO 8601; BCE; cultural heritage.

INTRODUCTION

While metadata is essential to access and retrieval, quality issues can hinder those goals. Libraries, archives, and museums (LAMs) encompass a rich variety of content, including works created Before Common Era (BCE), previously referred to as Before Christ (BC). While metadata and encoding standards exist to support this content, the question remains as to whether they are even utilized and what conflicts exist between standards.

ISO 8601 is the de facto international standard for encoding date and time; it is expansive and expensive. However, it is recognized for conventions including “YYYY” (four-digit year), “YYYY-MM” (four-digit year, two-digit month), and “YYYY-MM-DD” (four-digit year, two-digit month, two-digit day). ISO 8601 has evolved over time and subsets have been adopted by other organizations, e.g. the W3C Date and Time Formats (W3CDTF). In 2012, the Library of Congress published the Extended Date Time Format (EDTF). It bridged the gap between ISO 8601 and LAM-specific date encoding needs, including BCE dates as “-YYYY”. In 2019, EDTF was finalized and integrated into ISO 8601-2019. Despite the 2012 version of EDTF being a draft standard, it was quickly adopted by several organizations and recommended by metadata standards including Dublin Core and Metadata Object Description Schema (MODS). Prior to the creation of EDTF, Machine Readable Cataloging for Bibliographic Data (MARC) allowed the option to encode BC/BCE dates as “YYYY” values - without hyphens - in the 046 field and VRA Core accepted BCE dates as negative values (-YYYY).

In 2015, Zavalina et al. reviewed the impact of EDTF on metadata in the Digital Public Library of America (DPLA, <https://dp.la/>). DPLA is an aggregator with digitized and born-digital content from organizations across the United States with a focus on special collections and archival materials. Then storing more than 8 million records, the study found significant use of ISO 8601 date formats, specifically the W3CDTF profile, and some use of EDTF – then a draft standard – in the Date Created field. Zavalina et al. also observed many non-conformant date values including dates expressed as text values and mapping errors. The study did not address the specific issue of BCE dates.

METHODS

DPLA now has 43 million records. For this study, the entire data set was extracted via bulk download (<https://pro.dp.la/developers/bulk-download>) and then uploaded to a high-performance computer in the Compute Canada Federation system (<https://www.computeCanada.ca/>). R (<https://www.r-project.org/>) was used to identify more than forty-thousand date patterns. This involved converting all Arabic numerals into a placeholder digit and text strings representing years and months into placeholder values. The subsequent date patterns were further examined in OpenRefine (<https://openrefine.org/>) to filter text-based BCE and BC dates as strings. EDTF-compliant dates were found with University of North Texas’ edtf-validate (<https://github.com/unt-libraries/edtf-validate>) Python library.

RESULTS

In the Date Created field, there are various potential values for BCE content. There are 16,598,377 records with no date values. In other cases, there are ambiguous text values, e.g. “undated”. Without extensive examination, it is unclear how many of those records represent BCE content. However, there are 12,632 records that have BC/BCE

dates as text values. As per Table 1, text strings were searched to allow for variation in terms of letter case and punctuation. There are also mis-mapped values that correspond to publisher and place values. Many values also included the combination of BC/BCE dates in intervals (start and end dates) with a Common Era (CE) date as its end date. In some cases, BC/BCE dates were provided in addition to dates that conformed to non-Gregorian calendars, e.g. Islamic calendar. There were no matches for the expanded version of the abbreviations—“Before Common Era” and “Before Christ”—regardless of case.

Date patterns	Number of records	Notes
BCE, bce, B.C.E., b.c.e., B.C.E, b.c.e	10,297	Last period omitted in some patterns.
BC, bc, B.C., b.c.	2,335	Removed matches that corresponded to “B.C.” as publisher in British Columbia.

Table 1. Record count for Date Created with text BCE/BC dates

Due to varying date metadata standards, encoded BCE dates are more difficult to identify. As per Table 2, five EDTF-compliant date patterns for BCE content were identified across 8,566 records in the Date Created field. Only a portion of this content corresponds to BCE content. For instance, the pattern “-YYYY” is an EDTF Level 1 negative calendar year. In other standards, it represents a date range with an unknown start date. While EDTF provides options for encoding dates with various qualifiers to denote ambiguity, those qualifiers were not used in the data set for BCE dates. However, there were open intervals—date spans—with only an end date, e.g. “/YYYY-MM~”, that may or may not represent content that spans from the BCE era into the CE era.

Date Patterns	Number of records	Records with BCE content	Notes
-YYYY	3,489	553	Non-BCE content uses hyphen to denote
-YYYY-MM	1	0	Possible overlap with open date ranges.
-YYYY-MM-DD	4	4*	*These records do correspond to BCE content. However, the inclusion of month and day suggest a possible error.
-YYYY/-YYYY	4,004	4,004	Intervals separated by a forward slash (/) denote a date range where the start date is BCE and end date is BCE.
-YYYY/YYYY	1,068	1,052	Intervals separated by a forward slash (/) denote a date range where the start date is BCE and end date is CE.

Table 2. Record count for Date Created with EDTF-compliant BCE dates

CONCLUSION

As metadata shifts to linked data, the challenge of representing BCE dates becomes more profound. Textual dates present a barrier to multilingual audiences and interoperability for searching and browsing. On the other hand, BCE dates encoded according to EDTF create semantic problems. What is intended versus what is clear to humans is not necessarily apparent. Negative date values may confuse users who encounter them and thus require scripting to convert them to human-readable dates. This puts a burden on platforms and institutions to support the conversion of these dates in order to use them effectively. A limitation of this study is that some textual BC/BCE dates in the data set may have been previously converted from encoded dates into human-readable text. Depending on the metadata standard and platform used to enter metadata, it may or may not be possible to indicate the encoding standard used—if any. Due to conflicting content standards, there are issues with interpreting dates with the same patterns for harvesting and reuse. Further study is necessary to identify barriers to encoding dates, including metadata practitioners’ knowledge of date encoding standards, their support level for encoding dates, and the impact of conflicting content standards.

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Public Engagement with Science via Social Media: A Case of Communicating the Pandemic on Twitter

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ABSTRACT

The poster describes a project which analyzes interactions between laypeople and experts via social media. Our aim is to understand how experts and the general public interact with each other on social media, and how we can use current data to improve these interactions in the future. We created a Twitter bot to obtain data from 15 COVID-19 experts and 7 federal government-sponsored public health organizations from English-speaking countries. The data were analyzed in R to investigate the relationships among Followers, Favorites, Retweets, and Hashtag Count per tweet. The preliminary analysis indicated statistically significant differences between various variables including: Number of Favorites, Number of Retweets, Number of Hashtags, and Number of Followers; the results shed light on the current relationship between the public and experts on social media.

KEYWORDS

Social media; online public engagement with science; Twitter; science communication.

INTRODUCTION

Effective communication of scientific knowledge encourages the public to take a greater interest in science, place increased value in the contributions of scientists, and help foster public support for the funding of scientific research (Dudo & Besley, 2016). Traditionally, scientific knowledge has been largely disseminated in a linear fashion—from the scientist to the general public via mediators like journalists—limiting participation in discussion, interpretation, and production of knowledge on the part of the general public (Callon, 1999). However, due to the prevalence of social media platforms like Twitter and Facebook, it is now much easier for the public to engage in the production of knowledge. This affordance has helped shape the presentation of scientific knowledge on online social media platforms (National Science Board, 2018), as well as provided opportunities in which the public can easily process facts in relation to their values (Feenberg, 2017).

The recent pandemic, COVID-19, created dire needs among scientists and public health organizations to communicate directly to the general public swiftly (Rufai & Bunce, 2020). We investigate the factors that affect greater engagement among the public on social media by investigating Twitter posts by 15 renowned scientists (i.e., Aaron Carroll, Jeremy Faust, Tom Frieden, Atul Gawande, Tedros Adhanom Ghebreyesus, Scott Gottlieb, Syra Madad, Vivek Murthy, Angela Rasmussen, Caitlin Rivers, Andy Slavitt, Craig Spencer, Devi Sridhar, Eric Topol, Rochelle Walensky), as well as governmental health organizations from 7 countries (i.e., Australia, Canada, Ireland, New Zealand, South Africa, United Kingdom, United States).

METHODS

First, we conducted multiple searches to identify the names of as many renowned scientists and researchers as possible. We surveyed various articles from trustworthy sources, such as Nature and BBC, and identified researchers and scientists who had direct connections to COVID-19 research, COVID-19/Pandemic discourse and discussion, and vaccine research/production. We then examined their individual Twitter accounts to evaluate if they had enough followers (approximately over 20,000) to receive active engagement (Wadhwa, Latimer, Chatterjee, McCarty, & Fitzgerald, 2017). Our previous observations showed that this number of followers generally correlates with active engagement rates on almost every post. We also confirmed that these accounts had enough posts from which to obtain relevant data (i.e., a post at least once every other day). We then narrowed down the selection to individuals with the highest number of followers. From that group, 20 were chosen based on the frequency of posts, engagement numbers, and the ratio between unique posts and retweets. We also added Dr. Aaron Carroll's account, given his recent New York Times op-ed articles and active Twitter involvement, even though he was not mentioned in any of these lists.

For the country selections, we first searched for “majority English-speaking countries” by comparing various lists publicly available on the internet from online encyclopedias (e.g., Wikipedia) and academic institutions (e.g., University of Northampton, University of Sheffield). From these lists, we chose 7 of the largest nations considered to be in the “Anglosphere” because they are comparable with government structure, as well as the quality of life.

Then we identified each country's largest government-sponsored public health organization with a substantial social media presence.

Once we had the list of the 20 top scientists and 7 countries, we harvested the 100 most recent tweets from each individual as of June 1, 2021, which we then analyzed by calculating correlation coefficients to identify relationships between the numbers of favorites, retweets, hashtags, and followers.

FINDINGS

The results of linear regression of the scientists and their total combined values (labeled as *All Individuals*) are presented in Table 1. We examined the relationships between the numbers of favorites, retweets, hashtags, and followers. We found statistically significant correlation coefficients between the numbers of favorites and retweets among 9 of the 15 individual Twitter accounts and *All Individuals*. Similarly, 4 out of 7 public health governmental organizations' Twitter accounts, as well *All Countries*, had a positive correlation between the number of favorites and retweets that were statistically significant. This means that with regard to these 13 Twitter accounts, the higher number of retweets, the higher the number of favorites—and vice versa. In addition, two individual Twitter accounts had statistically significant, yet moderate correlations, between individual accounts with the number of hashtags and favorites, and numbers of hashtags and retweets. In terms of hashtags, the numbers of hashtags and followers had a statistically significant correlation for *All Individuals*.

Twitter Account	Favorites / Retweets	Hashtags / Retweets	Hashtags / Favorites	Followers / Favorites	Followers / Retweets	Followers / Hashtags
All Individuals	0.1459421*	-0.0289164	-0.0204321	-0.0015537	0.005994603	0.3004851*
All Countries	0.6276162*	0.1344761*	0.1778187*	0.3497*	0.17782*	0.21853

Table 1. Correlations For Individuals and Countries Twitter Accounts Total

Table 1 also shows that 5 of the 6 relationships examined had a statistically significant positive correlation for the combined data extracted from these public health organizations' Twitter accounts (labeled as *All Countries*). In particular, the numbers of retweets and followers had strong correlations, while the numbers of favorites and followers had moderate correlations. This indicates that organizations which tend to employ social media managers, compared to individuals, have more variables that are statistically significant positive correlations. Obviously, social media managers are likely to have more sophisticated understandings of how Twitter and user engagement work. As such, they appeared to use hashtags more effectively. Surprisingly, the Institute of Public Health in Ireland's Twitter account (publichealthie) had a negative correlation between the numbers of hashtags and favorites. Further investigation of the data is necessary. The United States' Center for Disease Control's Twitter account (CDCgov) had shown a very strong correlation between the numbers of hashtags and retweets, possibly indicating that the audiences in the U.S. are more familiar with the use of hashtags, therefore employing them more effectively than the other accounts. The New Zealand's Ministry of Health Twitter account (minhealthnz) had three relationships (i.e., favorites and retweets; hashtags and retweets; hashtags and favorites) that were statistically significant. It is uncertain why this was the case, but one speculation is that New Zealand's Ministry of Health had a savvy Twitter account manager. Further investigations including interviews with these organizations will be useful.

CONCLUSION

These preliminary results provided an understanding of social media interactions between experts and laypeople via social media like Twitter. Just being an expert in a particular field may not be enough to make a noteworthy impact on social media; the knowledge of how to increase user engagement on Twitter may be necessary as well. We plan to expand the data set for further analysis. This will hopefully help scientists and public health organizations to effectively communicate with the general public, thus increasing their engagement on social media platforms. Information professionals who work in scholarly communication fields will likely benefit from the research. As noted by Collins, Shiffman, & Rock (2016), scientists have begun to take advantage of social media in order to communicate directly with the general public. As such, we need to unbox the dynamics of online public engagement with science in order to develop effective communication strategies.

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Evaluation of a Chat Interface for Diary Studies in Information Behavior Research

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ABSTRACT

We report about our work in progress evaluation of a Telegram-based chat-interface for collecting diary entries in the field of information behavior research and compare the results to web-form based entries. We expect participants to complement their chat entries by multimedia files and engage more openly.

KEYWORDS

diary studies; chat bot; ethnographic methods; information behavior; research methods.

INTRODUCTION

With the current pandemic limiting our choice for ethnographic studies in information behavior, we were looking for remote observational methods to be used in an ongoing project. Investigating the activities in the scholarly research process, diary studies quickly attracted our attention, as they are staple methods for research in our field (e.g. Case, 2012, p. 222 ff. Sohn, Li, Griswold, & Hollan, 2008) and offer the possibility to gather a multitude of data, like e.g. “personal testimonies”, “everyday events”, “longitudinal or chronological details” and more (Hyers, 2018). The possible study designs are at least as diverse as the data they may collect; thus, we chose to use a chat-interface to elicit daily activities of students, to understand the problems they encounter, the progress they make, and the role of software in their daily work. We present our work in progress evaluation of a chat interface for collecting diary entries, asking the two main questions: What data does it collect and how is it different from plain web forms?

RELATED WORK

Mobile phones have been used in the past to conduct diary studies. Palen & Salzman (2002) presented a voice-mail diary study, praising the method for the opportunity to study activities naturalistically and with minimal intrusion, especially when using mobile phones. Supplementing voicemail Brandt, Weis, & Klemmer (2007) using text and picture messages to capture snippets of information in situ which were followed up in a web form eliciting more information for each snippet. Just little later Sohn et. al. (2008) conducted an influential study of mobile information needs, using text messages to capture diary entries in situ. Their study used several reminders and they also captured snippets via text messages, followed up by a daily web survey to add additional data to their text message snippets.

More recently studies by Kaufmann & Pfeil (2020) and Kim et al. (2019) used contemporary instant messengers. Kaufmann and Pfeil utilized WhatsApp to perform a mobile instant messaging interview to gather qualitative data. This method showed several advantages like not being intrusive in everyday life, encouraging informal interaction which stimulates open communication, and the data being more diverse as the participants could send pictures and other media. Kim et al. went another direction. They investigated whether text-based chatbots are a better alternative towards web-based questionnaires. They showed that participants who answered questions from the chatbot gave more diverse and less satisfactory answers.

All in all (mobile) phones have proved useful to capture diary entries. In the past, however, text snippets needed to be complemented by surveys and structuring voice diary study was complex. Modern messaging applications answer some of the shortcomings in the first mobile diary studies. The literature proves their use for interview studies and positive effects as an alternative interface for questionnaires. Thus, we investigate how mobile diary studies may be improved using a chat interface using instant messaging.

METHOD

The Chat Interface

We developed a chat bot using the Telegram platform. While called “Bot” by the Telegram documentation, we decided to use the term “chat interface” to prevent any misinterpretations: Our implementation is not “smart”, thus we are not making use of any Natural Language Processing, rather platform buttons or commands are used. As the Telegram app is intrinsically linked to mobile devices, multimedia messages, like speech, video and image messages are permitted as they are part of the “typical” chat experience, offered by many contemporary chat apps including e.g. WhatsApp.

The bot is implemented using the python-telegram-bot package (at <https://github.com/python-telegram-bot/python-telegram-bot>). The python script connects to several Google Spreadsheets storing user input and user information. Once a user has signed up, their incoming messages are recognized by the users' telegram-account-id. This id is used to link information across the tables of our semi-structured diary study. Messages that contain media files will be forwarded to the research directors personal telegram account as the official Telegram API only allows to download files which are up to 20 MB large. With the forwarding method we secure to collect every media file that is sent to the bot, as video files, for example, quickly exceed the limit.

The Form Interface

We decided to evaluate the chat interface against an online form using Google Forms. We used the same questions guiding the diary when creating a form with free-text input fields and an additional file upload field for each text field. File upload was limited to 10 files per question for technical reasons. (This is the maximum number of files Google is allowing to upload per file upload field.) Submitted forms are saved in a spreadsheet format on Google Drive, thus they may be exported easily for further data analysis.

The Study

To evaluate the chat interface, we designed a diary study to elicit daily activities and problems during the scholarly research process. The study consisted of 4 short open-ended questions (see Table 1) to be answered by the participants during the period of two weeks once a day. Two types of interfaces were offered to create a diary entry: A google form interface or a Telegram chat interface. Both allowed writing entries in a text field or sending / uploading media. The latter option was not emphasized, however all interfaces offer sending audio messages, images, and other media, allowing both, to create an entry by e.g., speaking with the device, or complementing the entry by artefacts. In our within-subject study each participant was asked to use the one interface for a continuous week, then the other. To control for unwanted effects due to the change between interfaces, the participants were randomly split into two groups. Group A started using the chat-interface, group B the web-forms. Following the week-long period for each interface-type, participants were asked to answer the System Usability Scale (Bangor, Kortum, & Miller, 2008; Brooke, 1996) and the NASA-TLX (Hart & Staveland, 1988) to assess the perceived usability and perceived workload of the web and chat applications. These questionnaires were embedded into an independent, self-developed website.

Q1	What have you accomplished today regarding your university work?
Q2	Are you happy with all you've accomplished today? Please elaborate.
Q3	Is there anything that might have worked better today? If so, what might have helped?
Q4	Would you like to tell us anything else?

Table 1. Diary Study Questions

Participants were reminded daily at 5 o'clock using a Telegram message to submit a diary entry. Chat messages were triggered for both interfaces to control for any effects another medium for notifying the user might have had. Following the study, participants are asked to partake in a follow-up interview. They are asked to elaborate about unclear entries and about their personal preference between the two capturing techniques.

FUTURE WORK

At the time of writing 51 participants signed up for the study which has not yet been concluded. The collected data will be analyzed quantitatively and qualitatively: We are interested in the differences between collected responses by the length of the data, the number of responses and type of responses: How often do participants use the multimedia options? Further it may be interesting to see whether emoticons are used and how much time passes between reminder and submitting the entry. Speech messages, another stock feature of modern chat applications, might blend the diary study with a traditional interview. From the qualitative point of view, we are planning to code the responses using a grounded theory approach (Corbin & Strauss, 2008). These processes may be complemented by frequency analysis and topic modelling techniques.

DISCUSSION

If the chat interface's responses provide a more thorough look into the work and problems of our subjects, we are confident to use and recommend this technique for further research using diary studies. The implementation of a chat interface is more time-consuming, thus the additional information captured needs to justify the extra work. While comparing different methods for capturing information in diary studies we see two potential shortcomings in our design: We need to evaluate whether our design measured information behavior once data collection concluded and, while exploring the technique as a COVID-compliant approach to ethnographic studies, we are not evaluating the diary study itself against in-situ or other ethnographic approaches.

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Investigating the Influence of Cute Aesthetics in Community Crowdsourcing

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ABSTRACT

This paper investigates the influence of cute aesthetics design in community crowdsourcing. Specifically, we propose that cute aesthetics design is a viable approach to appeal to the crowd and motivate everyday participation in community crowdsourcing as prior works indicate that cute aesthetics can invoke positive emotion. We conducted a comparative study on two sets of interface designs on a community crowdsourcing app where respondents evaluated and assessed if cute aesthetics interface design has effects on app usage intention. Data were collected from 103 respondents and results indicate that cute aesthetics design appeal to younger female adults. Findings contribute to a better understanding of the conceptualization of aesthetic-usability in community crowdsourcing.

KEYWORDS

Community crowdsourcing, aesthetics, usability, cuteness.

INTRODUCTION

Community crowdsourcing is a form of crowdsourcing in which online participants collaborate to develop an outcome or a solution that benefit the community (Nguyen et al., 2016). With the proliferation of mobile devices, community crowdsourcing apps for the smartphone are used to harness the power of the mobile crowd to participate or engage in everyday community activities. Separately, research has demonstrated the relevance of including aesthetic and usability elements in mobile applications design (Tuch et al., 2012). Norman (2004) explained that users are influenced by the aesthetics of any given interface even when they try to evaluate the underlying functionality for everyday usage. Further, prior works have also established that aesthetics designs are more effective at fostering positive attitudes than unaesthetic designs (Tuch et al., 2012). Put differently, aesthetics designs are applicable in promoting everyday usage.

Here we propose that cute aesthetics design is a viable approach to appeal to the crowd and motivate everyday participation in community crowdsourcing as cuteness invokes positive emotions and offers cues for social engagement (Macpherson, & Bryant, 2018). Specifically, cute aesthetics refer to the cute elements in the interface design of the community crowdsourcing. We focus on the perception and effects of cute designs. Prior works have established that cute aesthetics designs appeal to the visceral level of emotions as they provide reassurance, connection and comfort (Allison, 2002). It has also been shown that perceptions of cuteness also invoke care and altruistic tendencies (Sherman and Haidt, 2011) and more recently Steinness et al. (2019) established that cuteness perception can elicit positive emotions. For instance, Kalawski (2010) suggested that “tenderness” is an emotion in response to seeing a cute image. Collectively, the aim of this study is to understand how cute aesthetics design influences an individual's users experience and affects participation on community crowdsourcing. More specifically, we also investigate whether demographic factors (i.e., age and gender) have potential influences because perception of cuteness is subjective depending on a person's background, age and gender (Nittono et al., 2021).

RELATED WORK

Community crowdsourcing describes the process where individuals are willing to collaborate and solve everyday problems in the community (Lee et al., 2019). Specifically, community crowdsourcing typically requires many participants to engage in a discussion, make suggestions or propose solutions regarding an issue (Nguyen et al., 2016). This implies that attracting the crowd to participate and engage in community crowdsourcing is critical. Research has also unequivocally demonstrated that usability is an important component of mobile application design (Goh et al., 2021). Hence, cute aesthetics design is a viable means to enhance usability.

The study of cute aesthetics designs on usability is a relatively new phenomenon in user studies. Separately, studies on cuteness have gone beyond the studying of physical traits that are deemed cute and how they elicit caretaker behavior. A related development in this field is the concept of “kawaii”—the Japanese term to describe entities and objects as “cute”. Some Japanese academics go beyond the linguistic dimension of “kawaii” and its Western counterpart, exploring the socio-cultural landscape that informs “kawaii” perception (Nittono, 2016). An example of application of cuteness perceptions on moral education (Zhang & Zhou, 2020).

METHODOLOGY

We developed a community crowdsourcing prototype as part of a larger study. The prototype allows users to login, seek, create, share and contribute community content (refer to Figure 1 for the original interface design). To investigate the comparative effects of cute aesthetics design, we redesigned the interface by injecting “cuteness” design elements (Figure 2) focusing on colors, images, icons, shapes and sizes (Cheok & Fernando 2012). The design rationale and details are omitted in this paper due to page limitation. For this preliminary study, a total of 103 adult respondents (42 males and 61 females) were recruited to evaluate the two sets of interfaces. Forty-four respondents (43%) were thirty-years and older while the rest were between twenty-one to twenty-nine years old (57%). Respondents were briefed about the purpose and functionality of the application and then were introduced to two sets of interfaces (i.e. original and cute aesthetics). After that, they then completed a questionnaire that elicited demographic information, information related to attitudes and perception as well as usage intention of the app.

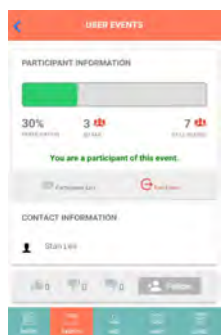


Figure 1. Original Interface Design

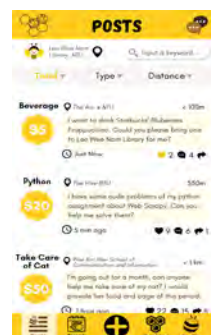


Figure 2. Cute Aesthetic Interface Design

RESULTS

Preliminary results (see Table 1) indicate that usage intention is significantly higher for the interface with cute aesthetics design. Younger adult females were more inclined to prefer cute aesthetics design than others.

Variable	N	Original Interface Mean	Cute Aesthetics Interface Mean	t	p-value
Usage Intention	103	3.48	3.61	-4.865	0.04*
Usage Intention (21 to 29 years old)	59	3.57	3.75	-2.166	0.03*
Usage Intention (30 years old and older)	44	3.36	3.41	-0.608	0.55
Usage Intention (Males)	42	3.48	3.57	-0.864	0.39
Usage Intention (Females)	61	3.48	3.63	-2.151	0.04*
* statistically significant differences at $p < 0.05$					

Table 1. Results

DISCUSSION AND CONCLUSION

Our preliminary results show that cute aesthetics design has significant effects on some segments of the population in motivating community crowdsourcing participation. Specifically, we found that cute design elements can be incorporated in mobile crowdsourcing apps to motivate younger female adults. This suggests the potential benefits of enabling interface customization for apps catering to the masses. Notably, the sample size of males and older adults were smaller and as such more data should be collected to derive any conclusive finding on the influences of cute aesthetics design. Nevertheless, this study is one of earliest research to incorporate cuteness in interface design and hence the results contribute to a better understanding of the conceptualization of aesthetic-usability in community crowdsourcing.

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Understanding the Temporal Effects on Tweetcussion of COVID-19 Vaccine

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ABSTRACT

In the fight against COVID-19, the Pfizer and BioNTech vaccine announcement marked a significant turning point. Analysing the topics discussed surrounding the announcement is critical to shed light on how people respond to the vaccination against COVID-19. Specifically, since the COVID-19 vaccine was developed at unprecedented speed, different segments of the public with a different understanding of the issues may react and respond differently. We analysed Twitter tweets to uncover the issues surrounding people's discussion of the vaccination against COVID-19. Through the use of Latent Dirichlet Allocation (LDA), nine topics were identified pertaining to vaccine-related tweets. We analysed the temporal differences in the nine topics, prior and after the official vaccine announcement.

KEYWORDS

COVID-19, Topic Modelling, Twitter, Vaccine.

INTRODUCTION

In the fight against COVID-19, 9 November 2020 perhaps marked a significant turning point in the battle as Pfizer and BioNTech (Pfizer-BioNTech) announced that their vaccine candidate was more than 90% effective in preventing the disease (Pfizer, 2020). The development of the Pfizer-BioNTech and other COVID-19 vaccines occurred at an unprecedented speed (World Economic Forum, 2020) and has led to scepticism and other concerns among some segments of the public. Indeed, conversations about the vaccine proliferated on social media platforms after the announcement, presenting an opportunity to understand online reactions to this announcement.

Given that vaccination is a critical tool in the fight against COVID-19, the present study aims to investigate the public reactions towards COVID-19 vaccines and the temporal differences in topics, prior and after the vaccination announcement. To identify the underlying topics, we employ topic modelling in our analysis. Twitter is used in our research because it is currently being actively used for sharing COVID-19 and vaccine-related content (Thelwel et al., 2021). Research has shown that content shared online not only reflects the public's understanding of health issues but also has the potential to shape perceptions and attitudes (e.g., Massey et al., 2016; Deiner et al., 2019). So, understanding topics discussed is critical in rolling out vaccination programs since prior work on vaccines has also found that consumption of online health information sources can be risky due to the amount of misinformation and unverified content available (e.g., Tomeny et al., 2017; Yuan et al., 2019). Here, we propose that tweets are useful and timely for policymakers to frame COVID-19 vaccination messages in their communication to the public. We propose to answer this research question: *What are the topics discussed surrounding the Twitter conversation on COVID-19 vaccine following the announcement?*

RELATED WORK

Prior works related to the sharing and seeking health-related content have shown that Twitter can be used for surveillance of public health topics, categorisation of health-related tweets, Twitter-based public health interventions, (Gunaratne, 2019; Osop et al., 2020; Sinnenberg et al., 2017). Recent studies have identified major topics on vaccine refusal (Bonnevie et al., 2021) and vaccine hesitation (Thelwell et al., 2021; Griffith et al., 2021) to understand the source of concern and, importantly, combat against vaccine misinformation. Our study complements prior works by incorporating the temporal component since time matters when examining tweets in a public health context.

METHODOLOGY

This study was part of a larger project that analyses tweets pertaining to COVID-19 vaccine from November 01, 2020, to November 16, 2020. English tweets were extracted from a public dataset on GitHub (Chen et al., 2020) that contains an ongoing of tweets IDs related to COVID-19, since January 28, 2020, through Twitter's Search API using a list of keywords (e.g., "Covid-19", "pandemic", etc.). The tweets were filtered for vaccine-related keywords

(e.g., “vaccine”, “vaccination”, etc.), and we removed emojis, “RT” text, mentions, URL links, special characters, and spaces. A list of standard stop words (e.g., “the”, “does”), frequently appeared words (e.g., “covid19”, “virus”), and the vaccine-related keywords were also removed. Porter stemmer was used to abbreviate the words into root words and eliminated infrequent sparse terms. The final dataset comprised 44,699 tweets with 365,288 words and 1,566 unique words. Latent Dirichlet Allocation (LDA) topic modelling was used to identify COVID-19 vaccine-related topics discussed on Twitter due to its potential and effectiveness to detect new trends on social media as an unsupervised classification technique (Ostrowski, 2015). In this process, we used two data-driven metrics to evaluate the model fit (Cao et al., 2009; Deveaud et al., 2014), and after evaluation we ran the LDA model with nine topics for our dataset.

RESULTS

Nine topics were identified from the LDA topic modelling approach comprising T1: **Administration of local vaccine program**, T2: **Complementary measures to vaccine**, T3: **Social aspects of vaccine**, T4: **Efficacy of vaccine**, T5: **Global distribution and access of vaccine**, T6: **Myths about vaccine**, T7: **Legal and economic aspect of vaccine**, T8: **Pace of vaccine development** and T9: **Political aspects of vaccine**. The evaluated trend of the topic weightage score (see Figure 1) was obtained by dividing the number of tweets per day in each topic by the total number of daily tweets in all topics. Within expectation, an increase in discussions related to efficacy and social aspects of the vaccine was detected around the vaccine on the day of the announcement, on November 9, 2020. We also observed an increase in interest, likely with concerns, over the global distribution of the vaccine (T5: Global distribution and access of vaccine), possibly leading to the debate on the legal and economic aspects of the vaccination (T7: Legal and economic aspects of vaccine), with the USA presidential election (T9: Political aspects of vaccine) being a potentially linked political topic over the situation, while reduced conversations over vaccine development and administration (T1: Administration of local vaccine Program and T8: Pace of vaccine development) was found.

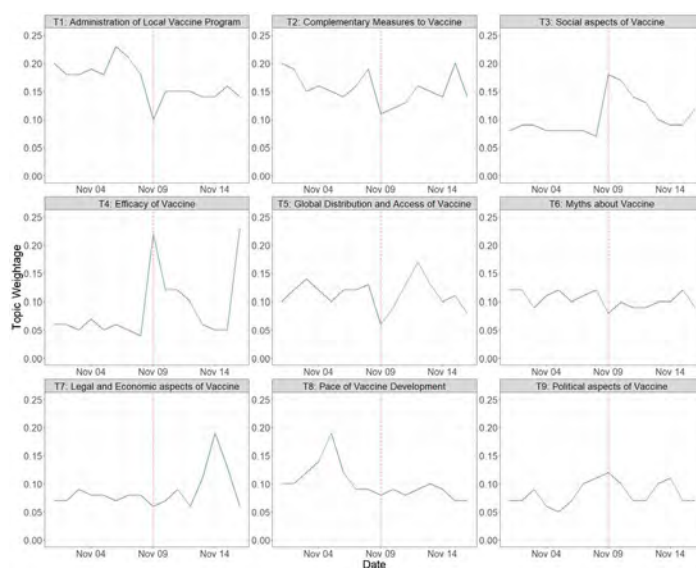


Figure 1. Change of topic over Time

DISCUSSION AND CONCLUSION

Our findings reveal the shared thinking and understanding of the public and their opinions surrounding the vaccine announcement. Our preliminary findings indicate some topics continued to proliferate on Twitter while other topics saw a decline in discussion. The findings help to better understand people’s attitudes and opinions about the COVID-19 vaccine. Importantly, we found that despite efforts put in to debunk misinformation surrounding vaccination against COVID-19 (Russell, 2021), it appeared that as COVID-19 vaccine programs continued to roll out globally, the myths around the vaccines continued to proliferate on Twitter (Figure 1 Topic 6). With new developments and controversies surrounding specific vaccines and the vaccination process in various countries, we plan to collect more data and incorporate newer tweets to ascertain if and how topics have changed. We also plan to conduct sentiment analysis to shed light on the sentiments behind the topics. Comparing vaccine discussions across different social media platforms and languages would also be worthwhile. By focusing on the conversations around the announcement, this study aims to contribute to better understand reactions to vaccination against COVID-19 which may ultimately help policymakers in ensuring equity and inclusivity in implementing vaccination programs that work for everyone. Also, understanding how social media conversations shift will help in the creation of better official responses to the public.

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A Survey of Exclusively Data Journals and How They Are Indexed by Scientific Databases

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ABSTRACT

As data becomes omnipresent in the scientific system, a new academic genre aiming to describe data objects (*data papers*) and the venue to publish these articles (*data journals*) gradually emerged from the end of the 2000s. However, it is largely unknown how much these scientific outputs are indexed in scientific databases, which has greatly prevented them from being thoroughly studied in large-scale, quantitative studies. This poster presents our preliminary efforts to address this gap, by compiling a list of data journals that primarily accept data papers (i.e., *exclusively data journals*) and examining their presence in four major scientific databases. Our results indicate that exclusively data journals are comprehensively indexed in Crossref and Dimensions, two relatively new scientific databases, which can be used to conduct future studies on data papers and journals. The next steps of our project are also discussed in this poster.

KEYWORDS

Data papers; Data journals; Scientific database; Quantitative science studies.

INTRODUCTION

Data publication has become an important framework to make data more transparent and accessible in scientific communities (Kratz & Strasser, 2014). A key implementation of this framework is to publish datasets into academic papers (i.e., *data papers*) that aim to describe data objects, in order to facilitate their sharing and reuse (Chavan & Penev, 2011). As a distinct academic genre from regular research articles, data papers have been increasingly investigated as a research object during the past few years (Kim, 2020; Li et al., 2020; Thelwall, 2020).

Since the late 2000s, more *data journals* have been created as the venue for the publication of data papers. Some of these journals have high impacts and popularity among researchers, such as *Scientific Data* and *Earth System Science Data* (Jiao & Darch, 2020), even though there is a strong variance across journals. Candela and colleagues offered a highly-cited survey of data journals that have been founded by the beginning of 2014, where they found seven *exclusively data journals* (i.e., journals that ONLY publish data papers) and over 100 *mixed data journals* (Candela et al., 2015). However, no other survey has been conducted on this rapidly developing topic since then to evaluate whether newer data journals have been created during subsequent years and particularly how these journals are covered by scientific databases. This has prevented data papers from being analyzed in large-scale studies.

This project aims to fill the gap by compiling a list of exclusively data journals and examining how these journals are indexed in the most popular scientific databases, including the Web of Science (WoS), Scopus, Crossref and Dimensions, to facilitate quantitative studies on this topic in the future. As the first step of this project, this poster reports methods and preliminary results of how we identified major exclusively data journals and queried their publications in the four databases. In the end of the poster, we also discussed the next steps of this project.

METHOD

We used the following resources to identify **data journals**: (1) Candela and colleagues' survey (Candela et al., 2015), (2) data journal lists created by academic libraries and other parties (One example is the list of data journals created by the University of Edinburgh: <https://www.wiki.ed.ac.uk/display/dataset+peer+review>) indexed by Google, (3) journals with "data" or "database" in the title included in the Journal Citation Reports or Scopus List of Journals, and (4) manual examination of whether the journal is a data journal or a regular research journal. From these sources, we further selected **exclusively data journals** based on the following criteria: (1) the journal primarily accepts data papers based on its scope, (2) the journal is active as of January 2021, and (3) the journal only publishes English-language articles.

The above steps were conducted from January to May 2021, and we identified 25 exclusively data journals that meet all criteria. For all these journals, we gathered information from their websites, especially when the journals were founded. Moreover, we also collected the numbers of publications being indexed in the Web of Science, Scopus, Crossref and Dimensions. For the latter task, we considered all publications from the 25 journals that are (1) in

English-language, (2) published by the end of 2020, and (3) being classified into either research articles or data papers in these four databases.

RESULTS

The list of all 25 exclusively data journals identified from this research has been deposited on Figshare (Li, 2021). Figure 1 summarizes the years in which these journals were established. We preliminarily separated the history of data journals into the three periods. While three journals were established before 2000 (all before 1975), none of them was covered by Candela's survey. Even though all these journals (most notably *Nuclear Data Sheets*) meet our criteria, we acknowledge that their publications may not be totally consistent with how data papers are defined today. More recently, the year of 2014 is also the year where six data journals were established, including *Scientific Data* and *Data in Brief*, two of the most important data journals.

Period	Journals
Before 2000	3
2000-2013	8
2014-2016	14

Table 1. Number of data journals established over time

Table 2 illustrates the number of journals and articles covered by the four databases. As shown in the table, the WoS and Scopus have rather limited coverage of these data journals, echoing existing evidence about how these databases index non-traditional materials, such as digital humanities journals (Spinaci et al., 2020). On the other side of the spectrum, however, Crossref and Dimensions have similar numbers of journals and publications from our journal list. This indicates that both of the latter databases may have strong potentials for future studies on data papers, despite the fact that more efforts are needed to understand differences between them, especially whether different publication types exist under their relatively coarse metadata.

Database	Journals	Publications
Web of Science	10	16,781
Scopus	16	21,046
Crossref	24	26,913
Dimensions	25	28,042

Table 2. Number of journals and publications from the journal list indexed in the four databases

CONCLUSION

This poster presents our methods to identify exclusively data journals as well as some preliminary results about how these 25 journals are indexed in the four major scientific databases that are frequently used in quantitative science studies. This work is the first step of establishing the infrastructure to support large-scale empirical studies on data papers. Our results show that more exclusively data journals have been founded since 2014, many of which are not covered by the previous survey. Moreover, we also found that both Crossref and Dimensions may serve as solid data sources for this line of research, given their comprehensive coverage of exclusively data journals. As compared, the Web of Science and Scopus, two most popular scientific databases, only cover around half of data journals in our list.

In the next step of this project, we plan to analyze how different publication types (especially data papers and research articles) from these journals are indexed in the databases over time. More importantly, we also plan to include mixed data journals into our analysis to more systematically understand the landscape of data publication. These efforts will contribute to future studies on the roles played by research data and data papers in the scholarly communication system.

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Interdisciplinary Collaborations in Digital Humanities: Evidence from Public-Funded Projects in China

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ABSTRACT

The term digital humanities (DH) has been much talked about for its interdisciplinarity since its conception. Existing studies have explored interdisciplinary collaboration in DH mainly from the perspective of academic literature rather than projects. By employing content analysis and social network analysis, this paper selects projects in the DH category of the key National Social Science Foundation of China for analysis, with an aim to discovering the structure and patterns of interdisciplinary collaboration in DH research. The preliminary findings show the collaborative relationships between disciplines and institutions as well as the characteristics of digital scholarship in DH research.

KEYWORDS

Digital humanities; Interdisciplinary collaboration; Institutional collaboration; Collaborative digital scholarship.

INTRODUCTION

The term digital humanities (DH) has been much talked about for its interdisciplinarity since its conception. The practice and development of DH cannot be achieved without interdisciplinary communication and collaboration. This collaboration is reflected in the interaction between different disciplines on the one hand, and the cooperation between institutions and agencies on the other. Existing studies have explored interdisciplinary collaboration in DH mainly from the perspective of academic literature using bibliometric methods (Su, 2020; Tang et al., 2017; Wang, 2017), while fewer studies have revealed the interdisciplinary characteristics of DH from the perspective of public-funded projects. We believe that compared to academic literature, the analysis of DH projects at the macro level can provide a clearer picture of interdisciplinary collaborations and thus better reveal the collaborative relationships between disciplines and institutions as well as the characteristics of digital scholarship. To fill this research gap, this paper selects projects in the DH category of the key National Social Science Foundation of China (NSSF) for analysis, with an aim to discovering the structure and patterns of interdisciplinary collaboration in DH research.

METHODS

The sample includes DH projects of the key NSSF collection between 2016 and 2018. The key projects of the NSSF were selected for analysis because of their significant academic impact and high transparency. After thematic coding and judging the projects manually, we selected 69 DH projects from the NSSF as the sample for analysis in this paper. The selection was based on (a) the explicit mention of DH in the project title; (b) the explicit mention of DH in the abstract and opening report of the project; and (c) the construction of databases, repositories, and platforms around the humanities in the project. For some projects where the attributes of DH are not clear, we further clarify them by contacting the principal investigators. We used an excel sheet to extract the following dimensions for further analysis, including project name, principal investigator and key team members, the disciplinary background of subject participants, collaborating institutions, disciplines to which the project belongs, team structure, project objectives and outcomes, tools, and techniques mentioned in the project, etc. Then we adopted social network analysis and content analysis to explore the interdisciplinary collaborations in DH research.

RESULTS

The Characteristics of Disciplinary Collaboration in DH

As shown in Figure 1, the DH projects show significant interdisciplinary characteristics, uncovering the related disciplines in humanities, social science, engineering, and natural sciences. Among them, history has the highest display in DH projects. In addition to the traditional humanities disciplines, library & information science (LIS) and computer science have played essential roles in the DH projects. A closer examination of the network shows higher frequency co-occurrence of some disciplines, such as History and LIS, Ethnic Studies and LIS, and Ethnic Studies and History. The statistical results show that the graph density of the network is 0.545, indicating that the disciplinary collaborations of these DH projects are relatively close.

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The Characteristics of Institutional Collaboration in DH



Figure 1. The network of interdisciplinary collaboration



Figure 2. Clustering of institutional collaboration network based on institution types

Figure 2 presents the clustering of institutional collaboration networks based on institution types. The different colored nodes in the network indicate various types of institutions, including universities, research organizations, cultural memory institutions (e.g., LAMs), IT companies, public and government sectors. We can see that universities (blue nodes), research institutions (yellow nodes) and LAMs (red nodes) are the three main types of organizations in institutional cooperation. Figure 3 shows several institutional collaborative communities formed by clustering based on the modularity results of the network. It is worth noting that LAMs are present in most of the communities. Combined with a content analysis of the project data, the results suggest that LAMs play bridging roles in DH collaborations (Poole, 2017; Sula, 2013).

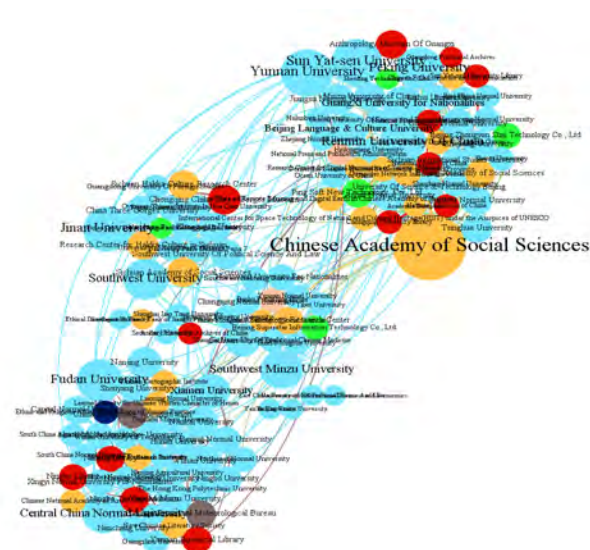


Figure 3. Clustering of institutional collaboration network based on modularity results

Collaborative Digital Scholarship in DH

The collaboration in DH projects is the typical embodiment of collaborative digital scholarship (Baillargeon et al., 2020). We identified three distinct models of collaborative digital scholarship through a content analysis, depending on the technology source of the DH projects. First, we found that some DH teams included both humanists and technologists in their composition. This type of digital scholarship is the most collaborative, with both teams conducting DH research through dialogues and joint workshops. Second, we observed that in some DH projects, information scholars play a vital role as a bridge, facilitating the translation and collaboration between humanities scholars and technologists in the project and effectively connecting the needs of humanities scholars with the practices of technologists. Third, many DH projects have adopted a technology outsourcing model, in which humanities research teams outsource part of the technical challenges, such as system development and database construction, to specialized teams, while humanities scholars still focus on fundamental research work.

FUTURE WORK

The next step of this ongoing work is to carry out semi-structured interviews with the project members of these DH projects to further explore the collaboration in DH research. We will interview scholars in the subject areas of these high-frequency collaborations to try to understand the purpose and manner of their collaboration. In addition, we will select typical cases to explore the dynamic role played by cultural memory institutions in DH projects.

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Investigating Learner's Online Learning Behavioural Changes during the COVID-19 Pandemic

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ABSTRACT

The objective of this study is to understand the pandemic's impact on online learning behaviour based on learners' comments collected from online video tutorials hosted on YouTube. The topic modelling approach is employed to uncover the changes in topic prevalence during the pre- and post-pandemic timeframe to infer learning behaviour. Ten topics were uncovered, and each exhibited a varying degree of changes over time. Overall, the study identified two learning behavioural changes, (1) learners were more active in learning relevant skillsets through sharing their experiences; and (2) learners had altered their help-seeking behaviour to aid in their learning.

KEYWORDS

Online learning, topic modelling, pandemic, YouTube, user-generated content.

INTRODUCTION

On March 12, 2020, the World Health Organization declared COVID-19 as a global pandemic after assessing the severity of the virus (World Health Organization, 2020). Many countries have taken unprecedented measures to lockdown the cities, including the closure of schools to curb the virus transmission. As a result, learning has changed drastically, seeing a sharp increase in online learning (Shah, 2020; YouTube, n.d.), whereby learners access the learning content remotely on a digital platform such as massive open online courses and video tutorial hosting sites. Amid the high participation rate, there are concerns about the pandemic's impact on online learning (Mheidly et al., 2020). Studies have since focused on areas, for example, learners' engagement, satisfaction, and perception of online learning (Alawamleh et al., 2020; Baber, 2020). There are also indications to suggest that the pandemic could affect behavioural changes in online activities (Popa et al., 2020; Rosa et al., 2020).

To date, there is limited study on the pandemic's impact on learners engaging in online video tutorials, in particular, on the use of learners' online comments to uncover changes in learning behaviour. Posting online comments allows learners to share their learning experiences publicly or even seek guidance or clarifications when they encounter learning difficulties. Past studies have shown that it is valuable to analyse comments to understand commenters' concerns or satisfaction (Chen et al., 2020; He et al., 2020; Lee et al., 2017), and feasible to use the computational technique to analyse user behaviour in an online environment (Kim & Cho, 2020). Thus, this study aims to address the current gap by proposing a topic modelling approach to analyse learners' online comments from the content hosting site, YouTube, to understand learners respond to online learning before and after the declaration of the pandemic.

METHOD

According to a report by World Economic Forum, many people have picked up coding as a new skill or reskill themselves as technology jobs were seen to provide better job security amid the COVID-19 pandemic (Marchant, 2021). As such, the dataset was built from a popular YouTube channel, the freeCodeCamp, that curated coding-related video tutorials and have a large number of subscribers. A total of 52,431 comments were collected from 24 video tutorials ($M = 2,185$, $SD = 3,437$) that had more than a million views and published before 2019. Structural topic modelling (STM) was used for analysis as it had the advantage to incorporate documents' metadata such as date into the model in the form of covariates to estimate the covariates' moderation effect on the topics (Roberts et al., 2013).

First, the comments were filtered to focus on the seven months before and after the pandemic announcement to assess for potential changes in the two periods. Words were extracted from the comments and pre-processed by removing stopwords, high-occurrence words, numbers, punctuations, and followed by auto-correction and lemmatisation of the remaining terms. Next, STM was used to uncover latent topics and compute the topic prevalence. Before building the STM model, the number of topics was evaluated using three metrics: held-out likelihood estimation, semantic coherence, and residuals (Naab & Sehl, 2016; Roberts et al., 2013). The STM model was then fine-tuned to obtain a good model fit determined by exclusivity and semantic coherence (Naab & Sehl,

2016). Topics generated were manually assigned with meaningful and representable labels to describe the topics based on the uncovered keywords and their associated comments.

RESULTS

The STM model uncovered ten topics and broadly grouped into two distinct categories: text-based topics and coding-based topics. Text-based topics consist of descriptive comments, while coding-based topics comprise primarily programming languages. For example, Topic 2 (*free, exam, pass*), categorised under text-based topics, reflected how learners engaged in the learning activities. Similarly, in Topic 6 (*work, error, create*), learners posted coding questions and codes related to technical errors, and thus categorised as coding-based topics. The text-based topics comprised Topic 2, 3, 8 and 10, were associated with *sharing learning practices*, *sharing compliments*, *sharing general feedback*, and *sharing specific feedback on video content*, respectively. The remaining six topics were coding related comments that constituted about 50.7% of the overall expected topic proportion. These topics included Topic 1 (*sharing learning achievement*), Topic 4 (*sharing clarifications*), Topic 5 (*sharing coding errors*), Topic 6 (*sharing technical errors*), Topic 7 (*sharing coding queries*), and Topic 9 (*sharing programming codes*).

The combined topic prevalence plot in Figure 1 showed that nine topics converged towards a similar topic proportion during T_2 , suggesting a shift in learning behaviours. Meanwhile, Topic 3 remains relatively high and stable throughout T_1 and T_2 compared to other topics. Figure 2 showed an example of the detailed topic prevalence plots for Topic 2 and 6 that exhibited a sharp rise and significant drop in the topic proportion leading towards T_2 , respectively.

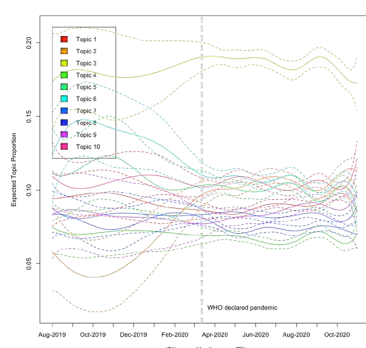


Figure 1. Combined topic prevalence

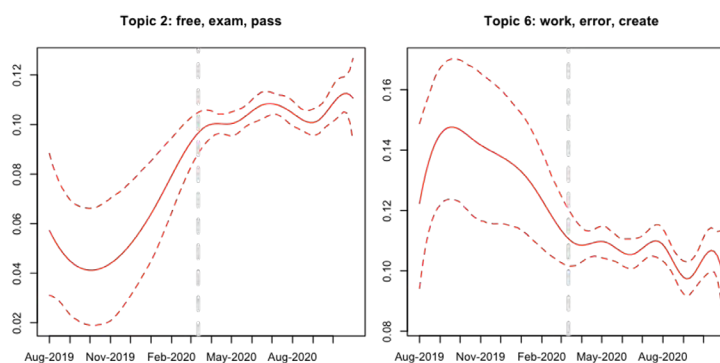


Figure 2. Topic prevalence over time for Topic 2 and 6

DISCUSSION AND CONCLUSION

This study presents a preliminary analysis on the use of topic modelling to study the pandemic's impact on learners engaging in online video tutorials and infer learning behaviour changes. Latent topics were first identified by the STM model, followed by computing the topics prevalence over the pre- and post-pandemic timeframe.

The topic prevalence plots showed that there were differences in learning behaviour between the pre- and post-pandemic. The convergence of the nine topics and the high fluctuation of the topics observed during T_2 reflected the pandemic's volatility and effects. This phenomenon could be attributed to the different lockdown periods among the various countries during T_2 and a higher take-up and completion rate of learning (Hirsch, 2020; YouTube, n.d.). In particular, Topic 2 and 6 exhibited the most significant changes in topic prevalence. Topic 2 offered a perspective that active learning occurred during T_2 when more learners shared their learning experiences during the lockdown period. The drop in Topic 6 suggested a possible change in the type of questions posted during T_2 . In sum, these changes highlighted events such as the pandemic could alter learners' concerns and learning focus. Thus, it is important for educators and content creators to quickly identify these changes to better address learners' needs and support them.

This preliminary study may be limited by the homonyms used among the comments. Thus, it required additional effort to ensure that the keywords generated were interpreted correctly against its associated comments. To address this, we plan to explore the use of semantic-based topic modelling to improve topic identification. In addition, this study focuses on coding-related learning and could not be generalised to other types of courses. Hence, we also plan to investigate other learning domains (e.g., learning languages). Against the backdrop of interrupted schooling from the pandemic where online learning will become more common and increasingly important, this study is critical and contributes to better understanding of how learners responded to online learning during the pandemic.

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XR Accessibility Initiatives in Academic Libraries

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ABSTRACT

Virtual reality and other extended reality (XR) technologies are being integrated into academic libraries to support research and teaching in innovative ways; however, new technologies are often adopted without considering disabled users. XR accessibility depends on establishing appropriate policies and best practices. This paper examines the current state of XR accessibility initiatives in academic libraries by reporting findings from a survey sent to the academic library community from February to May 2021.

KEYWORDS

virtual reality; academic libraries; accessibility; policies; institutional theory.

INTRODUCTION

With the release of affordable, consumer-grade virtual reality (VR) and other “XR” technologies (including augmented reality, etc.) over the last six years, academic libraries have quickly adopted them into their services and spaces (Cook and Lischer-Katz, 2019; Grayburn, 2019; Hurrell and Baker, 2020). XR technologies offer immersive, multi-sensory experiences that support a range of learning styles, and provide tools for analysis and pattern recognition for fields where data have a spatial dimension (Donalek, et al., 2014). XR technologies show great educational promise across diverse disciplines, including anthropology (Lischer-Katz et al., 2018), chemistry (Qin et al., 2021), interior design (Pober and Cook, 2016), and others. However, without proper consideration, XR technologies can exacerbate the exclusion of disabled users. This paper examines the current state of XR accessibility initiatives in academic libraries by reporting findings from a survey sent to the academic library community from February to May 2021.

LITERATURE REVIEW & BACKGROUND

Libraries have historically taken the lead in providing accessible information resources and spaces (Jaeger, 2018). Furthermore, academic libraries typically have general accessibility policies in place for their physical and digital resources and services, working to be in compliance with ADA (Americans with Disabilities Act) requirements (although a number of recent lawsuits suggest that libraries and academic institutions may fail to live up to these legal requirements, e.g., *Hunters Point Library*..., 2019; and McKenzie, 2018). Kazuye (2018) identified a number of library studies that examined accessibility methods for digital resources. Wentz et al. (2011) point to gaps in existing laws for supporting accessibility of online digital resources, emphasizing the importance of legal frameworks in facilitating accessible resources. Oud (2019) and Schomberg (2018) pointed to the exclusionary practices and mindsets that still bias library support for disabled librarians and users alike. Joint (2005) argued for focusing on customer service improvements rather than technological solutions. Current work in the field of XR accessibility has focused on developer toolkits and software plugins (e.g., *Accessibility Toolkit For Unity*, 2021; *UI Accessibility Plugin (UAP)*, 2021; *WalkinVR*, n.d.; Zhao et al., 2019), and on finding ways of using XR for therapeutic or pedagogical benefits (e.g., Chaves et al., 2021; Garzotto et al., 2018, 2017; Kellems et al., 2021; McMahon et al., 2020; Yiannoutsou et al., 2021).

The 2019 XR Access Symposium issued a report (2019) that stressed the importance of best practices and policies: “Participants agreed that the most urgent next step in the XR Access agenda is developing unified best practices for how to make XR technologies accessible” (p. 20). Few studies have examined XR accessibility at the level of library policy and institutional practices (Clark and Lischer-Katz, 2020), but establishing standards and practices is essential for ensuring the success of XR accessibility initiatives (Clark, 2021). International guidelines already exist for implementing XR technologies. In addition to the general framework offered by Web Content Accessibility Guidelines (2021), which specify how to make web content accessible to disabled people, other guidelines include: *Game Accessibility Guidelines* (n.d.), the *Digital Library Accessibility and Usability Guidelines (DLAUG) to Support Blind and Visually Impaired Users* (n.d.), and the W3C’s *XR Accessibility User Requirements* (2020), which is establishing principles for XR accessibility.

THEORETICAL FRAMEWORK

Institutional theory frames this project, guiding inquiry into the factors that shape adoption of XR accessibility policies in academic libraries. It draws on DiMaggio and Powell's (1983) *institutional isomorphism*, and W. Scott's (2003) idea of *institutional carriers*, which considers standards and guidelines as agents of organizational change.

METHODS

Data were generated using a 33-question Qualtrics-based online survey disseminated to the academic libraries community from February to May 2021. The survey was based on questions from the 2019 LYRASIS report, *Understanding the Landscape of Library Accessibility for Online Materials* (Rosen and Grogg, 2019), with modifications made to reflect this project's focus on XR. Surveys were sent out to library-related listservs and to library staff at 116 Association of Research Libraries (ARL)-member libraries.

RESEARCH QUESTIONS & FINDINGS

34 surveys were completed, with participants from 30 institutions (four of the institutions each had two participants). In their 2019 review of academic library websites, Greene and Groenendyk (2021) identified 33 ARL-member libraries hosting XR programs, thus this sample is fairly representative of current academic library XR programs. Participants' indicated their "highest educational degree attained" as follows: 14.29% (n=5) bachelors, 60.00% (n=21) masters, 22.86% (n=8) doctorate, and 2.86% (n=1) indicated "other." Participants indicated their professional identity as follows: 37.21% (n=16) as technologists, 34.88% (n=15) as librarians, 6.98% (n=3) as administrators, and 20.93% as "other" (n=9; 4 of which identified as instructional designers or educators).

RQ1: *What is the level of development of accessibility support for XR technologies in academic libraries?* The majority of institutions surveyed do not have policies or dedicated staff to support accessibility for XR technologies. When asked "Does your institution have an accessibility policy specifically for emerging technology spaces, services and/or technologies?" only 20.59% (n=7) reported "Yes"; however, 26.47% (n=9) reported that they were in the process of developing policies for XR accessibility. When asked "Does your department have staff specifically dedicated to accessibility?" two-thirds (67.65%, n=23) reported "No"; while 20.59% (n=7) reported "Yes"; and 11.76% (n=4) indicated "Not sure." Of the six libraries that have developed XR accessibility guidelines, 50% (n=3) indicated that they were planning on implementing them in the next 1-2 years. Of the nine libraries that were interested in guidelines, 44.44% (n=4) said they planned on developing and implementing them within 1-2 years.

RQ2: *What XR accessibility knowledge do library staff and administrators currently have?* Nearly all of the participants had some basic awareness of XR accessibility challenges (only 1 participant was completely unaware), but altogether, only a quarter of participants were either "very familiar" (20.59% n=7) or "extremely familiar" (5.88%, n=2) with accessibility challenges. Many participants were unfamiliar with specific accessibility guidelines: 55.88% (n=19) were "not familiar at all" with Game Accessibility Guidelines; 23.53% (n=8) with Section 508 of the Rehabilitation Act of 1973; 20.59% (n=7) with Web Content Accessibility Guidelines (WCAG); and 11.76% (n=4) with the ADA. Rather than looking to other institutions for guidance, many participants look to professional peers, through organizations and conferences (50.00%, n=17); to publications, including reports, scholarly articles, and newsletters from XR spaces (47.06%, n=16); to local and national library groups and communities of practice (44.12%, n=15); social media, forums, and listservs (29.41%, n=10); or to tech vendors and news (38.24%, n=13).

RQ3: *What are the main barriers to developing accessibility support for XR technologies in academic libraries?* The top three barriers to developing accessibility policies and processes identified by participants were: lack of staff knowledge (21.74%, n=20); lack of funding (17.39%, n=16); and lack of time (16.30%, n=15). The top three barriers to implementing accessibility policies and processes identified by participants were similar: lack of staff knowledge (20.21%, n=19); lack of time (20.21%, n=19); lack of funding (15.96%, n=15).

DISCUSSION & FURTHER RESEARCH

Findings suggest that XR accessibility in academic libraries is still developing. Policies and staff support are not currently in place, except within a few institutions, and staff are not always aware of all relevant guidelines. It is promising that many institutions have plans to develop guidelines soon; however, the barriers identified by participants are not easily addressed without advocacy at the institutional level. In terms of institutional theory, the fact that participants primarily look to their peers, community groups, and publications for new knowledge on XR suggests that *normative*, rather than *mimetic* or *coercive* pressures (DiMaggio and Powell, 1983) may be shaping efforts in libraries to adopt XR accessibility policies. Further research is also necessary to identify specific institutional and professional barriers to librarian knowledge and the development of XR accessibility initiatives.

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Exploring the Computational Recovery of the Typographical Logic of Book Indexes as Paratext for Improving Navigation within Digitized Historical Texts with Semantic Model

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ABSTRACT

The rapid growth in the number of digital texts has posed challenges for information professionals to make them more navigable and usable. These challenges have prompted researchers to develop different approaches to creating semantic descriptions for these resources aiming at more efficient and effective navigation and granular access to specific textual content. In this poster, we report on ongoing work that utilizes cluster-oriented machine learning algorithms to recover the logical relationships embedded in the typographical layout of book indexes, structures that are lost when standard page-level OCR scanning techniques are deployed on the index pages of digitized historical books. Recovering typographical logic would aid in the construction of semantic representation of indexes that can provide granular access to digital texts thus improving textual navigation.

KEYWORDS

Digital historical texts; Semantic description (RDF); Navigational paratext; Typographical logic; Layout analysis

INTRODUCTION

Gerard Genette introduced the concept of paratexts as functional agents that can “mediate the relations between text and reader” (Genette, 1997, p. xi). The book index, as one important class of paratextual element – “navigational paratext”, plays an important role in supporting readers’ understanding of textual content and text orientation by connecting readers with relevant information within a text (Birke & Christ, 2013). An important characteristic of the book index as a closed indexing system is the listing of the entities mentioned within a single book along with locators (page numbers) for each. This provides access points for more granular access to the content of a book, thus facilitating more precise and efficient information retrieval (Skare, 2020a, 2020b). A second characteristic of the book index is the role of indentation to indicate logical relationships between main entries and subentries of the index. We suggest that this role is an expression of a typographical logic that connects various related entities represented by the entries in a book index. The logical relations include hasPart / partOf and hasSubclass / subclassOf, and these relationships provide the framework to build the semantic data model for a knowledge graph as an overlay index that can serve as a paratextual element for text navigation. In this view, the book index represents the output of the indexer’s cognitive efforts in analyzing, synthesizing, and organizing the interrelationships of entities that are logically arranged via typographical indentation (Mulvany, 2009). In our examination of the index pages of books hosted by the HathiTrust Digital Library (HTDL), we found evidence of this problem (see Figure 1). The impact of this loss of typographical logic is the reduced functionality of these indexes as navigational paratext. In this poster, we report on our research into using cluster-based machine learning algorithms to computationally recover the typographical logic lost when conventional OCR techniques are applied to index pages of digitized historical books.

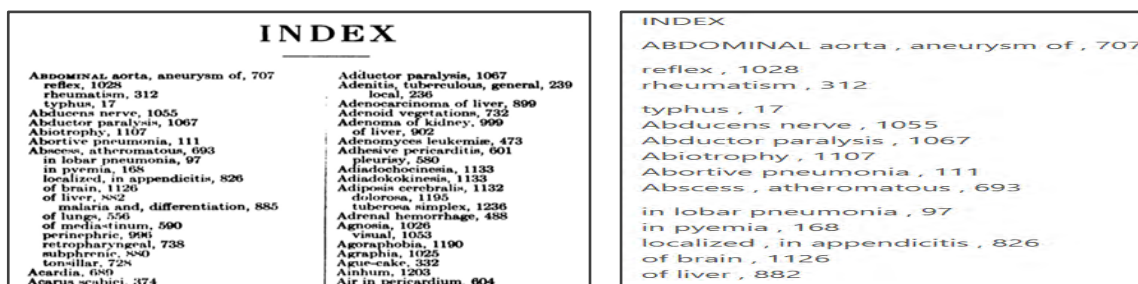


Figure 1. Sample page scan of an index page (left); OCR results of first column of index scanned (right); note the loss of typographical logic as reflected in lack of indentation and inconsistent line spacing.

METHOD

To address the issue of losing logical representation when scanning and OCRing digital documents, researchers have conducted layout analysis employing machine learning techniques to analyze, identify and classify different regions, such as titles, section headings, body text, captions, and figures in digital documents (Rahman & Finin, 2019; Stahl et al., 2018; Wei et al., 2013; Yang et al., 2017; Zulfikar et al., 2019). We extend the work on layout analysis to the classification of entries in the indexes of digitized historical books based on their spatial information. With respect to specific type of algorithm, several researchers have deployed cluster-oriented algorithms in their layout analysis tasks (Collins-Thompson & Nickolov, 2002; Klampfl & Kern, 2013). The essence of the approaches is to conduct cluster analysis on the physical structure of the document in order to detect or extract the embedded logical structure. We adopt the similar approach with different cluster algorithms to addressing our specific challenges in layout analysis of book indexes. The machine learning algorithms were implemented with the Python package provided by Scikit-learn.org (Pedregosa et al., 2011).

PROCEDURE

To prepare for the cluster analysis, the document is preprocessed with the Microsoft Azure Computer Vision service to generate bounding boxes with the positional coordinates for text blocks. The scanned pages contain different kinds of noise that negatively affect the extraction process, such as section headings, page numbers, and watermarks. To automatically eliminate noise based on the bounding box coordinates, the DBSCAN algorithm was employed as it can identify outliers based on the density of samples in a particular area (Ester et al., 1996; Ienco & Bordogna, 2018; Kurumalla & Rao, 2016; Schubert et al., 2017). In an index page, there is often a large gap between the entries from the left and right columns regarding their x coordinates, which makes it difficult to detect the hierarchical structure in the index. To avoid the issue, the entries from the two columns need to be separated and treated individually. To accomplish the task automatically, the K-Means algorithm is run on the x coordinates of all index entries and assign the entries into different groups based on their distance to the cluster centers (Arthur & Vassilvitskii, 2007; Dhanachandra et al., 2015; Likas et al., 2003). Another factor affecting the cluster analysis of digitized index pages is the rotation of the content in the scanned pages, which can result from the malalignment in the scanning process. The errors in the x coordinate of each text line resulted from the rotation can be estimated based on the rotation angle. If the maximum error surpasses a predetermined threshold of 5, the x coordinates of all the entries will go through a correction process. To detect the hierarchy of book index entries, the processing unit were generated from the output of previous steps which contains index entries along with their corrected coordinates from an individual column. In each processing unit, entries of different indent levels in the semantic hierarchy can be grouped based on their indentation, which is reflected by their left x coordinate measure. The Mean Shift algorithm is deployed for this entry classification task (Carreira-Perpiñán, 2015; Comaniciu & Meer, 2002; Wu & Yang, 2007). Based on the entries' relative horizontal distance with one another, the algorithm was able to determine several cluster centers and assign each data point into a particular cluster. According to the position of the cluster centers, the level of entries in the hierarchy from a particular cluster was determined.

EVALUATION

We measured the effectiveness of the pipeline by examining the accuracy of major steps (noise elimination, column separation, entry classification) as they employ different clustering algorithms. The noise elimination with the DBSCAN algorithm achieved an accuracy of 95.4%. The column segmentation with the K-Means algorithm showed an accuracy of 98.2%. The entry classification process with the Mean Shift algorithm had an accuracy of 93.8%.

CONCLUSION

Book indexes as navigational paratext play an important role in facilitating access to the textual content of books at a granular level, which makes problematic the loss of such navigational functionality in digitized historical book indexes. To recover this functionality, this research explored a computational approach employing cluster-based machine learning algorithms to automatically recover the typographical logic and then extracted the hierarchical relationship embedded in the physical layout of the indexes of digitized historical books so that the relationships can provide the logical framework for a knowledge graph as overlay index. The pipeline from document preprocessing to entry classification was presented, and the result of an initial testing on samples from a collection in the HathiTrust Digital Library showed satisfactory. Further work will focus on the introduction of rule-based mechanisms that accommodate layout variations expected across the large number of digitized historical books.

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Impact of Gain-Loss Message Framing on Bedtime Procrastination of College Students: From the Perspective of the Powerful Effect Theory

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ABSTRACT

Bedtime procrastination leads to hormonal and immune disruption, especially for college students who tend to stay up late on their own initiatives. Previous studies showed effectiveness of the message framing in smoking cessation and physical disorder by presenting gain and loss information. We try to explore the effect of message framing on college students' bedtime procrastination behavior, also the powerful effect theory was combined into our approach to augment the acceptance of gain and loss information. The ongoing study recruits 3 groups of participants (experimental group A, B and control group C), each group will be recorded of their information acceptance and behavior changes by bedtime procrastination scale for 4 weeks. Initial findings suggest that our research design is feasible and indicate the possibility of improvement in bedtime procrastination scale. This study shows light on combining communication theory and health behavior changes.

KEYWORDS

Gain-Loss Message Framing; Bedtime Procrastination; Powerful Effect Theory; Health Communication.

INTRODUCTION

Bedtime procrastination refers to the behavior that individuals habitually postpone their scheduled bedtime when they have choices (Kroese et al, 2014). Xu (2017) investigated the lack of sleep among college students in China, and indicated that the bedtime was not equal to sleep time, in the absence of external obstacles or physiological factors, individuals voluntarily chose to postpone their predetermined bedtime instead of going to bed straightly. There are many causes of this, including an aversion to everyday tasks that must be done before bed, such as brushing the teeth, and being immersed in activities such as playing mobile phones (Nauts et al, 2016). Studies have shown that the lack of sleep associated with habitual bedtime procrastination leads to hormonal and immune disruption, putting people at risk for diabetes, obesity, cancer, cardiovascular disease etc. However, statistics from the *China Sleep Index 2020* shows 58.9% people stayed up more than three times a week on average. Among them, 49.4% chose to stay up late on their own initiatives, 52.5% of them were born after the 1990s. Researches tried to study bedtime procrastination interventions for college students. However, few studies have considered the effectiveness of gain-loss message framing. According to gain-loss message framing, one of the two message forms might be more effective in the intervention of certain behaviour, gain-framed messages or loss-framed messages respectively (Divdar et al., 2021). This study tries to explore the intervention strategy of bedtime procrastination based on the message framing effect to provide a new idea for the intervention of bedtime procrastination, and the powerful effect theory is also hybridized into the study frame work, adding the perspective of health communication.

RELATED LITERATURE

Many factors are associated with bedtime procrastination. Nauts et al. (2016) distinguish between genuine procrastinators (needlessly delay their bedtime), and strategic delayers (self-label as a procrastinator, delay their bedtime in order to achieve intended objectives). Bernecker and Job (2020) find that after a stressful day, people with a limited theory (this argues that willpower is a limited resource that will be consumed by activities requiring self-control) versus non-limited theory (this argues that willpower is not limited) procrastinate more on going to bed, while there is no difference in bedtime procrastination on less stressful days.

Bedtime procrastination interventions can be divided into technical approaches and health communication approaches. Zhang et al. (2016) carry out appropriate health education intervention. The results showed that the degree of bedtime procrastination in the experimental group was significantly lower than that in the control group, which means that health education could effectively improve the awareness of sleeping late and influence the sleeping behavior of the students. Previous studies showed that application of health communication theories can improve effectiveness of health intervention. For example, the powerful effect theory has been proved to reduce the incidence of heart disease through health communication, and suggested the possibility of exerting the

communication influence (Meyer et al, 1980). The powerful effect theory suggests that a message transmitted repeatedly over a period of time will be more effective than a message transmitted only once (Meyer et al., 1980). Gain- versus loss-framed messages have been used in many fields, such as antismoking (Zhao & Nan, 2010) and influencing the physical activity in individuals with multiple sclerosis (Lithopoulos et al, 2017). However, few existing theory-based behavioral interventions, especially from the perspective of health communication, are developed to reduce bedtime procrastination. This study attempts to explore the intervention effect of message framing on college students' bedtime procrastination behavior from the perspective of health communication.

RESEARCH METHODS

Subjects: 30 students (equal number of males and females) were selected in college and randomly divided into three groups (experimental group A, experimental group B, and control group C) equally in number and sex. The demographic characteristics of the three groups were basically matched.

Research Tools:

(1) Seven texts of loss-framed text and seven texts of gain-framed text. Gain-framed text emphasizes that compliance to a certain behavior will result in some positive and good results. Loss-framed text emphasizes that if you don't conform to an action, there will be some negative, bad outcome. One example of the seven gain-framed texts and loss-framed texts are as table 1. (2) Bedtime procrastination scale. Kroese et al. (2014) developed a 9-item scale to assess bedtime procrastination (Cronbach's $\alpha = 0.92$). The scoring method of Likert Scale was adopted, with numbers from 1 to 5 indicating "never" to "always". The later studies proved its good reliability and validity (Kamphorst et al., 2018). (3) Data analysis. Data from the bedtime procrastination scale will be analyzed in SPSS. Firstly, ANOVA will be used to compare the mean variables of three groups. Then, I will adopt paired t-test to compare the mean variables before and after the intervention.

Gain-Framed Text	Loss-Framed Text
<i>There are many benefits to going to bed early. 1 help maintain weight... 2 a stronger immune system... 3 make one look very lively and young... 4 it can improve your memory...</i>	<i>Staying up late will do great harm to health. 1 lead to overweight and obesity... 2 worsen the physique... 3 decline in the body's immunity... 4 decline in memory and concentration.</i>

Table 1. Example of gain-framed text and loss-framed text

Study Design: All subjects were required to take a bedtime procrastination scale on the first day. Then, a gain-framed text and a loss-framed text were sent to experimental group A and B every second day during the experiment, and the subjects need to read the received text before going to bed. The control group received no text. According to the powerful effect theory, it is more effective to sending these texts repeatedly over a period of time. Besides, the experimental duration of prior researches were about 4 months (Divdar et al., 2021; Rafieyan-Kopaei et al., 2019). Considering the complexity of this study and the purpose of looking for a shorter but still effective intervention time, the process of sending text will last for only 4 weeks.

PILOT STUDY

In the pilot study, two college students were asked to fill in the bedtime procrastination scale at the beginning (also at the end of the study), then to read texts allocated to them before bedtime. It proves that the study design is basically feasible. The structure and expression of the texts are clear and understandable, and the length are acceptable. Both scale and analysis tools utilized are practical. However, the bedtime procrastination scale may need to be further improved to distinguish between the bed time and sleep time.

DISCUSSION AND FUTURE STUDY

Through the pilot study, I found that the average score of them on the bedtime procrastination scale was 33.5 points (full score is 45 points), which was consistent with their self-cognition, indicating that the bedtime procrastination scale was relatively applicable. In addition, the subjects should be asked to take the bedtime procrastination scale again at the end of the study, in order to compare the data with the original results.

The undergoing research has recruited 30 college students (15 males and 15 females). Data collection and analysis from the subjects are in the process and the effectiveness of gain-loss message framing in bedtime procrastination needs further exploration.

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Modeling the Preferences of Demographical Reading History: A Primary Case Study of a Public Library in Shanghai

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ABSTRACT

Reading habits are influenced by various aspects, such as personal characteristics, reading history and book characteristics. It remains uncertain that which factor determines reader's choice. In this primary work, we attempt to model the preferences based on readers' demographical information to examine the impact factors on their reading habits. We selected all the reading information of Shanghai Pudong Library in 2015 as the dataset. By applying the logistical regression and likelihood ratio tests, we found that readers' stickiness, gender, and books' publication time significantly influence readers' preferences. Future work will focus on facilitating the model and expanding the data.

KEYWORDS

Reading Habits; Public Library; Reading Preferences; User study.

INTRODUCTION

Understanding readers' reading interests and habits plays an important role in information recommendation and prediction of best-seller books. The current methods for information recommendation mostly focus on questionnaire and content analysis of readers' comment and reading history (Pera & Yiu-Kai, 2018). This research attempted to use large-scale data analysis to analyze reader's demographical information in the library, the reading history, the reading preferences, and the stickiness for a public library. To this end, we eventually can recommend books to readers, and in the meantime suggest libraries import worthwhile books.

RESEARCH DESIGN

Sample collection and process

The dataset of reading information in 2015 was requested from Pudong Library, a major public library in Shanghai, China. It includes three components, (1) 117,376 readers' demographical information, such as readers' ID, the ID created date, and the gender, and (2) 662,047 books' information that readers had borrowed, such as book ID, title, publisher, publication time, and Chinese Library Classification (CLC), as well as (3) 4,264,301 records of the borrowing information between readers and books including each borrowing and returning time.

The content of books will be identified by CLC, which is composed of 22 categories, entitled by capital letters A to Z. The stickiness of a reader for this library will be represented by the period from ID created year till 2015.

Data analysis

We used the logistic regression model to explore the factors influencing readers' borrowing behavior. Hypothetically the content of interest of readers, which is represented by the CLC category, can be influenced by reader's stickiness, gender, and books' publication time. The CLC categories was set as the dependent variables and assigned to the numbers of 1 to 22. The stickiness, gender, and books' publication time were set as the independent variables. χ^2 test was applied to test if independent variables are related to the selection reference of book contents. Likelihood ratio method was used to test the effect of model fitting. Regression coefficient B and Significance were used to express the model calculation results.

RESULTS

Descriptive results of the relationship between readers and books

In Figure 1 (left), we can see that readers who have been consistent with this library for less than 10 years and between 20 to 30 years occupy the largest reader population in 2015. Other readers, especially the readers who created longer than 40 years are unlikely active this year. Figure 1 (right) tells us that new books (5 years old of publishing time) are more popular than older books. Figure 2 illustrates the borrowing preferences in terms of content. Books in the Class I (literature), followed by K (history), T (industry technology), H (linguistic), F (economics), and G (cultural and education), have been borrowed the most and the most frequently. However, averagely speaking, due to the larger reader population in the above categories, the averages of borrowed times

appeal to be reversed as the absolute numbers. It infers a purchasing demand of books in the popular categories to increase the average borrowed times.

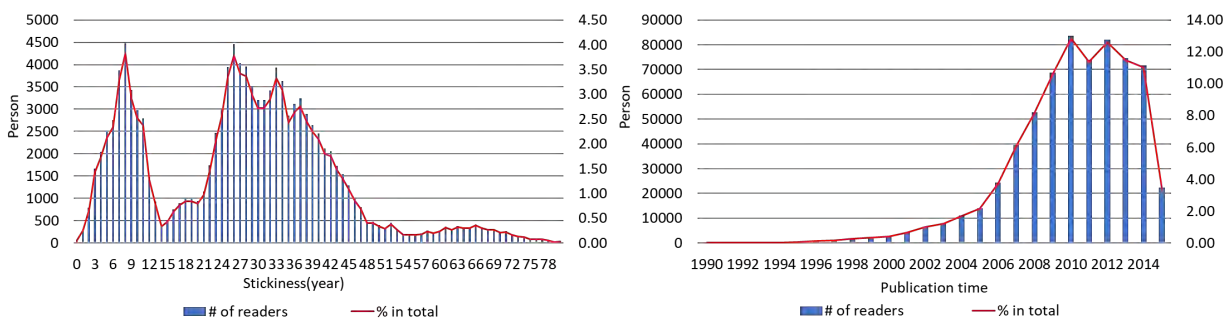


Figure 1. The time distribution of readers (left) and books (right)

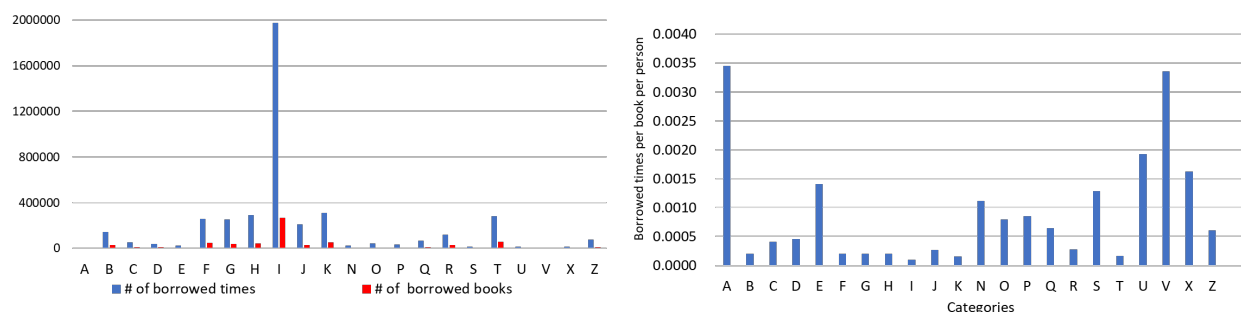


Figure 2. Comparison of the numbers of borrowing times by category (total and average)

Modeling the relationship between readers and books

Likelihood ratio test results showed the model fits well with significance differences. All the k values of three independent variables (15095.816***, 952733.855***, 78773.860***) are much greater than 0, which indicates the impact of them on the dependent variable are significant. Figure 3 illustrates the estimation in the model for one of the parameters. The gender difference is significant in terms of book selection. Male readers tend to borrow books in Class E (military), U (transportation), and V (aerospace), while unlikely to read literature and linguistic books.

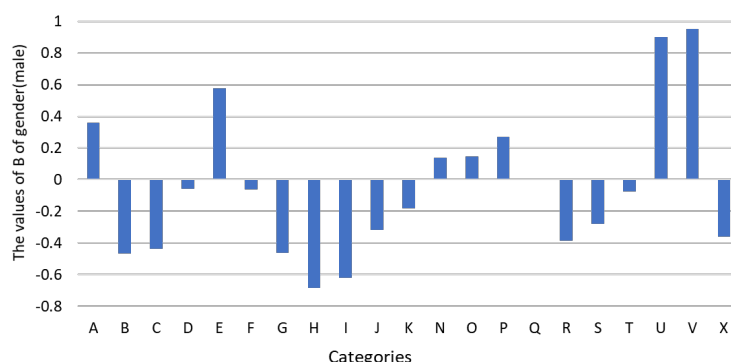


Figure 3. The parameter estimation in different categories (gender)

CONCLUSION AND FUTURE WORK

In this primary work, we found readers' stickiness, gender, and books' publication time significantly influence readers' preferences. We can provide new ideas for library purchasing decision-making and the library can recommend books to readers based on these factors. However, in the future work, more factors will be taken into consideration to conduct a thorough model, such as the writers and publishers of books, and the borrowing duration. We will try to request more information in multiple years as well.

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A Structural Topic Model Analysis of Privacy in Mandarin Chinese News: 2010-2019

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ABSTRACT

This poster presents a study that analyzes privacy using a 10-year privacy news corpus in Mandarin Chinese, using an unsupervised machine learning technique, structural topic modeling (stm). The 13 topics revealed several dimensions for understanding privacy in the Chinese language, including how privacy is concerned, by who, and in what context/domain. This study is one of the first empirically-rounded explorations of the concept of privacy in the current Chinese language. Findings from this study could be used to further the discussion and investigation to understand privacy as an intercultural information ethics concept.

KEYWORDS

Privacy; topic model; news; Chinese language; natural language processing.

INTRODUCTION

This study is the first empirically-grounded exploration of privacy in Mandarin Chinese using a decade's news corpora. This study serves as a first step to map out the rich meanings of privacy in Mandarin Chinese, based on which continued discussions can move on to explore "what should different cultures share" (Wong, 2009). This mapping of privacy is particularly needed for the Chinese language given the rapid change that this language has gone through. This study seeks to explore two research questions. **RQ1:** What are some of the most notable topics that can be observed in the corpus regarding privacy? **RQ2:** What are some of the trends or patterns that topics of privacy demonstrate?

DATA & METHOD

A 10-year (2010-01-01 to 2019-12-31) news corpus in simplified Mandarin Chinese from mainland China with "privacy" (yinsi, 隐私) in news titles were purchased from a data vendor, Wisers. The corpus went through cleaning and preprocessing using the *nltk* package (Bird et al., 2009), in addition to segmentation and transforming potential traditional characters to simplified Chinese characters. Afterwards, a structural topic modeling (stm) (Roberts et al., 2014b) was performed using R (Roberts et al., 2018). The hyperparameter *K* that indicates the number of topics was set to be 13 by using the *coherence-exclusivity score* (Roberts et al., 2014a).

RESULTS & DISCUSSION

Internet and mobile applications as the major context of privacy concerns

In the leading topic Topic 12 (see Figure 1.) "personal information", "internet" among the highest probable topic words. This suggests that privacy is seen as equals "personal information" on the "internet". In addition, privacy appears to be in high association with some of the most popular Internet/mobile applications in China, including "Alipay" (which is the leading mobile payment app), and "Ctrip" (which is one of the leading online booking platforms), both have hundreds of millions of monthly active users. The presence of these mobile apps suggests that understanding of privacy is associated with the practices of these apps in terms of if and how they are acting to protect users' privacy. Similarly, Topic 10 is filled with words like "smartphone", "mobile user", etc.

Government leading the protection of consumer privacy

In Topic 12, words like "China Consumer Association", and "Cybersecurity Week" (which is a recurring annual event hosted by the Cyberspace administration office of China), and a person name "Jianjun Yang" (who is the associate director of the China Electronics Standardization Institute), all suggests that the *government* and government-driven initiatives are another important thread of ongoing privacy discourse. This sense of government-led privacy protection can be seen in Topic 7.

Privacy at Offline Domains: Surveillance Camera, Health Information, and Court Information

There are distinctive offline domains each refers to a specific industry/domain of practice, as reflected through Topic 3 (camera surveillance at public places), Topic 4 (healthcare record), and Topic 9 (legal record related to teenagers).

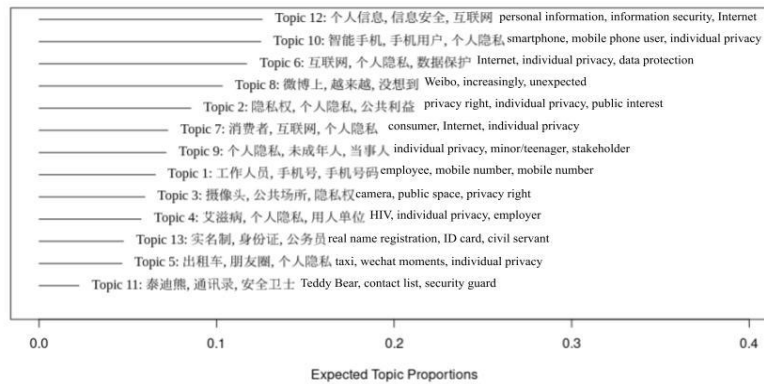


Figure 1. 13 topics in descending order of topic proportion and the top probable words

Top topics (Topics 12, 10, and 6) are all associated with some of the most popular internet and mobile applications, and mobile phones. Top topic words in topic 6 include “internet”, “personal privacy”, “data protection”, “browser”, “electric protector”, “third-party”, and “the Administration” (which refers to the Cyberspace Administration of China). Top topic words in topic 10 include “smartphone”, “mobile user”, “personal privacy”, “contact”, “internet service provider”, “application”, “QR code”. The high proportions of these three topics do suggest that what’s partly driving discussions of privacy in the news are problems of privacy in these technological applications as they get adopted by an increasing number of users. The topic prevalence plot over time (see Figure 2.) revealed a peak of topic proportion around 2018 and 2019 in topics 5, 6, and 7. It appears that the peaks of topic proportion were likely associated with some of the domestic regulation and legislation progress, as 2018 was the year China had seen multiple regulation and legislation progress related to privacy (Luo, et al., 2019).

The pervasive theme: privacy of the individual

“Individual privacy”(个人隐私) is present in 10 out of all 13 topics, which suggests that there is a prevalent sense of considering privacy as an individual’s issue, in addition to consumer protection. It also suggest that protection of privacy as protecting individual’s interest has become a common understanding underlying many ongoing privacy discussions in the Chinese news.

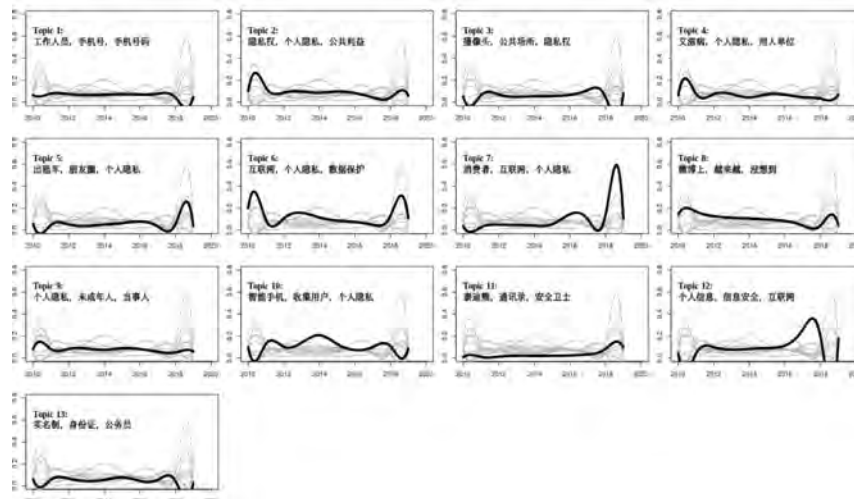


Figure 2. A Plot of 13 Topics and Proportions for 2010-2019

CONCLUSION

There are two limitations of this study. Firstly, because this study only works with news corpus, hence the findings are inherently limited by this particular genre of natural language when it comes to mapping out the semantics of privacy in the Mandarin Chinese language. Secondly, this study primarily relies on computational results; though it resorts to checking the original documents as a way to validate the topic modeling results, a strengthened way of validation may need to compare the results from topic modeling to independent human interpretation. With these limitations in mind, this study still provides a dissection of the concept of privacy as it lives and keeps evolving in Chinese society.

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Written News Search Engines and Retrieval Systems of the Databases of Spanish Digital Newspapers

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ABSTRACT

In light of the dearth of empirical studies of the quality of the databases of Spanish digital newspapers, this paper delves into the issue. Accordingly, the databases of 55 Spanish digital general newspapers were examined for the purpose of determining the quality of their retrospective written news search engines and retrieval systems. The results indicate the following: (1) the vast majority of the databases analysed employ search models based exclusively on a calendar or text box, thus hindering the selective retrieval of information; (b) a large proportion of these databases do not allow users to employ several fields in order to filter and narrow down their searches; and (3) all the online news databases lack search guides and controlled vocabularies or thesauruses. From these findings it is possible to infer that the majority of the databases of the Spanish digital press are, as a rule, rudimentary and inefficient.

KEYWORDS

Search engines and retrieval systems; news databases; Spanish digital newspapers; journalistic content curation.

INTRODUCTION

Despite the importance that journalistic content curation has for the study of the efficiency of the search engines and retrieval systems of news databases (increasingly more numerous), few studies have been performed in this respect in Spain. Most research was conducted at the end of the twentieth and at the beginning of the twenty-first century (Fuentes and González, 1998; Jiménez, González and Fuentes, 1999, 2000; García and González, 2001; Crestani, De la Fuente and Vegas, 2001; Bechini, Burguillos and Díaz, 2001; Abadal, 2002; Rodríguez y Giménez, 2004; Martínez, 2008; Guallar and Abadal, 2009, 2010; Guallar, 2012; Nuño, 2014). All these authors concur that the selective retrieval of information requires documentary databases that allow for combining several search fields (both descriptive and content-related), in order to enable users to filter and narrow down the results obtained until encountering those news pieces of real interest to them.

The rapid and efficient retrieval of information is an inherent aspect of the very nature of databases. If, on the contrary, users are obliged to waste time and effort in finding the news that they are looking for from among the many available documents, the database in question is clearly inefficient.

Given the lack of studies addressing this issue in recent years, and in light of the important growth of digital newspapers in Spain, the intention here is to determine whether or not there have been any improvements in their written news search engines and retrieval systems, thus picking up from where previous research has left off.

RESEARCH OBJECTIVES AND METHODOLOGY

The main research objective was to analyse the search engines currently employed by digital general newspapers in Spain. This general objective was then broken down into three more specific ones:

- 1) To explore the different types of public, free-access search models that these Spanish digital newspapers offer users for retrieving news pieces stored in their databases.
- 2) To determine the fields that are most frequently used by the databases of these digital newspapers.
- 3) To confirm the presence or absence of search guides for users and controlled vocabularies or thesauruses which facilitate and expedite selective information searches.

Employing a qualitative exploratory method, the search engines of practically all of the Spanish general newspapers with digital versions—totalling 55—were reviewed.

The model proposed by the Brazilian authoress Cunha (1989) for the documentary analysis of press reports provided the universal categories that a database should include so as to allow for the selective search for news content. Accordingly, the basic descriptive fields considered here were as follows: section, date, author, front page and genre (news story or opinion piece); and with respect to the content fields: topic, characters/objects and places.

RESULTS AND DISCUSSION

It is common knowledge that the quality of a database is gauged by the ease with which documents stored in it can be retrieved. In order for this retrieval to be efficient and selective, it is essential that there be professional search engines that enable users to perform the most precise queries possible.

The first research objective was to explore the different search models employed by the 55 general newspapers with digital versions in Spain. The results (see Table 1) point to the existence of three different types of tools for retrieving retrospective written news pieces. The most frequent (54.6 per cent) are those that employ simple searches, based on a text box for information retrieval. These are followed by those (29 per cent) that use a search interface that correlates several fields, although this combination tends to be very poor. The most common search engines feature two or three fields (11 newspapers), while those with five or six fields are unusual (only two newspapers). Lastly, the least frequent are solely calendar-based (16.4 per cent).

As to the second research objective, namely, to identify the fields most habitually used by the databases of the digital newspapers under study, the results show, on the one hand (see Table 2), the very infrequent use of those descriptive fields that are considered as basic for filtering searches. Indeed, only 1.8 per cent of the newspapers include a genre field, 3.6 per cent author and front-page fields, 18.2 per cent a section field and, lastly, 38.2 per cent a date field, this also being the only one for searching for information in 9 per cent of the cases. On the other, and in contrast, the Spanish digital newspaper analysed here appear to attach greater importance to content fields. Specifically, users can search for information by 'topic', 'characters' or 'place' in 83.6 per cent of the cases, albeit using only one of these categories. Only the newspaper *ABC* (with print and digital versions) allows users to combine the 'topic' and 'place' fields.

The third research objective was to determine whether or not the online news databases featured search guides or controlled vocabularies (thesauruses). The results indicate that none of the newspapers provide search guides or a thesaurus enabling users to choose concepts so as to narrow down their queries. It is surprising that these elements, so essential to search engines, are conspicuous by their absence in the databases analysed.

In sum, the lack of descriptive and content filters, as well as search guides and thesauruses, gives rise to a series of complications, such as documentary noise or silence (caused by synonymy, polysemy, imprecision and terminological ambiguity), two of the most frequent problems of these databases, thus making the efficient retrieval of retrospective journalistic information very difficult.

	Text-box-based	Based on a combination of fields	Calendar-based
Newspapers	30 (54.6%)	16 (29%)	9 (16.4%)

Table 1. Information search and retrieval models

	DESCRIPTIVE FIELDS					CONTENT FIELDS		
	Date	Section	Author	Front page	Genre	Topic	Characters	Places
Newspapers	21 (38.2%)	10 (18.2%)	2 (3.6%)	2 (3.6%)	1 (1.8%)	46 (83.6%)	46 (83.6%)	46 (83.6%)

Table 2. Search fields

CONCLUSIONS

We have observed many shortcomings in a large proportion of the search engines and information retrieval systems of the Spanish digital newspapers analysed in our study. Features like several search fields, which are a matter of course in professional databases, are all but non-existent in those of these digital newspapers. Likewise, they lack search guides and controlled vocabularies (thesauruses) that allow users to narrow down their searches. In conclusion, the majority of public, free-access databases of Spanish digital newspapers are currently very rudimentary and a long way from satisfying the requirements of the selective search for news stories or opinion pieces. If this shortcoming is not remedied and if the volume of online news archives continues to increase, there will come a time when information overload will make the precise and exhaustive retrieval of retrospective press information inviable, thus losing many of the stories preserved in these databases: news, opinion pieces, reports and so forth, documents that form part of the rich collective memory in Spain.

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Towards Identifying, Understanding and Controlling Cumulative Revelations in Social Media

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ABSTRACT

Every day, people post information about themselves and others on online social networks, making such information accessible within their social circles but also, potentially, way beyond. While the information posted may seem benign or innocuous, small pieces of information, when tied together, can potentially reveal much more about the person than intended. Such cumulative revelations could expose them to risks such as identity theft, fraud or loss of employment. This paper describes findings from interviews about people's online interactions, focusing on their requirements and desires for improved ways to identify, understand and control cumulative revelations arising from their social media profiles that could put them at risk of grave consequences. These findings motivate our future work on how to better raise awareness among social media users of the risks and consequences to which combinations of posts may lead.

KEYWORDS

Social Media, Online Social Networks, Personal Information Sharing, Cumulative Revelations.

INTRODUCTION

Online Social Networks (OSNs) allow people to construct personalised profiles, post content and build connections with others. Such actions enable people to introduce themselves online while expressing their personality, thoughts, feelings, and sharing personal information (e.g., birthday, location, school, etc.) (Krasnova et al., 2010; Xia et al., 2013; Haimson et al., 2016). While small pieces of information shared online by or about a person may seem harmless, over time they may reveal cumulatively more than the person intends, as identifiable traces can be linked then exploited. Such linking leads to “cumulative revelations”, for instance, geo-tagged posts could reveal a home address, while posts from the airport about a trip away, could give sufficient clues to thieves to target a home. Meanwhile, a social media user may lament online about living alone, while sharing check-ins at cafes and running routes. Taken together, a stalker may infer that the person is vulnerable and follow or otherwise target them. Further, the combination of many posts may reveal aspects of a person's personality, preferences (e.g. politics) and even their mental health, such traits being increasingly detectable via machine learning tools. When coupled with machine learning capabilities, the abundance of information online about social media users constitutes a major privacy exposure risk and could, potentially, have serious negative consequences for an individual e.g., via identity theft (Acquisti and Gross, 2009), financial loss, damage to reputation (Chen et al., 2016), cyberattacks or reputational damage for their employer. There could even be risks to national security (Dressler et al., 2015). Previous studies have highlighted risks and consequences of revealing information online, and e.g. the trade-offs of doing so e.g. (Min et al., 2014; Vishwanath et al., 2018) but little research has investigated social media users' understanding of risks and consequences from combinations of traces, and how people conceive of, and control social media usage given such risks. This work contributes to our understanding of these phenomena and outlines some requirements for tools to manage such risks.

OVERVIEW OF STUDY

To investigate cumulative revelations in social media, we conducted semi-structured interviews to inquire about information sharing habits, social media use and digital traces, with additional exploration of effects of the pandemic lockdown and homeworking. We asked participants about the private and public aspects of online information sharing, explored the personal and professional contexts of information sharing, and their experiences of cumulative revelation, whether direct or observed. We interviewed 26 people aged 20-59 years, (13m, 12f, 1nb), in employment in the UK, May-July 2020. Interviews were conducted via videoconferencing, each lasting 60-90 minutes. Participants received a shopping voucher (approx. \$30 USD). Interviews were audio recorded, transcribed, then coded and analysed thematically (Braun and Clarke, 2006), using NVivo software. Analysis drew out similarities

and variations between participants' practices, with coding reducing the data into themes. We summarise key findings organised as follows:

- (i) concerns and fears about social media usage
- (ii) control over social media streams
- (iii) awareness of risks and consequences of using social media
- (iv) reflections on risks of own usage of social media

Concerns: Fears about Social Media Usage

Participants feared that very detailed information about them (e.g. from location tracking) could be shared without permission by (or be stolen from) “big tech firms”. They feared this information could be used to target them with advertising or content in a way they could not understand or control. An additional concern was that information collected about them (e.g., date of birth, address, credit score, images) could be used to cause them harm (e.g. via identity or financial fraud). For those <25 years old, there were concerns that childhood online activities would be visible to new peers or potential employers, causing embarrassment or compromising professionalism. For participants from or wishing to visit authoritarian countries, there were worries that governments could collect their information and use it against them e.g. to deny visas or right to remain, or to sanction them for inciting political unrest etc.

Control: Over Social Media

Participants had desires regarding social media and controls they wished were available. Specifically, the ability to easily:

- Correct false online information about themselves
- Remove/delete online shared information permanently
- Prevent data aggregation of their information across sites and usage
- Filter the audience for their shared information

Participants also stipulated that social media sites should present to users (in an easy to understand and usable manner) the information held about them. In addition, any tools developed to help manage their online postings should also assure data protection i.e. would not collect and store their information in the manner of many social media companies.

Awareness: Understanding the Risks and Consequences of Using Social Media

Given that social media users often do not know the consequences of sharing certain information, participants suggested that training or education should be available to help raise awareness about the potential for cumulative revelation from social media usage by: (i) giving advice on how to protect one's personal information, and (ii) showing how to avoid revealing details which can be combined together, increasing the risks of harmful consequences.

Reflections: Identifying Risks in One's Social Media Profiles

Most participants did not have a clear sense of the image they projected to others online or how it might be interpreted. Increased and novel use of social media due to the lockdown and homeworking meant that for many it had become even more of a challenge keeping track of their digital traces. They desired to see more clearly the picture they present online via visualisation of their online information where they could: identify and flag false, misleading or outdated information about themselves, remove, delete or hide any past shared online information and be able to compare how much information they shared about themselves relative to other social media users. Many participants indicated the importance of simplicity and ease of use of a tool that would help them control, identify and understand their information, emphasising that it should be usable by people at particular risk online e.g. older people and children.

SUMMARY AND FUTURE WORK

This paper presented themes emerging from a qualitative study of cumulative revelations in personal information shared online. Participants expressed fears about their online activity, discussed the types of information they tended to share, and outlined how their desires and needs for safer online activity might translate to requirements for tools to manage this. Our next steps will be to further investigate these fears, before developing appropriate technological and other interventions to mitigate risky social media usage that can lead to such revelations and associated consequences.

ACKNOWLEDGMENTS

This work was supported by grant EP/R033889/1 and was subject to approval by the ethics committee of DJCAD, University of Dundee. We acknowledge the input and effort of our interview participants.

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Breaking the Information Cocoon: When Do People Actively Seek Conflicting Information?

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ABSTRACT

Influenced by existing beliefs, people are often biased in favor of information that supports their attitudes, intensifying the information cocoon effect. To break information cocoon and promote open-minded searches, it is important to guide seekers to approach to conflicting information and formulate critical thinking. This study aimed to examine when and why people actively seek conflicting information using grounded theory. Specifically, we interviewed 13 people who have experiences of actively seeking conflicting information. All the transcript data were coded for analysis. The results demonstrated that context, user characteristics, and motivation were the three main factors that led users to seek conflicting information actively and influenced seekers' preferences of information. Finally, we define this type of search tasks as "attitude tasks," and call for more attention on this type of tasks.

KEYWORDS

Information Cocoon; Conflicting Information; Attitude Task.

INTRODUCTION

In Social Psychology, research shows that people prefer supporting information over conflicting information after having made a decision (Schulz-Hardt et al, 2000 & Jonas et al, 2001). Therefore, information seeking process is often influenced by the seeker's existing beliefs, which may lead to biased information search (Johnston, 1996). In biased information search, people might acquire misinformation or disinformation due to unconscious biases (Jonas et al, 2006 & White, 2013). More seriously, if we only seek information that supports or comforts us, we would imprison ourselves in Information Cocoon (Sunstein, 2006). Approaching to conflicting information could be beneficial to open up people's mind and help people formulate critical thinking. However, the first step is to be open to conflicting information. When people begin to seek conflicting information actively, they would not choose to avoid such information. There has been considerable study about biases in web search, but most of them are technocentric (e.g., Adomavicius, 2005 & White, 2013). McKay et al (2020a) firstly examine view change from a human-centric perspective, and in another paper (McKay et al, 2020b) they proposed and illustrated a 'bounded chaos' information system to support less-structured tasks. However, little is known about when and why people want to seek diverse information, especially conflicting information. On this condition, this study focus on the influencing factors and characteristics of Attitude Task, in order to help information system better support open-minded searches.

METHODS

In this study, 13 participants (5 males and 8 females) were recruited through questionnaires online (March 22-March 29, 2021). After signing the consent form, each participant was interviewed for about 30-60 minutes. After the interview, each was paid \$30 for the participation. Each interview started with participants' descriptions of their experiences, and then focused on the factors influenced their attitude change and behavior. A total of 18 experiences from different fields such as health, entertainment and sports were collected (see Table 1 for some examples). Following the grounded theory (Glaser & Strauss, 1967) and basic process strictly, we derived a model from the interview data. And NVivo12 was used to open coding, axial coding and selective coding.

Personal choice field	T11. Begin to consider being a civil servant after graduation (S01); T22. Became concerned about marriage (S02);
Entertainment field	T12. Begin to break the idol stereotype (S01); T31. Begin to understand anti-fans' thoughts (S03);
Health field	T21. Be aware of the serious harm of staying up late (S02);
Sports field	T41. From indifferent to interested in football. (S04)

Table 1. Examples of the Participants' Experiences (Participants who reported this example)

FINDINGS AND DISCUSSION

After encoding 13 interviews by the grounded theory method, the study obtained 45 initial concepts, 19 sub-categories and 4 main categories (context, user characteristics, motivation, and task characteristics). And based on the selective coding, we summarized the theoretical framework, to describe how people begin to seek conflicting information (See Figure 1). In general, Contextual factors play an important role in people's attitude change, and user characteristics are served as mediating variables between contextual factors and motivations. In addition, motivation is the main trigger of attitude, and all these variables could influence the characteristics of attitude tasks.

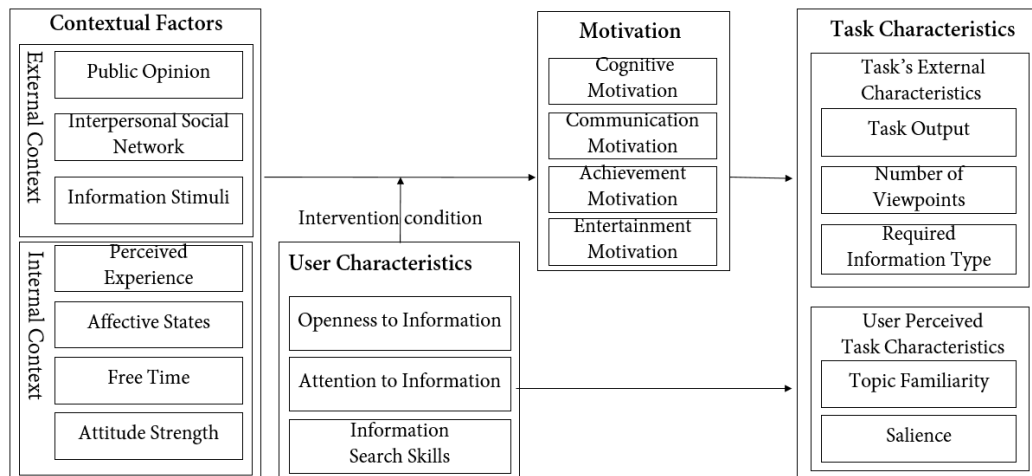


Figure 1. Framework of How People Begin to Seek Conflicting information for *Attitude task*

Contextual factor refers the environment and state of the user, which is the starting point that pushes people to actively seek conflicting information. When exposing more frequently to diverse viewpoints from the external environment, it is easier for people to trigger to actively seek for conflicting information. Or in the other case, when people are in strong positive mood, or when they experience a calm and relax state, they are more likely to reflect on their existing beliefs and actively seek for more diverse or conflicting information.

User characteristics, includes the openness to information, attention to information and search skills, which could be served as a stimulating role, that affect people's awareness and responses to the context. People's receptivity to and ability to seek for diverse information will directly affect their sensitivity to conflicting information in the context, and people who pay more attention to unknown information are more likely to generate approach motivation.

Motivation, as an intermediate variable between context and the task, is a reflection of the awakening of users' autonomous consciousness. Approach motivation directly promotes users to generate subjective intention to achieve a certain goal under a specific context. Four types of motivations were found in this study: cognitive motivation, entertainment motivation, achievement motivation and communication motivation. The strength and type of motivation will affect the specific characteristics and performance of the task.

Task characteristics include the external characteristics and perceived task characteristics. The task characteristics are influenced by the context and the internal cognition of users. The perceived task characteristics include topic familiarity, importance, and tasks' external characteristics include task output (knowledge, decision), number of viewpoints (binary, multiple) and information type required (subjective, objective).

CONCLUSIONS AND FUTURE WORK

This study examines how people begin to seek conflicting information, which may lead to or not lead to attitude change. It is found that the users' own motivation is the key factor that derives users to seek conflicting information; in addition, the exposure to conflicting information, dominant opinion surrounding the person, and personal experiences could all influence people's openness towards information. This study highlights a new type of search task, attitude tasks, in which people are aimed to seek and formulate opinions rather than fact or information, and argues that more attention should be paid to this type of tasks.

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Where Did They Come From? On Global Mobility of Chinese Returnees

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ABSTRACT

This study investigates the scientific mobility of Chinese returnees. Based on an analysis of scientific affiliation data in the Web of Science between 2008 to 2019, the paper explores the distribution of Chinese returnees from temporal and regional perspectives. The results confirm that there is an increasing number of Chinese migrant researchers who return home, and that mainly come back from developed countries.

KEYWORDS

Scientific Mobility; Chinese Returnees; Scientific policy.

INTRODUCTION

As one of the largest exporters of global talent in the world, China have been greatly beneficial for international scientific research. However, in recent years, we are witnessing that an increasing number of emigrant Chinese researchers returning to China. The goal of this paper is to provide a better understanding of mobility patterns of Chinese researchers, with a focus on where they returned from. Exploring the global mobility of Chinese returnees has policy implications for China's funding and mobility programs and on the training of Chinese researchers.

DATA COLLECTION AND METHODS

We retrieved all the Web of Science papers (more than 17 million publications) of all the authors (more than 23 million disambiguated authors), and selected those who have ever published with a Chinese affiliation (N=7,738,758). Chinese returnee refers to the author whose original and latest publication country are China, but were affiliated to at least one other country during the period. A researcher's original country is not assumed to be the mother country of the researcher or nationality, but rather the country affiliation of their first publication. Following Robinson Garcia et al. (2019) we identified travelers and emigrants. Traveler refers to authors who keep a Chinese affiliation while adding other countries to their affiliation lists, while emigrants are researchers who, at some point lose their Chinese affiliations and are strictly affiliated with non-Chinese. Duration is defined as the time period between the year of affiliation to other countries and the year they returned to China.

RESULTS

A total of 7,738,758 Chinese researchers were identified, representing 33.45% of all researchers in the dataset. Table 1 summarizes the number of Chinese researchers by different mobility types. Most researchers (99.27%) show no evidence of international mobility. Only less than 60,000 Chinese researchers have had international research experience over the 2008-2019 period. Among these 0.73% of Chinese researchers, the most common type of mobile researchers are Chinese returnees (51.77%) followed by those travelers who keep the relationship between China and other countries (26.43%) and those immigrants who have not returned back to China yet (21.81%).

Mobility Type		Total	% of Total	% of Mobile
Non-mobile		7,682,267	99.27	/
Mobile	Total	56,491	0.73	100
	Returnee	29,243	0.38	51.77
	Traveler	14,929	0.19	26.43
	Emigrant	12,319	0.16	21.81

Table 1. Number of Chinese researchers by mobility status

Figure 1 (left) shows that the number of Chinese returnees has increased steadily since 2008. To take into account the fact that there is an increasing number of Chinese researchers in the dataset, we compiled this value as a percentage of all Chinese researchers. It shows that, even in relative terms, the percentage of Chinese researchers coming back home has been increasing steadily. The decrease in 2010 and 2011 is perhaps due to the rapidly growing number of Chinese researchers going abroad.

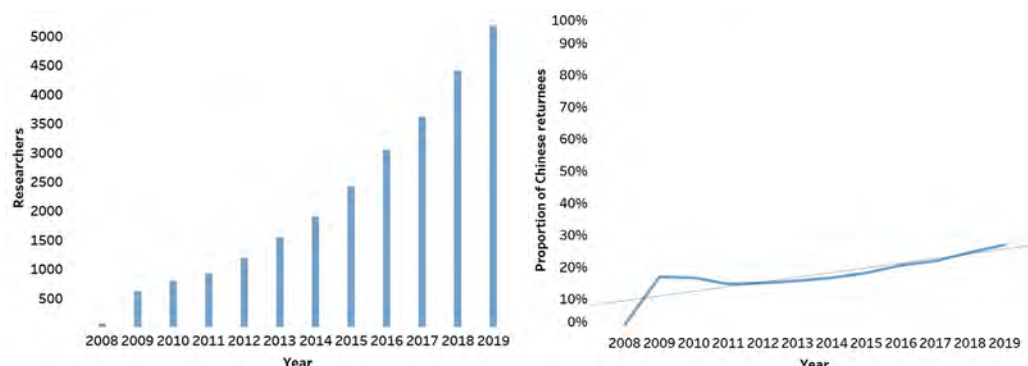
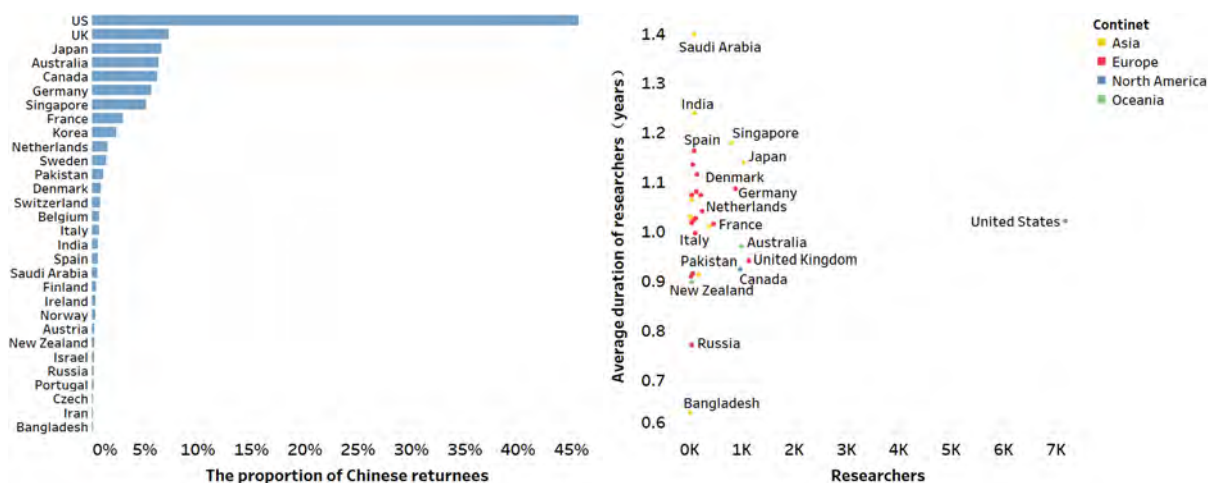


Figure 1. Number of Chinese returnee researchers by year (left) and the proportion of Chinese returnees to all Chinese researchers abroad by year (right)

Figure 2 (left) shows which countries have Chinese returnees come back from. United States is the country that attracted the highest number of Chinese researchers, representing almost half of researchers. Other six countries, United Kingdom, Japan, Australia, Canada, Germany, and Singapore, respectively account for 5%-8% of Chinese returnees. However, even though United States has attracted the biggest population of Chinese returnees, the average duration that they stayed in is relatively shorter than other countries such as Japan, Singapore, and Germany (Figure 2 right). Chinese returnees stay abroad less than two years on average, with longer duration in Asian and



Europe.

Figure 2. Proportion of Chinese returnees by country (left) and average duration per country and number of researchers (right)

CONCLUSION AND FUTURE WORK

The study provided empirical evidence of the extent to which emigrant Chinese researchers are returning to their country, of the time to return, and on main country of emigration. Our findings provide new insights for China that may be used in talents policy. This study explored scientific mobility only by bibliometric data, which may neglect Chinese researchers who published their first academic article in a foreign country, worked for several years there and then went back to China. Future research will focus on variations in mobility by discipline, on the relationship between mobility and scholarly impact, and on the qualitative assessment of the factors that affect mobility.

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Makerspaces Designed for All: Creating Equitable and Inclusive Learning Environments in Libraries

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ABSTRACT

In this Institute of Museum and Library Services (IMLS) funded study, the authors investigate ways in which to bring about more inclusive and equitable makerspaces in public libraries (Brady, Salas, Nuriddin, Rodgers, Subramaniam, 2014; Yi & Baumann, 2018). Public librarians, librarians with disabilities, and disability self-advocates were interviewed and took part in focus groups. In doing so, researchers worked to hear directly from members of the disability community and to learn from librarians at the intersection of disability, through their work or through personal experiences. This work-in-progress study has completed the majority of its data collection and is beginning in-depth data analysis. Although still developing themes and takeaways, there has been initial findings that can be of benefit to the larger library and information science (LIS) community. Individuals with different needs and abilities should be represented when designing and providing a makerspace. While this study focuses on public libraries, it has implications for makerspaces in all libraries and similar learning environments.

KEYWORDS

Disability; equity; makerspaces; inclusion; libraries.

INTRODUCTION

In this IMLS funded study, the authors investigate ways in which to bring about more inclusive and equitable makerspaces in public libraries (Brady, Salas, Nuriddin, Rodgers, Subramaniam, 2014; Yi & Baumann, 2018). Public librarians, librarians with disabilities, and disability self-advocates were interviewed and took part in focus groups. In doing so, researchers worked to hear directly from members of the disability community and to learn from librarians at the intersection of disability, through their work or through personal experiences. This work-in-progress study has completed the majority of its data collection and is beginning in-depth data analysis. Although still developing themes and takeaways, there has been initial findings that can be of benefit to the larger library and information science (LIS) community. Individuals with different needs and abilities should be represented when designing and providing a makerspace. While this study focuses on public libraries, it has implications for makerspaces in all libraries and similar learning environments.

METHODOLOGY

The researchers conducted focus groups and one-on-one interviews with three categories of participants: public librarians working in makerspaces or familiar with public library makerspaces, librarian living with disabilities, and library patrons with disabilities. Over the course of several months, these focus groups (6) and interviews (3), the researchers gathered data that resulted in 480 minutes of conversation. An initial analysis of this data has been conducted using thematic analysis and open coding (Saldana, 2021). While data collection is on-going in the form of an open response online survey via Qualtrics, the early data does show some intriguing findings.

INITIAL FINDINGS

The initial findings suggest that as individuals are becoming more open regarding their disabilities that there is great potential for makerspaces to fine tune programming and redesign the space itself with inclusion in mind. One librarian with a disability suggested one-on-one, individualized attention while programs are taking place. This would be a benefit to those who may desire extra attention or have needs that differ from their neurotypical peers. Another librarian acknowledged that patrons living with invisible disabilities may not comment upon issues they encounter such as interfering sights, smells, sounds, etc. A library patron echoed this comment by referring to an incident where they had a panic attack due to the lengthy wait and busyness of the environment. Clearly, by listening to patrons with disabilities much can be done to create a welcoming and encouraging atmosphere in public library makerspaces.

FUTURE DIRECTIONS

The next step in this study will be an online, open response survey which includes the same questions as the focus groups. This survey will be shared with librarians and library patrons living with disabilities to encourage more

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participation and ensure the accessibility of the data collection tool. The researchers want the survey to be available for those who may not be comfortable or capable of engaging in focus groups and/or interviews.

CONCLUSION

While this study is currently still a work-in-progress, the preliminary data does reveal the need for more inclusive and equitable makerspaces in public libraries. The librarians in this study indicated an awareness of the need for ensuring that their public library spaces are welcoming and comfortable for all. The librarians living with disabilities highlighted issues they noticed while working that impaired their ability to participate easily. This is merely the beginning of a study that has the potential to provide librarians and library staff with practical and useful training.

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Preliminary Simulation for Obtaining Accurate Heart Rate Data Using Imputation Methods

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ABSTRACT

Increasingly data acquired from consumer activity trackers are being used by clinicians to monitor and treat patients. There are many reported cases where medical doctors leverage data retrieved from these devices to successfully treat and diagnose patients with heart conditions. In addition, hospitals are testing these devices in clinical trials to support telemedicine. One challenge is sensor susceptibility to distortions, resulting in missingness and impacting on validity. In this study we are exploring optimal methods of imputation through an experimental simulation using heart rate interval data. For this initial methodology we are utilizing Fitbit heart rate data to investigate performances of four imputation methods using 1000 Monte Carlo runs. Normalized errors from simulated missingness experiments were determined by comparing observed and predicted values. Preliminary findings show that linear and Kalman imputation methods are most appropriate when imputing heart rate data.

KEYWORDS

Ubiquitous healthcare, Missingness, Heart rate variability, Wearables.

INTRODUCTION

Activity tracking technologies enables users to acquire greater awareness of their health and fitness-related behavior. The COVID-19 pandemic has catalyzed adoption of these consumer devices integrating them into telehealth enabling delivery of care remotely (Wosik, et al., 2020). Before the pandemic, clinicians experimented with these devices on outpatients, especially heart related cases. Survival of patients with cardiovascular diseases is a dependent on detecting early warnings. Incorporation of multi-sensor technologies from these wearable devices provides real time data from outpatients enhancing routine monitoring (Baek, et al., 2017). Despite the convenient incorporation of these devices, ubiquitous occurrences of missing data tends to be a problematic, thereby reducing statistical power and increasing misrepresentation when it comes to validity of statistical inferences and predictiveness (Roth, 1994).

As noted by Rubin, 1976 missingness can be categorized as completely at random (MCAR), missing at random (MAR) or not missing at random (NMAR). The occurrence of missingness as represented in our heart rate data from a Fitbit depended on chance or MCAR. Due to unknown reasons sometimes the sensor did not function or data transmission failed. Therefore, the probability for one heart rate missing was independent from other heart rate reading. In addition, there was no relationship between the occurrence of missing heart rate and the value of a specific heart rate.

Multiple imputation methods account for these uncertainties when handling missingness but performances of these methods can be compromised especially in the absence of large intervals. Also method selection depend on the given data set, missing data mechanism and patterns (Twala et al., 2005). In this simulation we explore these concerns of missingness by examining the performances of different imputation methods. We also look at the existing variances in the heart rate.

INITIAL METHODOLOGY

We found that there is no universal threshold value for classifying heart rate; researchers design their own standards based on their study. Considering recommendations from previous studies, we selected 45 to 130 beats per minute (bpm) as an acceptable range for our experimental simulation (Chakraborty et al, 2015; Chowdhury et al. 2017). We tested the performances of linear interpolation, Kalman, spline and Stineman interpolation. Data manipulation and analysis was done using the following R packages:

- Impute TS – Impute missing values in univariate time series.
- Changepoint - finds single and multiple change points within data
- Metrics – RMSE

Data from a Fitbit device was collected from one person. Five second intervals were aggregated into 1-minute intervals to facilitate analysis. Data munging was a straightforward process. We split date and time data into two columns and duplicated the heart rate data to a separate column for comparison. We used variance change point detection using the R package ‘changepoint’ to determine significant change points in our time series data. We chose to use variance as opposed to mean to better identify significant jumps in heart rate changes as opposed to using the mean that addresses distribution changes in a smoother fashion (Gao et al., 2018). To test imputation performances, we randomly deleted intervals from one recorded heart rate data column. We used four selected imputation methods to predict the missing heart rate in one column and compared imputed values with actual heart rate data points. For our preliminary experimental simulation we removed 5, 10, 15 and 20 percent of 2, 4, 6, 8 and 10 minute intervals from one day (see Table 1) and did Monte Carlo runs of 1000 to test the outcomes. We compared the known and predicted values to determine the performances of the various methods using the Root Mean Square Error (RMSE) function. To determine if there were significant difference between the mean error scores we did paired t-tests.

Percent	Minutes Removed	2 minutes blocks	4 minutes blocks	6 minutes blocks	8 minutes blocks	10 minutes blocks
5	72	36	18	12	9	7
10	144	72	36	24	18	14
15	216	108	54	36	27	21
20	288	144	72	48	36	28

Table 1. Data Sample Removed to Test Imputation Methods Performance

PRELIMINARY RESULTS AND CONCLUSIONS

Missing data was sporadic in our dataset, some days there were over 20 hours of data missing and at other times less than 1 hour. There were two distinct change points fluctuations across days. The lower RSME values of the imputation performance the better performance of this method for predicting missing data. Paired t-tests showed significant differences in performances of linear and Kalman (pvalue=0.004); linear and Stine (pvalue=0.003); and Kalman and Stine are significant different (pvalue=0.001). Therefore according to preliminary RSME results linear and Kalman methods for prediction had best performances when it came to imputing heart rate data.

NEXT STEPS

This ongoing study helps to fill the knowledge gap regarding data quality measures and its impact on inferences. The above experimentation is very preliminary but provides insights on which imputation method can potentially perform better with heart rate data. There are further steps to consider moving forward. Change point analysis indicates two distinct patterns in heart rate over the course of a typical day. We have yet to consider sensitivity analyses of performances of imputation methods given differing statistical properties of these changes. It is possible that the high and low variances will impact the performances of the imputation method. As such we intend to modify our existing algorithm by leveraging change points to dive deeper into our simulation results.

ACKNOWLEDGMENTS

We thank all volunteers of our Bayesian methodology research group for all the feedback and suggestions and Jeffrey Stanton for guidance and keeping us motivated.

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Understanding the Role of Community Collaboration Within Indigenous Cultural Heritage Data Migrations

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ABSTRACT

Many museums and archives globally hold heritage items belonging to Indigenous peoples of North America. There are current efforts to begin decolonizing the practices and legacies of these collections, and one way this is done is through digital access to Indigenous cultural heritage. This poster examines The Great Lakes Research Alliance for the Study of Aboriginal Arts and Cultures (GRASAC) Knowledge Sharing System, a digital platform that aggregates museum and archival records into a centralized database at a point of data migration. Data migrations are not only necessary as a point for technical updates, but also for theoretical changes in the system itself as the needs of its users change. This is the case for the knowledge sharing system as it moves from a password protected system to one that is open to the public. Rooted in qualitative research from semi-structured interviews with the creators, maintainers, and users of the database, this poster illustrates how GRASAC is working to meet the needs of their user community, and what unique challenges are faced when prioritizing Indigenous knowledge within a database created for western information organization.

KEYWORDS

Indigenous data practices; Data migration; Community collaboration; Platform design.

INTRODUCTION

This poster identifies and unpacks points of negotiation within The Great Lakes Research Alliance for the Study of Aboriginal Arts & Cultures (GRASAC) Knowledge Sharing database. GRASAC is a research alliance that hosts a database that aggregates records from museum collections belonging to Indigenous peoples of the Great Lakes region (Bohaker et al., 2015) and is currently undergoing a migration from password protection to a system that is open to the public. This change within the database brings to the surface some of the needs that the unique cultural data held within the system has, along with additional desires from users, many of whom are Indigenous. This research seeks to understand how negotiations are resolved and embodied within the sites of contestation in the infrastructure development of the GRASAC Knowledge Sharing System.

BACKGROUND

Many museums and memory institutions hold ethnographic collections, or material about or belonging to Indigenous people. Museums are institutions with colonial legacies, and for much of their history the goals of their collections were not to preserve knowledge for Indigenous communities, but for settlers' own agendas pertaining to Indigenous peoples including research, government organization, and land control. Some institutions that manage these collections are now realizing the need to share their collections and its knowledge with the original communities, and are making efforts to do this, often through online portals, digital archives, or other digital platforms. These are sometimes aggregated data sets that include multiple museum collections, or a single institution's own online platform. This is not a straightforward process though, as the needs of the Indigenous communities must be centered as a priority, and often western systems of archiving, organization, standardization, and cataloging are not equipped to handle this.

The theoretical framing of this research draws from interpretivist work in overlapping information fields including information organization, museum studies, and feminist and Indigenous data practices (Leavy and Harris 2019; Wemigwans 2018; Wilson 2008). Rooted in qualitative research from semi-structured interviews with the creators, maintainers, contributors, and users of the database, this research presents GRASAC as a case study to understand the motivations behind changes to their database. The knowledge sharing system currently holds two types of records: language items and heritage items. Language items are words and phrases from Indigenous languages (Anishinaabe and Cayuga are the languages with the most entries currently) that can be attached to a heritage item to describe it (Willmott et al. 2016), or used independently for language revitalization purposes. This poster is focusing on changes to heritage items specifically, which are generally objects in museum collections and archival material.

PASSWORD PROTECTED

One of the biggest points of negotiation within the database that was discussed during the interviews is the move from a password protected to a public facing system. The desire for a system without the obstacle of logging in is something that has been expressed by users, particularly Indigenous users, for many years. One reason is because the database does not currently hold any sensitive information that should not be shared with the general public. However, museum politics around open access made this challenging. At the inception of GRASAC, many museums were concerned about copyright issues with having images of their collections fully accessible on the web and were not willing to aggregate if there wasn't a password protecting their data. This in particular is an example of the continued colonial legacies of museum collections, that even though they were willing to share their data with GRASAC, they were still inadvertently placing controls on how records were being shared with Indigenous communities. As opinions around access have changed in the museum context, decision makers in GRASAC now feel as if they can meet this need of their users. One participant, who had been involved in the research alliance since its founding, described why the password was necessary to begin with, and how changing politics in both museums and within Indigenous communities have required them to rethink this policy. They stated, "We put the password on in response to museum concerns...to try to limit the circulation of images and data. And now museums as institutions have moved past that set of concerns. And it no longer seems necessary or relevant. And Indigenous communities are saying loud and clear, 'the password is a barrier, we should not have to ask for a password.'" For this research alliance, collaboration means working with Indigenous communities, but also with the museums who hold these heritage items. The knowledge sharing system has been around for almost 20 years, and it is important to understand that these long-lasting databases need to evaluate not only how to sustain themselves technically, but also be open to change as politics change within museums and Indigenous communities.

DATA STANDARDIZATION

Another negotiation in the knowledge sharing system is metadata standardization within heritage items. The maintainers of the database never implemented any controlled vocabulary or dictionary to guide the metadata of a heritage item. A team of researchers complete each record and can add multiple photos, sound recordings, and extensive documentation to a heritage item. Describing this thought process, one of the maintainers of the knowledge sharing system stated, "We actually had quite a lot of discussion about whether we would use Getty, or what other standards we would use. And none of them were adequate. We see a lot of problems in them, their different typologies and schemas. How museum catalogs describe material heritage culture. So we thought, well let's just see what people enter." This approach allowed robust information to be documented in a record but has also led to standardization problems within the data. This makes searching the knowledge sharing system complicated, especially for non-academic users. One example that came up in multiple interviews is that the word 'moccasin' is spelled 4 different ways in the database. This means when a user searches for the word spelled one way, the other 3 spellings don't appear in the search results. With the move to a public facing platform, members of GRASAC are reconsidering how to balance the desire for researchers to have some freedom and multiplicity in documenting a heritage item, but also how to make the knowledge stored within an item findable by a wider variety of users. This includes users who might be using search terms more relevant to their community and experiences but might not necessarily be academic or research oriented. Unlike the previously mentioned decision to move away from a password, this is an ongoing process that will require extensive data curation to fix and the maintainers of GRASAC are still trying to conceptualize the best way to accomplish this.

CONCLUSION

This poster disseminates some of the processes and decisions that GRASAC has recently implemented in order to continue meeting the needs of the members of their research alliance and users of their knowledge sharing system. Documenting these changes can pave the way for other collections holding similar cultural heritage material to question what more they could be accomplishing and how to best do so, while also acknowledging the change a system can undergo through time in order to meet the changing needs of a community. It also spotlights a research database that has successfully met the needs of Indigenous communities through respectful and reciprocal practices and what can be learned from them.

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Internet of Samples

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ABSTRACT

Material samples are indispensable data sources in many natural science, social science, and humanity disciplines. More and more researchers recognize that samples collected in one discipline can be of great value for another. This has motivated organizations that manage a large number of samples to make their holdings accessible to the world. Currently, multiple projects are working to connect natural history and other samples managed by individual institutions or individuals into a universe of samples that follow FAIR principles. This poster reports the progress of the US NSF-funded iSamples project, in the context of other efforts initiated by US DOE, DiSSCo, BCoN, and GBIF. By October 2021, we will also be able to present an iSamples prototype. We encourage individual organizations that hold material samples to get to know these projects and help shape these projects to realize the goal of a global linked sample cloud that connects all material samples and is accessible to all.

KEYWORDS

Material samples; open linked data; iSamples; Internet of Samples.

INTRODUCTION

Material samples, such as organism specimens, rocks, human tissues, and ancient coins are a basic element for reference, study, and experimentation in many scientific disciplines. Many (if not most) samples are not formally curated and are hidden in labs and offices. Samples curated at institutional levels are often missing necessary metadata for reuse. In addition, samples are often split to create subsamples, or subsamples (e.g. DNA) are extracted from parent samples (e.g. tissues). In many institutions, subsamples do not have their unique identifiers. All these make it very difficult to assemble a sizable set of high-quality, well-described samples for scientific studies, even when the needed samples exist somewhere. On the other hand, samples on which scientific findings are based are equally difficult to track, hindering the development of open and reproducible science. These issues are long recognized by the data infrastructure community and multiple projects are actively working to make sample data FAIR (Findable, Accessible, Interoperable, and Reusable). These projects include the Internet of Samples (iSamples, Davies et al., 2021), Digital Specimens (DS, DiSSCoTech, 2020), BCoN's Extended Specimens (Lendemer et al., 2020), and US DOE's work (Damerow et al. 2021). In this poster, we report the recent development of iSamples in the context of these other projects.

INTERNET OF SAMPLES

iSamples, or Internet of Samples, was funded by NSF Office of Advanced Cyberinfrastructure in 2020. The project is charged to develop "a national-level service infrastructure to uniquely, consistently, and conveniently identify material samples, record metadata about them, and link them persistently to other samples and any digital content derived from them, including images, data, and publications" (Lehnert et al. 2019). Figure 1 depicts the infrastructure. An instance of iSamples in a Box

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(iSB) is a portal that serves one domain or community and manages the persistent IDs (PIDs) and metadata profiles for the domain. The iSamples Central (iSC) aggregates all samples harvested from each portal and links samples to their related data and publications through explicit or inferred relations by utilizing the Event Data service provided by Crossref. Currently, SESAR (System for Earth Sample Registration), Open Context (opencontext.org/), National Museum of Natural History of Smithsonian, and GENOME (Genomic Observatories Metadatabase) are the four initial sample data repositories that are constructing the iSamples infrastructure, with close to 10 million samples currently identified with different persistent ID schemes and different metadata schemas. The project will develop iSB as a standard bridge that other sample collections can use to join iSC.

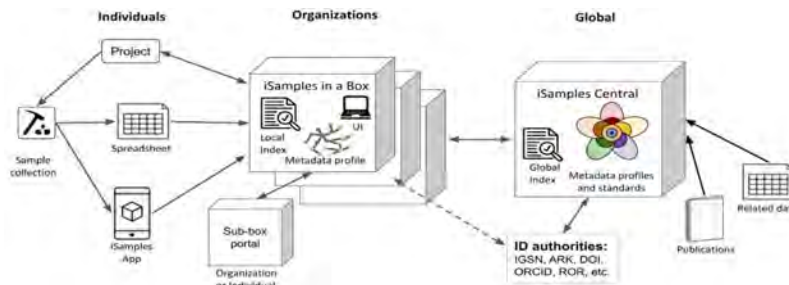


Figure 1. Conceptual infrastructure of the Internet of Samples.
Image from Davies et al. (2021) with permission

RECENT DEVELOPMENT

All projects recognize the importance of PIDs and a set of core metadata elements needed to organize heterogeneous collections of material samples. All projects are flexible in terms of accommodating metadata elements unique to a domain or even a collection, and adopt a layered architecture to organize core and additional metadata. But there are also differences in the choice of schemes for PIDs and the core elements. Upon reviewing nine different PID schemes, Damerow et al. (2021) concluded that IGSN (International GeoSample Number) is the most suitable scheme for physical samples, including but not limited to geosamples. iSamples' position is to treat all PIDs used equally as first-class citizens (e.g. IGSN, ARK, DOI, etc) as long as they are reliably resolvable to a sample record. On the other hand, DiSSCO differentiates the concepts of "material samples"(physical objects) from "specimens"(curated records) and would encourage all digital extended specimens to be identified using DOIs.

Core metadata elements (elements that are required for all samples) currently proposed by different projects are crosswalked and listed in Table 1, where "*" indicates a controlled vocabulary/ontology is required.

Damerow, et al. (2021)	iSamples core elements May28 (2021)	DiSSCO MIDS Level-1 v0.14 (2021)
Collection> Chief Scientist or Collector	producedBy>responsibilities	
Collection> Collection Date	producedBy>resultTime	
Collection>Collection Method Description	producedBy>sosa:usedProcedure	
Collection>Field Program or Project Name	producedBy>hasInitiative	
SampleAccess>Release Date	Curation>accessConstraints	Institution (Code, Referent)
Location>Latitude	producedBy>samplingSite>latitude	
Location>Longitude	producedBy>samplingSite>longitude	
Location>Country	producedBy>samplingSite>placeName	
EnvironmentalContext>Physiographic Feature*	producedBy>hasFeaturesOfInterest *	
SampleDescription>Sample Name	id, sampleIdentifier (physical), label	PID, PhysicalSpecimenId, Name
SampleDescription>Object Type *	hasSpecimenCategories *	TypeDef *
SampleDescription>Material *	hasMaterialCategories *	MaterialType *
Unmatched fields	Schema, description, additionalProperties, registrant, samplingPurposes, keywords, status, altIdentifiers, informalClassification, relatedResources	Modified, MIDSLevelLevel (MIDS: minimum Information about a Digital Specimen)

Table 1. A crosswalk among the three core sets of metadata elements proposed by different projects

While a level of semantic agreement at the metadata level is evident, the controlled vocabularies needed for specimen type, material, and physiographic features are more challenging to create. Current vocabulary sets are difficult to consolidate. Several card sorting exercises are created by iSamples, each with a guideline represented as a decision tree, to solicit user input on the three sets of proposed vocabularies (iSamples, 2021a, 2021b, 2021c). The iSamples' associated "Sampling Nature" Research Coordination Network invites LIS experts to contribute to its metadata and controlled vocabulary standards construction efforts. Contact Sarah Ramdeen to engage with the group.

ACKNOWLEDGMENTS

This material is based upon work supported by US NSF under Grant Nos: 2004562, 2004815, 2004939, and 2004642.

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Autonomy Framing and Cybersecurity Training Completion

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ABSTRACT

This pilot project conducted an AB test to see whether inclusion of an autonomy framed appeal in announcement of organizational cybersecurity training influenced training completion or time to training completion. The interim results, which include approximately 31% of the population, show that groups receiving the autonomy appeal had a lower training completion rate. The results show no difference in time to training completion.

KEYWORDS

Cybersecurity training; framing; autonomy; AB test.

INTRODUCTION

This poster describes the results of a pilot to assess whether inclusion of an autonomy framed appeal in communications about cybersecurity training impacts employee behavioral responses to the program. It is part of a larger evaluation project, conducted in conjunction with the UW-Madison Office of Cybersecurity, which assessed mandatory online cybersecurity training for approximately 26,000 employees in spring 2021.

Organizations struggle to motivate their employees to engage in basic security awareness training. The technical protections that surround data rely on human decisions, and bad actors compromise organizational security by exploiting those decisions. A security breach at an organization can impact millions of people and cost billions of dollars. For example, the Equifax security incident that exposed the data of 145.5 million people and was caused by a single employee (US Government Accountability Office, 2018).

Framing is when we change the way we communicate about something to get an audience to notice a part of the message. Framing purposefully includes or excludes key text to reinforce information or judgments (Entman, 1993). Studies using framing often examine the impacts (attitudes, actions etc.) that may be generated by altering the framing of messages. While the overall focus of a message may remain the same, different frames may evoke different responses in audiences (D. Scheufele, 1999). Taking a framing approach, this study examines the relationship between cybersecurity training communications and behavioral responses.

Some believe autonomy-supportive language in cybersecurity communication will lead to positive outcomes such as good security habits. Autonomy scholars argue that people have a need to perceive their own autonomy, a need to self-regulate their own experiences and actions, and that people will show more sustained behavior and attitude stability toward a subject when motivated with autonomy (Ryan, 2017; Villacorta et al., 2003). This study explores whether autonomy framing influences employee responses to cybersecurity training.

Prior research has explored how autonomy framings of cybersecurity messages may influence audience intentions or behavioral responses. Menard et al (2017) indicated significance for perceived autonomy in participant intentions to comply with cybersecurity recommendations. Lee (2015) showed autonomy as significant in predicting security compliant behavior. Wall et al. (2013) argue that self-determination, and its central component autonomy, increases self-efficacy, an important predictor for security behavior.

METHODS

This study uses an AB study design to test the impact of autonomy frames in invitations to participate in required cybersecurity training. We divided employees into a control group and a test group based upon even and odd ID numbers. Each group contains roughly 13,000 members. On April 27, 2021, the control group (standard group) received an email message from the campus Office of Cybersecurity informing employees about the new training to be completed between April 27 and June 30, 2021. The test group (autonomy group) received the same message with one additional line autonomy-invoking line: "You choose when to do your training!" Users could complete the training in multiple sessions, or all at once within the 10-week period. The system reports included the date/time of initial login and the completion of the training. In this paper we report on completion data from 4/27/2021 to 5/13/2021 to accommodate the conference submission deadline. The conference poster will include the full results.

We calculated the elapsed time between initial login and training completion. We asked two research questions: 1) Will there be a difference between groups in terms of training completion? 2) Will there will be a difference between groups in terms of length of time to training completion?

RESULTS

Eventually, approximately 26,000 employees will complete the training. Preliminary results include the 31% of employees who completed the training as of 5/13/21, including 3975 standard group and 3998 autonomy group employees. Approximately 18,000 employees had yet to complete the training. To compare training completion, we performed a chi-square test of independence and found that **autonomy group employees were less likely to have completed the training** than standard group employees. The relation between these variables was significant, $\chi^2 (1, N = 25,970) = 31.84, p = 1.67179E-08$.

We measured time in terms of minutes between initial training system login and training completion. To compare groups, we performed a one-way ANOVA and found **no significant difference between the groups in terms of time**, although the mean time of the autonomy group was slightly higher ($t(7932) = -.35, p = .73, F(1,7971) = .12, p = .73$). Visualizations show a large number of completions between 2 and 18 minutes. However, the group means are much higher at 226 and 237 minutes - representing just under four hours. A long right tail skews the mean high and creates a large standard deviation. The longest times taken were 13 and 15 days.

	Standard Group	Autonomy Group
Complete	39.62%	36.22%
Not Complete	60.38%	63.78%
Completion Time	$M=226.17; SD\ 1376.71; \max\ 18805$	$M = 237.27, SD = 1485.13; \max\ 21870$

Table 1. Training Completion Data by Group

DISCUSSION

This paper reports interim results; later presentations will include data from all 26,000 employees. Our population from UW-Madison is not representative of all organizational employees; however, results suggest what behavioral outcomes would be like for organizations whose employees have variable life-experiences, educational levels, and technology proficiencies.

The study's inclusion of behavior data is a contribution. The social cybersecurity literature tends to rely on variables of self-reported behavior intention (Crossler, 2013). This study's data about the relationship between autonomy framing and behavior provides an important comparison to studies focusing on intention. One important limitation is that this study does not tell us about security knowledge gained through the training or if or how training impacts behaviors related to security.

Past research suggests that autonomy increases participants long-term motivation to maintain good security habits. Our data to date do not provide evidence that an autonomy frame motivated employees to finish training faster. If we interpret time to training completion as an operationalization of self-efficacy, one explanation is that employees who received the framing message have higher self-efficacy and chose to take more time to complete it. Further analysis of the full data set will subdivide the standard and control group data set by time quartiles to look more closely at group differences in time to completion. Another explanation is that the one-sentence autonomy frame in the communications was not sufficiently strong to motivate faster training completion. Future data collection could increase the strength of the autonomy framing by including more autonomy-invoking sentences and messages.

It may be that autonomy framing may impact good security habits or attitudes other than time to completion. Future data collection will include interviews with a sample of participants about their experiences with the training. The autonomy message group participants may have different attitudes about the training experience than standard message group participants.

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Digital Contact Tracing in the EU: Data Subject Rights and Conflicting Privacy Governance

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ABSTRACT

The wide-spread use of digital exposure notification systems, often called contact tracing apps, raises questions about privacy and efficacy of technosolutionism to address COVID-19. As part of a broad study of global contact tracing apps, this poster explores the governance and privacy implications of European digital contact tracing solutions. We explore legal justifications for data collection in these apps and data subjects' rights with respect to the General Data Protection Regulation (GDPR) and national laws throughout Europe.

KEYWORDS

Privacy; contact-tracing apps; information policy; GDPR; human rights.

INTRODUCTION

Digital exposure notifications, via apps, automate traditional contact tracing processes to reduce the burden on public health workers and help stop the spread of the virus (e.g., Cho, Ippolito, & Yu, 2020; Sharma, Wang, & Bashir, 2020). Despite advanced technological capabilities, our study highlights the importance of appropriate governance structures in protecting users' rights and privacy. As part of a larger study of global digital contact tracing apps, we identified different treatment of data subject rights and interpretations of GDPR as apply to contact tracing, which led to questions about the legal basis for data collection and sharing under pandemic circumstances. This poster examines established practices and governance in EU contact tracing solution. to address the following questions: what rights do data subjects of contact tracing apps have in the EU; and what mechanisms exist for them to leverage those rights?

METHODS

We investigated governance and deployment of contact tracing apps in the 28 European countries. We performed qualitative content analysis of privacy policies and relevant regulations using the integrated codebook from Shvartzshnaider, Sanfilippo, and Apthrope (2021). We also employed computational linguistic methods, including sentiment analysis of privacy policies, specifically assessing assertiveness and tentativeness around data collection (Boukes et al., 2020), and automated annotation relative to an ontology of modal normative language (Siddiki et al., 2019) and a taxonomy of privacy considerations (Solove, 2005). As part of static app analysis, we examined permissions leveraged by apps, drawing on established methodologies to assess data collection by mobile applications, platforms, and devices of specific data types (e.g., Sanfilippo et al., 2020), and compared outcomes around governance and practice.

KEY RESULTS

It is important to look at the overall context in which apps in the EU are working together to share information to combat COVID-19. What implications do these development partnerships have and what impact do they have on control that data subjects have over their information?

The GDPR provides guidelines for individual member states and facilitates comparisons between various contact tracing approaches and regulatory impact. 14 EU countries, at the time of this study, also supplemented the GDPR by either developing their own guidance, in addition to Brussels' "Guidance on Apps supporting the fight against COVID 19 pandemic in relation to data protection," or new pandemic specific regulations. Our analysis shows the GDPR implementation differences affected local member states' pandemic guidance and the development and deployment timelines of contact tracing apps. We identify 4 different categories of actors leading national contact tracing apps: the Apple/Google partnership (n=16), public sector leadership, private sector leadership, and other public-private partnerships (n=4). Note that in contrast with non-EU solutions, the EU did not include any purely private or purely public solutions, as presented in Figure 1. Furthermore, Apple and Google infrastructures are not interoperable with other public-private partnerships and some apps on Apple/Google infrastructure are intentionally not interoperable with others.

We encountered various justifications for contact tracing apps' designs, their subsequent infrastructure, and why they limit data subjects' rights to their information. For example, both the Netherlands and Belgium emphasize data minimization at the expense of data subject expectations. Beyond the limits placed on data subject rights, citizens are confused by diverse justifications for information practices, despite shared governance. Figure 2 shows the legal basis for information collection and processing across 20 EU countries, including Latvia which does not cite GDPR. The most common (n=6) was in pursuit of public interest followed consent (n=5). We identified apps did not state any reason for the processing of information (n=5) and apps that stated multiple reasons (n=4) such as for public health compliance purposes, consent and public interest. In addition, we noted variations in the rights offered to data subjects. Even though contact tracing apps tout their privacy preserving features, not all of them fully de-identify data throughout the entire data lifecycle. 8 of the 24 apps refer to article 11 no. 2 of the GDPR informing data subjects that they are not in the position to identify them and articles 15 to 20 do not apply. 9 other apps still state that they offer certain rights to data subjects potentially meaning that data subjects are identifiable in these workflows and therefore are entitled to articles 15 to 20 of the GDPR.

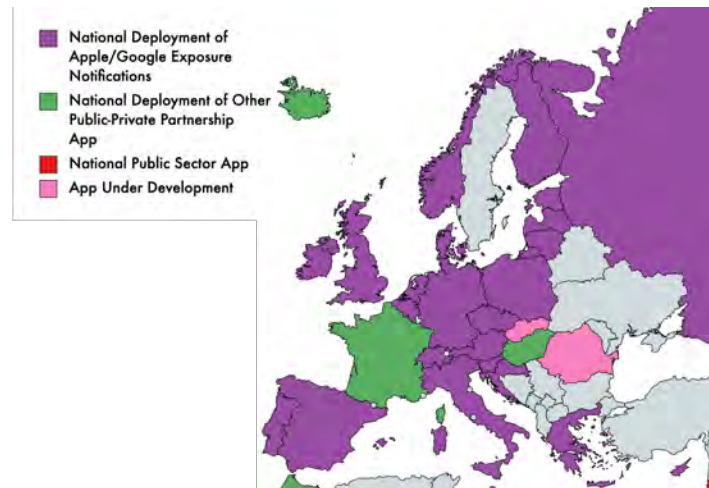


Figure 1. Actors Leading Development of Contact Tracing Apps



Figure 2. Applicable Data Rights under the GDPR

IMPLICATIONS

We find that many policies are contradictory, mimicking historical policy challenges (e.g., Reidenberg et al., 2015), leaving users questioning their rights. Rather than describing practices that conform to user expectations relative to GDPR established rights, policies direct users to Data Privacy Officer for questions about: who verifies that users' data rights are respected, how users can opt-out, how data is anonymized, and how this information will be used in the long run. This research highlights the prevalence of techno-solutionism rather than development processes that incorporate ethical considerations throughout.

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Gendered Sounds in Household Devices: Results from an Online Search Case Study

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ABSTRACT

Multiple household devices are now using human-like voices. We investigate whether there are gender differences in the voices used by different kinds of specialized smart devices (e.g., microwaves vs. toy trucks) as provided by Google's search engine. These gender differences could fuel gender stereotypes in the household environment, or they could help challenge them. Early results suggest a preponderance of male-sounding voices among household devices in the search results but also multiple instances of counterstereotypical media presentation.

KEYWORDS

Gender bias; algorithmic bias; search bias, audio bias.

INTRODUCTION

Media platforms and technological systems serve as gatekeepers for the spread of information. These systems then influence and reflect stereotypes, including those in the household and gender domains (Herdağdelen, 2011; Noble 2018, 2013). There is well documented evidence of marginalization based on gender in print and electronic media as well as digitally mediated platforms (Singh, Chayko, Inamdar, & Floegel, 2020; Arslan & Koca, 2007; Bligh, Schlehofer, Casad, & Gaffney, 2011; Sink & Mastro 2017). These media reinforce "traditional" stereotypes but can also serve as useful examples for counter-stereotypical imagery in certain situations (Singh et al., 2020).

Specialized smart devices with computerized voices, which are becoming ubiquitous in households, are currently understudied with respect to potential gender bias (Anderson & Rainie, 2018). The household is a highly gendered institution (Richardson, 2009), and gender stereotypes are often associated with digital voices (Reeves & Nass, 1996). Understanding how gender is portrayed and reflected in these devices allows for stereotypes to be identified and challenged before they become (advertently or inadvertently) baked into emerging platforms and diffused throughout the household environment and society at large (Silverstone & Hirsch, 1992).

This study does not include voice-enabled personal assistants, like Alexa, Siri, and Google Assistant, as there is an established body of research on these devices (Abrahams, 2018; Broussard, 2018; Shulevitz, 2018). This project instead focuses on speech that originates from specialized devices in household environments targeted to specific tasks and roles, whose impact has not been studied widely. Specifically, this study looks at search engine (Google) results on a selection of "talking" household devices. The devices selected are consistent with similar literature (England, 2017) on gendered labor in the home, and include traditionally female-associated devices viz. microwaves, vacuum cleaners, and soft toys, and traditionally male-associated devices, viz. security alarms, fire alarms, and toy trucks. Considering the above, the Research Questions for this study are:

- RQ1: For which types of household devices are male-sounding voices more commonly used? For which are female-sounding voices more commonly used?
- RQ2: Do stereotypical gender expectations play a significant role in the gender of the device voice?

METHODOLOGY

For each of the six device types, the first 100 video results (or as many as retrieved, if fewer) were downloaded from a Google video search. The format for the search was "talking X", where X is the device (e.g., "talking microwave"). A human annotator listened through each video. Speech in this case refers to audio content that is (a) human-sounding and (b) coherent words or language. The various types of audio content listened for included:

- Male-sounding speech
- Female-sounding speech
- Gendered but not "speech" - device makes a human-sounding noise

- Gender-indistinct human speech - cannot be distinguished as male or female
- Robotic voice - voice is not human sounding but does include speech

In case of multiple voices in the video, the scores were distributed proportionally in the different categories.

RESULTS

To answer RQ1, we look at the data summarized in Table 1. Of the 600 videos, 297 contained content that fit into one of the considered audio categories. The remaining videos did not include a voice of any kind emanating from a device and are not included in Table 1. The male- and female-sounding categories contained most of the instances.

Device	Male-sounding	Female-sounding	Gendered, not speech	Gender-indistinct human speech	Robotic	Total
Microwave	25	12	0	0	0	37
Vacuum cleaner	15.8	14.2	12	0	0	42
Soft toy	38.73	12.27	0	28	10	89
Fire alarm	8	31	0	0	0	39
Security alarm	15.5	18.5	0	0	0	34
Toy truck	52.66	2.34	1	0	0	56
Totals	155.69	90.31	13	28	10	297

Table 1. Overall Data Collection

For four of the six devices (microwave, vacuum cleaner, soft toy, toy truck), male-sounding speech is more prevalent than female-sounding speech. For two devices (fire alarm and security alarm), female-sounding speech is more commonly found. Overall, there were more male-sounding devices (155) than female-sounding devices (90). The overrepresentation of male-associated search results on the internet is consistent with past studies (Singh et al., 2020). However, the results did **not** match the gender stereotype expected in five of the six categories. For instance, while we expected more female-sounding speech for talking microwaves, we found more male-sounding speech. This could be interpreted as a challenge to traditional stereotypes or as an artifact of male overrepresentation in media and on the internet in general. Irrespective, knowing these search results' preponderances is important as they could impact household device adoption.

To answer RQ2, we undertook regression analysis. The dependent variable is the observed speech gender (male-sounding speech = 0, female-sounding speech = 1), the independent variable is the stereotypically expected gender, and the control variables are the six device types. The gender stereotype was found to play a significant role (p -value = 0.0117, i.e., $p < 0.05$) in impacting the observed sound. At the same time, the specific device type was found to be significant in multiple device categories.

DISCUSSION

For RQ1, of the six device types, only one (toy trucks) falls into the stereotypically expected gender group. There are a variety of reasons this may be the case. The first potential source of bias includes the search engine, where the ratio of search engine results may be biased. There is an overrepresentation of maleness on the internet (Singh et al., 2020). Next, the dataset is relatively small, and the labels were assigned manually by a single human annotator. This limitation will be mitigated with other annotators examining the same data (research is in progress). Another limitation of the study includes the use of gender as a binary construct. While the majority of the results appear to fall into the dichotomy, the authors acknowledge gender to include non-binary variants. The significance of the gender stereotype variable as observed in RQ2 aligns with past research. While there is a relationship, the dataset does not perfectly coincide with past research. Multiple devices showed counter stereotypical results, which demonstrates the potential for internet search results to challenge stereotypes.

This is one of the early studies to consider gender bias in the search for household devices. The study looked at Google search results for six devices falling into traditional household gender divisions. While the study suggests a statistically significant relationship between gender expectation and the apparent gender of speech, there are nuances of male overrepresentation and counter-stereotypical media presentation. With further refinement and analysis, these results could render explicit the biases in audio devices, and suggest potential ways to counter stereotypes.

ACKNOWLEDGMENTS

This material is in part based upon work supported by the National Science Foundation under Grant No. 1915790.

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Health Equity and Small and Rural Public Libraries During COVID-19

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ABSTRACT

Rural communities in the United States struggle with many health inequities that predate the COVID-19 Pandemic. This poster analyzes how public libraries responded to COVID-19 from March 2020 through March 2021 by utilizing the social media platform Facebook to continue sharing content that supports community health and wellness. It situates these responses in the context of health inequities in rural America. Although libraries in different parts of the country responded to COVID-19 in unique ways, common practices include sharing timely information about the pandemic and social services; adapting services to continue serving communities safely; and providing enriching educational content that also addresses social determinants of health. The poster concludes with a call to better understand the work small and rural public librarians do to address health inequities.

KEYWORDS

Health; public libraries; rural communities; COVID-19; community engagement.

INTRODUCTION

Inequities in access to healthcare and to the social determinants of health abound whether one is in the midst of a pandemic or not. One institution that strives to address inequities where they exist is the public library. As COVID-19 began inserting itself into every segment of life in the United States, public libraries, especially rural and small libraries, responded to COVID-19 by striving to keep their communities connected to resources (Chase, 2021). This poster analyzes how public libraries utilized the social media platform Facebook to continue sharing content in support of community health. It situates these responses in the context of health inequities in rural America. Thus, this study has the potential to contribute to current literature by examining how public libraries have already, and may further respond to, both this evolving health crisis and the broader rural health divide.

BACKGROUND

Rural areas in the United States rank poorly in national health rankings (Rural Health Information Hub, 2019) obesity, smoking, drinking, and poor exercise habits are factors (Henning-Smith et al., 2019), exacerbated by lack of access to healthcare and other health services (Rural Health Information Hub). In this context, small and rural public libraries have an opportunity to support health equity (National Libraries of Medicine, 2020). Small and rural public libraries, serving populations of 25,000 or less, comprise the majority of the estimated 17,000 U.S. public libraries (IMLS, 2021). Before the pandemic libraries worked to mitigate health disparities through health programs and services, often developed through community partnerships (Lenstra, 2017; Rubenstein, 2018; Whiteman et al., 2018), including community gardens; classes; checkouts of snowshoes and pedometers; and health screenings, among other services (Flaherty & Miller, 2016; Lenstra, 2018a, 2018b; Lenstra & D'Arpa, 2019).

When pandemic shutdowns began in March 2020, these libraries facilitated distribution of masks, provided patrons with links to reputable information sources, and called patrons who lived alone to check on them, all while coping with staff layoffs (Chase, 2021; Wang & Lund, 2020). These libraries were among the first to implement innovative strategies, such as virtual programming, virtual reference, extended WiFi access, and curbside services (Chase, 2021; Goddard, 2020; Public Library Association, 2020). The pandemic also exacerbated rural digital disparities, which libraries sought to address through the distribution of mobile WiFi hotspots, learning packets, one-on-one computer use, among other strategies to keep communities connected (Lai & Widmar, 2020; Robertson, 2020; Santos, 2020).

METHODS

The researchers analyzed Facebook posts made by 13 libraries and three public library systems in Michigan, North Carolina, Oklahoma, and Vermont from March, July, October, and December 2020, and March 2021. These libraries are the research sites for a larger IMLS-funded study (#LG-18-19-0015-19) focused on understanding health and wellness programs and services offered by small and rural libraries. The months selected are a convenience sample to allow analysis of a manageable number of library Facebook posts during the first year of the COVID-19 pandemic. Analysis was conducted by individual researchers reading through the posts numerous times to derive themes and subthemes. Then researchers collaborated to create a shared thematic framework which was then reapplied to the data to achieve interrater reliability. The study limitations include: 1) Since only public posts were examined, it is not possible to analyze the motivations that led to posting practices, and 2) Using a sample of months loses continuity of behavior that could be more apparent if all posts for the 13 months were examined.

FINDINGS

The thematic framework developed from Facebook posts included five types of content: library hours and services, COVID awareness, social and community services, programming, and wellness. In Oklahoma, one rural library system mostly posted library-created content designed to instill a sense of connection between library staff and their communities. Many of the videos they created were health-related such as cooking, gardening, and exercise. Another rural system, located in an economically depressed sector of the state, shared a wide variety of links related to jobs, unemployment, food and rent assistance, taxes, and access to healthcare. Both systems closed mid-March 2020, and both reopened, with some restrictions, by June 1. After March 2020, the pandemic did not overtly feature in posts. The libraries did continue to share a variety of health supporting content.

In North Carolina, as in Oklahoma, posts explicitly about the pandemic were infrequent after March 2020. Libraries took steps to share content related to wellness and social services. One shared information about where to go to get food. Another regularly shared content from the local health department. Library-created posts included content and programming on mental health, the importance of spending time outside, and how to cook at home and stay active during the pandemic. In March 2021, libraries shared information on starting spring gardens.

In Michigan, all libraries posted about closures in March 2020, and re-openings and access to virtual services thereafter. Limited COVID-specific content was shared after March 2020. Virtual programs began at one site in March 2020, and were common practice at all three sites alongside outdoor programs. Programs included StoryWalks, music and movement classes for kids, crafts, meditation, gardening, and cooking classes. Libraries also shared information about food access, an upcoming election, expanded 9-1-1 services, crisis help, and a community bike share initiative.

In Vermont, libraries started sharing virtual versions of scheduled in-person programming along with library closure information in March 2020. One library set up a program with its town to connect local residents with various social services including food sources, financial help, and crisis assistance, and posted regularly about this. In July, libraries announced brief walk-in visits of 30 minutes. They posted about pick-up kits for youth activities, virtual programs, gardening programs, museum and park passes, and StoryWalks, much of which continued thereafter. Shared content included posts about online forums on community needs such as free food. By December, library hours were limited again and only curbside was available, although borrowing of snowshoes began. In March 2021, libraries posted about COVID testing and vaccines, along with virtual programming (e.g., Qi Gong) and began offering outdoor programs with social distancing restrictions.

DISCUSSION AND CONCLUSION

By its nature, Facebook is a communication platform. Libraries used it to communicate with their communities throughout the pandemic. Engagement with Facebook, however, is predicated on patrons' having appropriate technology and tools. The lack of robust, affordable, and ubiquitous broadband in rural communities is a contributing factor to health inequity. It is a barrier that became more apparent during the pandemic as access to library services moved online. This work is a beginning to a better understanding of how rural libraries serving communities rife with digital inequities, innovated and adjusted to ensure access to and participation in this pandemic-fueled shift to online engagement. Libraries were able to leverage Facebook to continue to support community health and wellness during the disruption of the pandemic. The way libraries used Facebook varied considerably, with a broad mixture of virtual programs, timely information, advertisements for in-person services, Facebook Live events, and sharing social and community information. This poster demonstrates the ways small and rural libraries continued to support community health and wellness, even in the context of a global pandemic.

ACKNOWLEDGMENTS

We gratefully acknowledge the grant from the U.S. Institute of Museum & Library Services (#LG-18-19-0015-19) that funded this research.

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Can Knowledge Construction Be Harmful?

A Theory Building Approach to Explain Mr. Bolsonaro

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ABSTRACT

The production and spread of misinformation are phenomena of rising interest, and scholars in many fields attempt to explain this issue. Indeed, studies shed light on mechanisms that affect the way we interpret reality and create systems of belief that may not be consistent with what is broadly accepted as factual. We investigate potential connections between the ways in which we get absorbed by political discourse and how we construct knowledge. We discuss data from online and in-person conversations initiated by the Brazilian president, and we use those data to examine how he might be tapping into some effective devices in cognitive science and constructivism to “activate” theory building mechanisms in his audience, extending the impact of his messaging.

KEYWORDS

social networks, social computing, education, learning, constructivism.

INTRODUCTION

The creation and spread of misinformation and conspiracy theories are phenomena of rising interest, mainly due to the role they play in politics and its augmented reach through social media. The literature shows evidence that belief in conspiracy theories are part of a belief system that leads individuals to distrust authorities, who are seen as part of a “cover-up” (Wood et al., 2012). There is also evidence that humans have an inherent “tribal bias” that influences our beliefs according to our sense of and need for belonging (Clark et al., 2019). Other studies have shown that explanations offered by conspiracy theories satisfy epistemic, existential, and social needs (Douglas et al., 2017). Those studies describe individual and social mechanisms that affect the way we interpret reality and, to some extent, create systems of belief that might be inconsistent with what is broadly accepted as factual. In this poster, we investigate a related but likely unexplored dimension of the problem: connections between the ways in which we get absorbed by political discourse and how we construct knowledge.

Constructivism as a theory of learning proposes that humans learn through the constant development of “mini” theories to explain the unknown (Fosnot & Perry, 1996). That is, “mini” mental theories would be built upon existing knowledge, which serves as parameters to put new theories to the proof—the ones that comply with shared assumptions become part of a “canon.” Currently, established canons are being disputed: whereas in schools educators act as arbiters who define canons, in seemingly “horizontal,” online environments, authority is rather fluid, and users themselves may determine what accepted knowledge is. This could lead to a “twisted” form of discovery learning, in which learners are led to believe they have agency over the knowledge they are constructing upon information they are fed, which is sometimes strategically incomplete. While other theories are important in the understanding of human cognition such as Vygotskian views on learning as essentially social, in this poster we focus only on one aspect of the issue and one research question: *what are the possible and effective “activators” or triggers that start mechanisms of political theory-building?* As an example, previous research has shown that, in the US, QAnon has thrived in online forums with a clear “activator:” leaving only short, incomplete “clues” that anonymous users would use to decipher and collaboratively construct knowledge. Users’ conclusions become part of a shared rationalization that explains a global conspiracy (Partin & Marwick, 2020; boyd, 2018). In this poster, we explore whether and how a similar strategy is deployed by Brazilian President Jair Bolsonaro and his followers.

METHODS

The research team transcribed the content of 4 short, informal chats carried out by the Brazilian president and groups of supporters. Those video records of varied length (4’13” to 13’18”) were obtained from a pro-Bolsonaro YouTube channel. We also collected data from the president’s official Telegram channel. From that source, we analyzed the contents of one digital informative “card,” in addition to 155 comments to that publication. With this approach, we aimed to inspect (1) whether the president’s speech contains “activators” for his followership to build theories that help explain the state of affairs; and (2) whether the audience follows those clues and manifest their conclusions online. By applying this methodology, we build on previous scholarly work that investigated the role of a central

character (QAnon) as the source of inside information upon which laypeople would construct knowledge to uncover conspiracy theories (Lewis & Marwick, 2017). *For space considerations, here we discuss only a subset of the data.*

DATA AND RESULTS

In one of the transcripts/videos analyzed, *we observed Bolsonaro “constructing knowledge” with his audience.* A follower confronts him, and demands action against administrators who are supposedly making “the people, his ministers, and the president ‘bleed.’” The president then scolds the follower and inquires about her previous votes in the last 30 years (without offering an answer). The conversation goes on, and a few minutes later the same follower tries to fix the controversy by saying that Mr. Bolsonaro did not grasp what her point was. The president insists that he knows “what she meant”, adding that she has great political potential and that she would be able to quickly solve all the problems in the country. Never does Mr. Bolsonaro offer an answer. Next, a male follower assimilates the president’s *activation* and concludes: “You can’t have everything whenever you want, it doesn’t work in the blink of an eye. You gotta have patience. What you want is hard to get.” In the video’s comments, users reach analogous conclusions: “Bolsonaro won’t solve it all in 4 years There’s a time for everything!”

In the next excerpt in this subset, *Bolsonaro talks about electronic ballots*, which have motivated false claims of election frauds. The solution to this problem, as pointed by Mr. Bolsonaro in other occasions, is adopting a system for printing voting receipts—cleverly nicknamed “verifiable ballot.” This counterintuitive rationale is backed by the president’s followers on Telegram: one of the messages shared by Mr. Bolsonaro asks: “Why would one fear verifiable ballots?” Again, he offers no answer, but his audience offers many, following a tone that converges with the election fraud hoax: “They [the opposition] will not be able to exert control over the elections.”

In the final excerpt, Mr. Bolsonaro discusses public finances and the fight against corruption. He talks about governance at the public Postal Service and at a state-owned bank, saying that both started to turn a profit after he took power, because before him “each department [at the bank] used to have an ‘owner,’ not anymore. The Postal Service made a profit, who would have thought of it?” Again, Mr. Bolsonaro ends with a question and offers little information. One follower “fills in the blanks” and comments that: “It’s just a matter of stopping the theft and there’s money left, right?” A YouTube commentator echoes that same rationale: “if we stop the theft, there will be money, here is the proof.”

DISCUSSION AND CONCLUSION

In this poster, we applied a lens of knowledge construction to investigate the connections between how Mr. Bolsonaro’s discourse is structured and the conclusions expressed by his audience. In the data analyzed, his speech is not used as an instrument to “tell” followers what to believe or how to think about certain policies. Instead, he strategically offers clues that give followers the impression of arriving at the conclusions themselves. In this poster’s data subset, our preliminary results show that the president’s “clues” appear in the form of *rhetorical questions* (“Why would one fear verifiable ballots?”, “Who have you voted for in the last 30 years?”). Those questions invite followers to build their own theories of what is happening within an environment of confirmation bias, invariably supporting the president’s views. Our data analysis shows that the president employs language very effectively to engage his followership in knowledge construction leading to the narratives he is interested in, even if he is not offering much concrete information. Indeed, the findings reported here indicate that the methods employed by Mr. Bolsonaro are not as sophisticated as the approach implemented by QAnon, whose methods are the benchmark for this study. However, his speech points to a pattern of using one effective “activator” of the mechanism of theory-building: carefully constructed questions. In answering such questions, followers are channeled to conspiracy theories that feel like an authentic choice and a conclusion they reached by themselves. In our unabridged dataset, we see other activators as well, which we will discuss in future work, such as “puzzle-like” social media posts with cherry-picked data. We are actively collecting and analyzing data, including messages distributed across a broader range of social media, in order to investigate in more depth the processes employed by laypeople in their collective knowledge construction, finding and validating more theory-building activators.

This work seems relevant because, even in the small dataset here, we found a counterintuitive trigger rarely discussed in the Brazilian press: Bolsonaro’s “questions”. The most accepted explanation, conversely, is that his followers are just blindly believing wrong information fed to them. It seems like Bolsonaro’s method is far more intricate, and further research could shed light on more of his mechanisms and strategies.

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Flames of Justice in the Virtual Garden: A Preliminary Analysis of Tweets around the Death of an Indian Celebrity

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ABSTRACT

Social media, particularly Twitter, is a powerful medium for expression and discussion across regions and communities in the world today. Using hashtags, a powerful and popular affordance of Twitter, several forms of civic engagement and online social campaigns emerge and inform public discourse. Although several prior studies have investigated the rhetorical impact of such narrative movements on Twitter, an important consideration lies in understanding the structural forms that such narratives take depending on the context and regional culture where the movement originates. To this end, this study embarks on a preliminary analysis of 150 tweets related to calls of action and social justice in the aftermath of the death of a popular Indian movie star. The analysis reveals a diverse spectrum of themes ranging from expressions of loss and grief to critiques of institutions and mechanisms of power. Parallel but powerful themes also demonstrate attempts to nurture and embolden the campaign. The aim of this analysis is to provide insights into how such channels of discourse might be designed to create a medium of freedom of expression and foster safe spaces for civic engagement.

KEYWORDS

Narrative justice; E-protests; Civic engagement; Twitter; Content analysis.

INTRODUCTION

The 20th and 21st centuries have been marked by numerous struggles for independence and freedom, some of which are still ongoing (Fominaya, 2014). This is particularly true for newly independent states and postcolonial nations grappling with the injustices of former colonial rule and the internal strife that often stems from it (Sen, 1997). Most of these movements center around issues of social inequality and aim to bring accountability and fairness into discussions about colonialism and how we might repair a contemporary world that is still fragmented by this historical and ongoing process (Della Porta, 2020; Gerbaudo, 2017). In a similar vein, in the contemporary world, thanks to the advent of the Internet and other computing infrastructures, such protests have found a medium and channel for extended participation and propagation (Bastos et. al, 2015). Prior work has highlighted how social media channels, such as Twitter, have emerged as key spaces for voicing one's beliefs and perspectives related to civic and societal issues which have culminated into movements for social justice sometimes referred to as 'e-protests' (Shirky, 2011; Tufekci, 2017). In the aftermath of the death of Indian movie star Sushant Singh Rajput (SSR), Indian netizens took to Twitter to express their views, perceptions, and expectations from institutions of justice to address the situation at hand (Abkar et al, 2020). While several narratives were at play, interestingly, the narratives quickly took a turn towards demands of justice and retribution as well as challenging the authority and supremacy of the elite institutions demonstrating how social media can affect the way democracy is perceived and performed by the Indian people (Tekriwal, 2020). The goal of this study is to analyze the way a movement arises in a virtual medium and the narrative forms that emerge, to gain insights into the social awareness of Indian netizens who further bolstered these 'e-protests' and online social movements. The essential questions that this study addresses are:

1. *What are the main themes that are visible in the hashtags of interest?*
2. *How may the hashtags differ in the form of narrative that emerges around them?*

RELATED WORK

This work primarily builds on the frame of narrative justice. Rooted in theories derived from social and political philosophy, the concept of narrative justice is based on the idea that aesthetic experiences, such as interactions with art and media objects, have an influence on one's moral development (McGregor, 2018). It thus maintains that victims of unjust treatment can be accounted for and redressed through the rhetorical power of narrative (Rasras, 2005; Kapuscinski, 2007; Uwihoreye, 2019). With the rise of online communication, social media has become a fertile ground for the application of narrative justice as both an analytical lens and a praxis (Georgakopoulou, 2017). Hashtags and the narratives that emerge around them, can be considered key mechanisms to carry out narrative

justice (Joyce, 2010; Mutsvairo, 2016). So, the structure of the narrative that emerges in such campaigns is crucial to understanding the goals of such movements. Prior work in this area, highlights the concept of narrative agency, which states that the structure of such narrative movements may be contextual and dependant on several intersecting social and cultural factors, rendering each social movement unique in its narrative form (Yang, 2016). The nature of a narrative may assume many different proportions depending on the objective of the movement. Akin to the context of this study, prior work on celebrity death and use of social media has analyzed how the narrative in such circumstances depicts grief and a keen sense of public mourning (Gach et. al, 2017; Lisac, 2017). However, an understanding of how the narrative structure in such cases can also assume a character akin to a protest or uprising is yet to be fully explored. Thus, our chief aim is to extend the prior investigations by providing insights towards how the emergent narrative structure may indicate a combination of elements akin to mourning and grief related to the loss of a celebrity while also bearing an essence of justice and fairness.

METHOD

Data is primarily collected from Twitter using the Python-based Tweepy API for a week from 23rd December, 2020 to 30th December, 2020. Tweets associated with three hashtags #JusticeForSushantSinghRajput, #Love4SSR, #SSRWaiting4Justice were investigated. A random sample of 150 tweets, 50 for each hashtag was analyzed. The corpus collected had the username, tweet id, tweet text and the number of retweets. In total, there were 45 unique users in the corpus. For this initial stage of investigation, content analysis, using a thematic coding approach was used to infer the results as below (Boyatzis, 1998).

RESULTS

The main emergent themes along with the percentage of tweets in each of these categories were as follows.

Providing motivation and solidarity (43%): This was the most prominent theme of the movement and represented the different ways in which people came together to support each other to empower the movement. An example tweet for this category was: *Is India awake now? If yes then roar like you have never before!!!* **Disillusionment with the system (23%):** These tweets condemned the governmental response to the incident and critiqued the lack of values and integrity in the system of governance and leadership. An example tweet was: *It was a well-planned murder! The suicide narrative was set from the beginning, the police and media played along.* **Protecting the campaign (16%):** Essential to sustain the movement, these tweets involved sharing resources about discussions, videos and articles related to the case. An example tweet was: *I will not stop tweeting and will request all SSRians to do the same until justice is given.* **Parasocial attachment (8%):** These tweets helped to reinforce strong emotional bond with the departed soul. Through these tweets people conveyed their feelings, grief, and a sense of loss at the untimely demise of their much beloved actor. An example tweet was: *I am stuck with these feelings for him. Overwhelmed with each tweet, I am still in the same positive state.* **Raising awareness towards ground movement (7%):** These tweets highlighted the nature of protests on the ground and asked people to join and contribute to these movements. An example tweet was: *Today Protest in Delhi CBI Headquarters.* **Appreciation of contribution (3%):** These tweets thanked those who have contributed and helped to grow the movement, thereby fostering a sense of connectivity and attachment. An example tweet was: *Congratulations SSRians. Such achievements are only possible if we stand together united.*

DISCUSSION AND CONCLUSION

The emergent themes as described above indicate different ways in which Twitter users attempted to amplify, preserve and empower the campaign. Adding to the demands for justice, were attempts to network and create a sense of community; information sharing and occasions for reminiscence, all of which help to sustain the movement and its mission. Further, we see a divergence between the conversations that use the hashtags #love4SSR and #JusticeForSushantSinghRajput. While the second hashtag was primarily concerned with motivating and expressing solidarity, the first hashtag aimed to focus on expressing disillusionment with the system while also expressing feelings akin to the theme of parasocial attachment as mentioned above. This further provides evidence towards the form of narrative agency that emerged in this context. This study provides initial but important insights into the way in which a narrative around justice is performed and sustained. We further see cultural anecdotes embedded in the larger themes as highlighted in the results which further add to the motivation and contribution of this study. Such inferences can help inform a holistic understanding towards platform design and governance from a global perspective. For future research, the goal will be to scale the initial themes through more robust qualitative and quantitative analysis and also seek to explore insights towards the ways in which different narratives emerge around hashtags, glimpses of which have been found through this analysis.

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A Conceptual Framework of Data (Info) Quality Revisited

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ABSTRACT

This study reports a critical assessment of whether the framework of data (information) quality identified by Wang and Strong's (1996) seminal article continues to hold true in a diverse 21st century information environment. Our study attempts to identify the salient changes that have taken place since Wang and Strong's analysis by exploring wiki contributors' perceived information quality on Wikipedia. An online qualitative survey was conducted with 197 respondents who are Wikipedia readers and/or contributors. Our preliminary results from the unidimensional data analysis reveal over 20 information quality dimensions including a new category, with multiple dimensions.

KEYWORDS

Information quality; information behavior; social media; Wikipedia.

INTRODUCTION

Wang and Strong's (1996) seminal research on data quality was revolutionary because it sought to develop a framework on concepts related to data quality from the consumers' perspective rather than solely from information professionals. However, the information landscape has drastically changed in the nearly 25 years since the original publication and while researchers have continued to explore different aspects of information quality, we observed very little advancement in terms of new categories and dimensions that reflect the diverse information content and platforms of the 21st century. Additionally, there is concern that previous research overwhelmingly recruited study participants from a rather narrow homogenous population of white college students (Zhang 2014, Arazy and Kopak 2010, Wang and Strong 1996), while others were silent on the racial/ethnic demographics (Stvilia et. al, 2009).

Therefore, we explore the Research Question: What salient changes have occurred since Wang and Strong's analysis by exploring Wikipedia contributors' perceptions of information quality. Cognizant of equity, diversity, and inclusion we wanted a broad constituency of study participants that reflected a larger population cross section than was observed in previous studies. Results of the study will improve knowledge about users' conceptions of information quality in social media, particularly in the peer produced encyclopedia Wikipedia.

LITERATURE REVIEW

Since Wang and Strong's (1996) article researchers have sought to better understand aspects around users' perceptions of information quality. In this section we explore the relevant literature spanning several knowledge areas including web portals, Wikipedia, and consumer health information. Taking a consumer-focused approach, Wang and Strong (1996) identified four categories on data quality. Intrinsic, contextual, representational, and accessibility, which were further sorted into 20 discrete dimensions (see Figure 1). In their focus on student web portfolios, Katerattanakul and Siau (2007) proposed a new information quality framework comprising three categories: presentation quality, contextual quality, and accessibility quality. Their results were a departure from the original information quality framework (Huang et al., 1999; Wang & Strong, 1996) which included a fourth category, intrinsic information quality. Research by Stvilia, Mon, and Yi (2009) and Zhang (2014) emphasized aspects of health information quality. Their findings suggest that users employ different IQ criteria based on factors such as the information source, or container, and information provider. Stvilia and colleagues also noted the consumers' lack of information literacy skills as a likely barrier to online health information. While the previous studies devised new categories in IQ concepts, Arazy and Kopak (2010) sought to test the degree to which dimensions of IQ are in fact measurable. Using Wikipedia articles as a source of content, IQ dimensions were found difficult to assess, with little agreement among participants. Accuracy was rated with the most agreement, whereas participants were most inconsistent with the dimension completeness; representation and objectivity both scored in the middling ranges. The aforementioned studies explored various aspects of IQ but we see little evolution in the categories and dimensions observed.

METHODOLOGY

A qualitative survey was deployed that aimed at gathering the diversity of our research topic, the *information quality* on Wikipedia, within a given population. We recruited 197 study participants through the online Qualtrics survey site in 2020. They were individuals 20 or older who have also contributed to Wikipedia at least once over the last 3 years or have read articles in everyday life on the English edition of Wikipedia. Out of 197 respondents, 95 (48.22%) were male, 100 (50.76%) female, while 2 (1.02%) did not identify a gender. Fifty-two (26.4%) are high school graduates or less, 104 (52.79%) are Associates and bachelor's degree holders while 41 (28.81%) hold graduate degrees. Sixty-one (31%) of the respondents were white and 136 (69%) were non-white. We collected qualitative data through free word association (Jung et al, 2009, Schmitt, 1998). Study participants were asked to generate at least 3 items of concept/word/phrases that came to mind while reading Wikipedia; this content is considered as aspects of information quality encountered in Wikipedia articles. In total, 727 of responded items were collected from participants. We went through a data reduction process by eliminating erroneous/meaningless words and combining similar words into one concept; next we performed a first-level unidimensional analysis. This process includes identifying categories and dimensions and differentiating them from the data set (Jansen, 2011). In order to answer the research question posed in the current study, the organized data was analyzed by employing thematic analysis in order to elicit meaningful dimensions. Subsequently the emerging dimensions were mapped with the 4 categories and related dimensions identified in the original data/information quality framework proposed by Wang and Strong (1996).

PRELIMINARY RESULTS

Figure 1 shows the comparison of the emerged dimensions by the current study and Wang and Strong's conceptual information quality framework.



Figure 1. Wang & Strong (1996)'s original 4 categories and an emerged new category from the current study

CONCLUSIONS

Our preliminary results reveal over 20 information quality dimensions including a new category, with multiple dimensions, that do not appear in Wang & Strong's original IQ framework. These include Fun, Empowering/Uplifting, User-generated and various viewpoints. The original IQ framework (1996) was developed by surveying pre-web dated 'data consumers' while our data derives from surveying Wikipedia readers/editors. This difference in the information environment produces a new IQ category that information users perceive when assessing the quality of information on other Web sources. Especially, dimensions such as Empowering/Uplifting echo with Ju and Stewart's (2019) study exploring Black Wikipedians' views/perceptions of Wikipedia roles in terms of its content. Fun (Nov, 2007), and User-generated reflect Wikipedia's social aspects and user participation of content generation in the Web 2.0 environment. Future research will refine the coding scheme under five primary categories that include a newly emerged category 'Social Aspect', and will identify the ranked priorities for the different dimensions based on frequencies among users' responses. The results will provide a baseline perspective of IQ dimensions for user generated content in the current Web environment.

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Meta-gender-study: A Gender Study of Global Distribution on Gender Studies

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ABSTRACT

The purpose of this study is to explore the gender distribution of researchers in the field of gender studies. We used bibliometrics methods on a dataset of gender studies from Web of Science between 2007 and 2019. The results show that unlike other fields in scientific communities, gender studies are dominated by female researchers. The majorities of gender study communities come from North America and Europe, which are both dominated by female researchers.

KEYWORDS

Gender Study; Gender Distribution; Gender Difference.

INTRODUCTION

Gender study is a cross-disciplinary research area related to women, sex, gender, and feminism. The majority of gender studies primarily discussed how gender disparities connect with poverty, racism and heterosexism. Male researchers absolutely dominate many fields in scientific communities (Lariviere et al. 2013). However, the distribution of gendered researchers of gender studies remains unrevealed. This study aims to examine this matter from a global perspective.

RESEARCH DESIGN

We downloaded the metadata of all the Women's Studies journals in Web of Science from 2007-2019. We chose 2007 as a starting year because Web of Science started to provide authors' full names since 2006. 2,934 articles were randomly selected from a total of 21,981 articles in 45 journals (15% of each journal in each year). 9,752 of all the authors were collected to be disambiguated. We disambiguated the author according to research id, authors' emails, affiliations and addresses and identified 6,827 researchers across 96 countries in the study.

We primarily tested three existing methods, sexmachine, genderAPI, and NamSor. They all provide open APIs and single term retrieval functions. For the accuracy of all names and Asian names (87.18% and 65.41%), NamSor performed better than other methods (Santamaría et al. 2018). Therefore, we chose NamSor as a tool for gender identification. All the researchers' names are identified with gender.

FINDINGS

Overview

Continents	Publication	Female				Male			% of female researcher
		# of researcher	# of publication	M		# of researcher	# of publication	M	
North America	1,327	2,949	1,212	2.43	823	548	1.50		78.18%
Europe	868	1,156	652	1.77	354	235	1.51		76.56%
Asia	399	492	248	1.98	387	205	1.89		55.97%
Oceania	191	313	155	2.02	87	63	1.38		78.25%
Africa	114	112	64	1.75	79	36	2.19		58.64%
South America	35	48	23	2.09	27	15	1.80		64.00%
Total	2,934	5,070	2,354	2.15	1,757	1,103	1.59		74.26%

Table 1. Gender distribution of researchers

In Table 1, North America occupies the largest groups of researchers in gender studies (45%) and the most publications. Female researchers outnumber male researchers from both aspects of proportion of population and average publication. The average annual number of publications by female researchers exceeds that of male researchers in almost all regions, except in Africa.

Temporal gendered distribution of gender studies

In 2007-2013, the proportion of female researchers in the field of gender was increasing constantly from 55% to 80%. Afterwards, the percentage of female researchers has remained above 70%. Gender studies have been dominated by female researchers unlike other fields (Sugimoto et al. 2019).

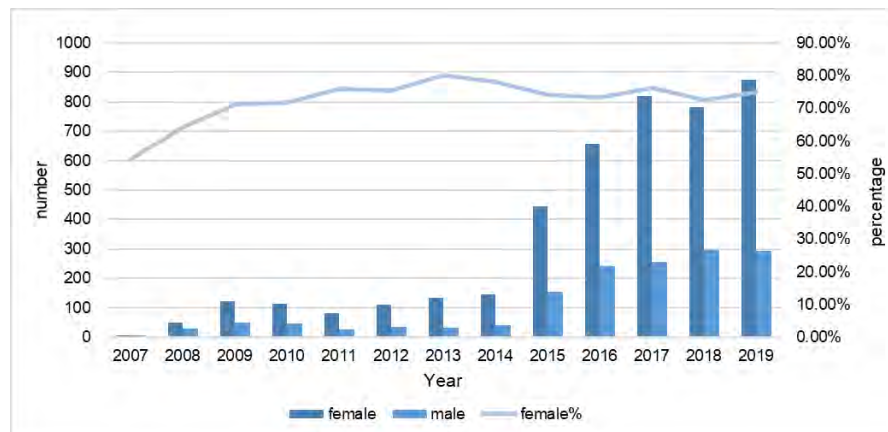


Figure 1. The trend of the proportion of female researchers

Global gendered distribution of gender studies

Figure 2 shows the scatters of gendered researchers in different countries. The further left away from the parity line a node is, the more female dominated the country is. The gender status of United States was excluded in the figure since it overnumbered all other countries, with the highest average of 52 male researchers and 183 female researchers. Apparently, countries in Europe (UK, Spain, Sweden, Germany) and North America generally share a higher proportion of female researchers. While some Asian countries are on the contrary, such as China and South Korea.

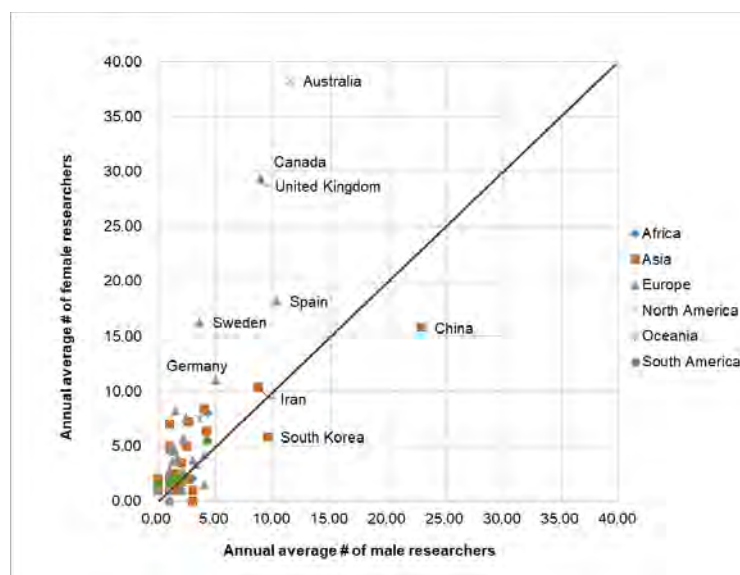


Figure 2. Gender distribution in different countries

CONCLUSION AND FUTURE WORK

In this primary study, we concluded that female researchers are the majority of gender studies, especially in North America and Europe. Due to political and cultural factors, the distribution of gender researchers can vary from regions. Follow-up studies will explore the subfield distribution and the leading authorship of the articles, and expand the dataset to the entire set of articles, trying to find out the reasons to these phenomena.

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Students' Motivations for Not Sharing Rumours during the COVID-19 Pandemic in Singapore

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ABSTRACT

The COVID-19 pandemic has underscored the importance of curbing harmful misinformation and prompted legislation against fake news. Based on the case of the COVID-19 pandemic in Singapore, this study investigated motivations behind college students' decisions not to share rumours on WhatsApp. Responses from 75 participants were collected through an anonymous online survey in July 2020. The findings suggest that during an infectious disease outbreak, students' decisions not to share rumours were motivated by concerns related to information quality rather than the fear of regulatory punishment.

KEYWORDS

rumours; misinformation; social media; fake news regulation; infectious diseases.

INTRODUCTION

Understanding social media users' motivations to share or not share rumours could inform efforts to curb the harmful spread of misinformation. Meanwhile, recent anti-misinformation laws provide a new frontier for research. One such law is Singapore's Protection from Online Falsehoods and Manipulation Act (POFMA), enacted in May 2019, which is one of the most comprehensive anti-fake news laws in the world (Funke & Flamini, n.d.).

Using the case of the COVID-19 outbreak in Singapore where exposure to COVID-19 misinformation has been widespread (Long et al., 2021), a study was done by the authors to investigate the motivations behind college students' decisions to share or not share COVID-19-related rumours on WhatsApp, and how the motivations varied by rumour type (dread or wish). Dread rumours refer to those that spell doom and gloom while wish rumours invoke desirable consequences. Results showed that more than 90% did not share or hardly shared either type of rumour. Thus, this paper adds to extant literature by examining the research question: *During an infectious disease outbreak, what motivates college students not to share rumours on WhatsApp?*

METHODOLOGY

This study used an anonymous online survey distributed in July 2020 via WhatsApp and email to the authors' personal contacts and on Telegram groups for college students. The participants were shown two sets of sample WhatsApp rumours related to COVID-19, one set each of dread rumours and wish rumours, with four rumours in each set. With each set described as representing a type of message (the word "rumour" was avoided) participants were asked about their frequency of sharing and motivations for not sharing each type of rumour. The rumours were drawn from news articles, fact-checking organisations (e.g. AFP Hong Kong, 2020) and the authors' collection of WhatsApp rumours received from contacts. To reduce social desirability bias, rumours that had been specifically debunked by the Singapore government were not used. Five types of motivation behind not sharing rumours were measured. Four motivation types were based on Uses & Gratification and rumour literature: (i) entertainment, (ii) socialisation, (iii) information-seeking and (iv) self-expression and status-seeking (Bordia & DiFonzo, 2013; Chen et al., 2015; Lee & Ma, 2012). In addition, the survey measured a fifth motivation type related to anti-misinformation regulation, namely, fear of punishment. The five motivation types were operationalized as 15 items on a 5-point Likert scale. To reduce biases arising from the ordering of items, randomised ordering was used to present the sets of rumours (i.e. whether the dread or wish rumours were shown first was randomised) as well as individual motivation items.

FINDINGS

Data was collected from 75 college student participants, who were mostly Singaporean. Sixty percent of participants were female and most participants were aged 21-25. Most participants indicated awareness of POFMA during the COVID-19 outbreak. (As the relevant question was optional, lack of response does not necessarily mean lack of awareness of POFMA.) An almost-equal number of participants indicated some level of not sharing dread ($n = 62$) or wish ($n = 61$) rumours. For both rumour types, the vast majority of recipients tended not to share the rumours:

93.6% of the dread-rumour recipients and 90.2% wish-rumour recipients reported that they did not share or hardly shared rumours of that type. Thus, the subsequent analyses focus on motivations for *not* sharing rumours.

Motivations for not sharing rumours

Tables 1 and 2 present the top three and bottom three motivation items, ranked by mean values, for each rumour type. For both types, the highest ranked motivations included “The information in the message(s) was not useful” and the motivation “I did not need to get attention by sharing”. On the other hand, the fear of punishment by the law ranked at or near the bottom for both rumour types. Twenty-two free-text responses were received for an optional question asking whether participants had other reasons for not sharing rumours. Most responses simply cited the questionable veracity of the rumours, using terms such as “fake news” and “dubious” to describe the messages. A few responses also suggested why sharing would be undesirable, e.g. “can cause significant harm”, “might spread fear and anxiety”.

Rumour Type	Rank	Item	Mean \pm SD
Dread	1	The information in the message(s) was not useful.	4.32 \pm 0.78
	2	I did not need to get attention by sharing.	4.08 \pm 1.18
	3	Not sharing would be more considerate to my friends and family.	3.94 \pm 1.16
Wish	1	The information in the message(s) was not useful.	4.46 \pm 0.79
	2	Sharing would not have helped me get more information.	4.16 \pm 0.88
	3	I did not need to get attention by sharing.	4.07 \pm 1.09

Table 1. Top 3 motivations for not sharing rumours

Rumour Type	Rank	Item	Mean \pm SD
Dread	13	Sharing would have made me look bad to my friends or family.	3.02 \pm 1.49
	14	I did not need to interact with people.	2.84 \pm 1.31
	15	I was afraid of being punished by the authorities.	2.76 \pm 1.48
Wish	13	The anti-misinformation law prohibited me from sharing.	3.02 \pm 1.32
	14	I did not need to interact with people.	2.89 \pm 1.33
	15	I was afraid of being punished by the authorities.	2.69 \pm 1.40

Table 2. Bottom 3 motivations for not sharing rumours

DISCUSSION & CONCLUSION

The study found that the top motivations not to share rumours were (i) finding the information not useful, likely due to information quality as indicated in the free-text responses, and (ii) motivations related to consideration for others. That consideration for others was also a major motivation may reflect a belief that spreading untrustworthy information is harmful, as expressed by some free-text responses. Fear of punishment by anti-misinformation regulation was found to be ranked lower as a motivation. On the whole, the findings suggest that compared with the motivation to avoid punishment, students are more motivated not to share rumours based on the principle that sharing unverified information during an outbreak is harmful. Also, given the similar ranking of motivations and high rates of not-sharing across rumour types, rumour type may not make a notable difference to students’ decisions not to share rumours and corresponding motivations.

Limitations of this study include restricted generalisability due to convenience sampling, and the lack of control of confounding variables, such as the perceived trustworthiness of the sample rumours. With those caveats in mind, this study offers tentative implications for information literacy programmes. With the right training, students may be able to serve as sources of positive influence for family members (Haigh et al., 2019). Also, since consideration towards others seems to be a major motivation not to share, this concern could be tested in future research as a frame for anti-misinformation messages.

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Collaborative Approach to Translating Online Learning Content: Research Data Management Librarian Academy (RDMLA) and National Taiwan University (NTU) Library Translation and Co-Creation Partnership

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ABSTRACT

The Research Data Management Librarian Academy (RDMLA) is a global professional development online program for librarians and other professionals working in research-intensive environments. To reach a broader learner community, the RDMLA team established a Chinese translation partnership with the National Taiwan University (NTU) Library in early 2020. Through collaborative problem solving, positive participation, inclusive coordination, and leveraging of teams' strengths, the project has succeeded in its mission, with the translated course due to launch in October 2021. Featuring team workflow illustrations and contributions, this poster covers collaborative translation processes and lessons learned, hoping to inspire similar international partnership projects.

KEYWORDS

International collaboration; community engagement; translation; open-access online learning; RDM.

INTRODUCTION

The Research Data Management Librarian Academy (RDMLA) is a global professional development program for librarians and other professionals working in research-intensive environments. This online program, collaboratively developed by librarians, LIS faculty, and industry professionals addresses learning gaps in RDM training. The curriculum framework consists of eleven units addressing expressed RDM needs while avoiding redundancy in current training offerings. Currently, the RDMLA has more than 5,200 active learners from 159 nations.

To reach a broader learner community, the RDMLA team established a Chinese translation partnership with the National Taiwan University (NTU) Library in early 2020. The partnership is based on a shared purpose of providing better access to quality, open access educational materials to broader learning communities. Through a collaborative approach involving an iterative review, both teams aim to ensure that the translation retains the authenticity and integrity of the original content.

PROJECT PROCESS AND CHALLENGES

The Translation Roadmap (Figure 1) illustrates the integrated project workflow. After signing a Memorandum of Understanding (MOU) in February 2020, the pilot translation phase was carried out, which enhanced the understanding of the time and resource commitment. The Statement of Work (SOW), signed in June 2020, specified the work expectations, capabilities, responsibilities, and timeline. The NTU team assumes the financial commitment of their translation work. RDMLA maintains the rights to the original materials. Both teams have equal access and use of the Chinese translation.

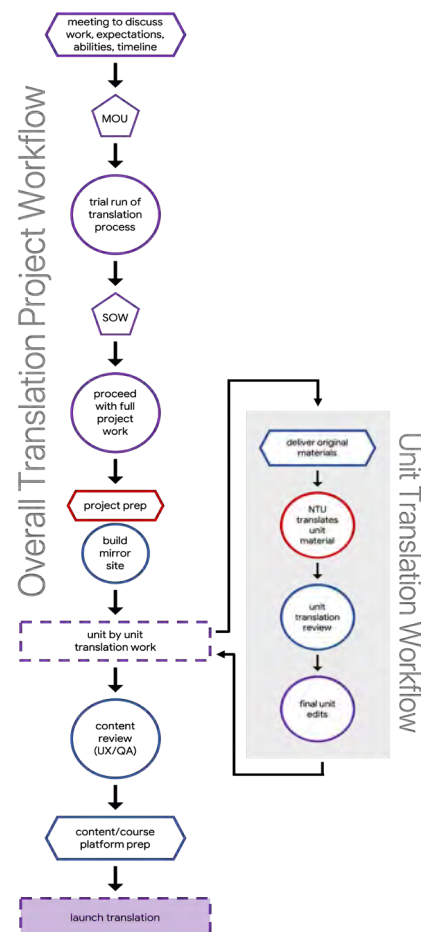


Figure 1. Translation Roadmap

The timeline of the translation project was configured to allow an overlap of the unit translation process, maximizing time and resources. Once NTU completed a unit translation, it was delivered to the RDMLA team for review. Over the review period, the NTU project staff began work on the next unit. Upon completion of all

translations, RDMLA will proceed with a thorough content evaluation, with proper quality control and user experience investigations.

CHALLENGES AND STRATEGIES

Throughout this process, key challenges include:

1. Issues with translation technologically oriented content: What terms should or should not be translated?
2. Issues with translating conceptional oriented content: How do we handle a typical American expression in case scenarios?
3. Differences between the terminology in Taiwan (traditional fonts) and Mainland China: How to approach different terms used in the two locations when our goal is to reach all Chinese language speakers?

Preempting potential issues, the teams established workable and easy to implement solutions to the above challenges prior to the start of the translation work. The joint consensus concluded that acronyms are to always be spelled out, and along with associations, programming languages, software, and platform tools, remain untranslated in the original English. Conceptional content requires different approaches. For field-related theories and principals (ex: FAIR), the phrase is spelled out in English and background context in Chinese is provided. Regarding idioms and American expressions, both teams work to find an equivalent Chinese expression. When a literal translation is not available, a semantically equivalent version is substituted. Given the expectation that the translated course will be usable by all Chinese speaking learners, including in Taiwan and other areas that use traditional fonts, and in Mainland China, which uses simplified Chinese, both teams agree to include a glossary table at the beginning of each unit to list frequently used terms translated in traditional and simplified Chinese.

Other common translation issues ranged from mistranslations of academic or professional terminologies, theories, and/or frameworks, misunderstanding of idiom phrases or difficult-to-understand complex sentences, to minor problems, such as awkward phrasing. During the joint review meeting, the RDMLA and NTU teams discuss and resolve unit-specific issues that occurred in the translation.

LESSONS LEARNED

The key to the collaboration's success was not an abundance of resources, but the shared commitment to make the RDMLA a viable learning tool for those whose first language is not English. This common goal inspired both teams to be diligent with their time and provide understanding and support for one another. The following are important lessons we learned from this process:

- “It takes a village”: A team needs to consist of more than just translators. Content experts and coordinators are also essential to make the project successful.
- Careful planning and flexibility: Planning from both parties helped minimize cost and maximize productivity, with the understanding timelines may need to change midstream. The teams encountered technical difficulties, yet were able to overcome hurdles by anticipating future snags.
- Best practices for the translation and review process: Translating learning content is not a literal “word-for-word” translation. There are strategies and mindfulness associated with handling both conceptually oriented topics and technology focused content.
- Maintain rigorously in translation accuracy: With the rich content of the RDMLA, it was important to keep a high level of rigor and quality. This was achieved by members of each team inspecting the translation at different levels of granularity to ensure consistency and accuracy.

CONCLUSION

This global collaboration was successful due to the emphasis placed upon valuing each group's contributions. The mutual respect created an open and inclusive environment allowing for honest communication and collaborative attitudes in solving translation issues. Positive participation was promoted throughout the process, including recognizing and leveraging each team's strengths. The dedication to equitable learning and growing a global community of practice was the essence of this partnership.

Reddit as a Forum for Social Service Workers

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ABSTRACT

Social work professions are increasingly studied as key sites for understanding precarity, affective labor, and the future of care work. However, little research has explored social workers' recordkeeping practices. This study expands on existing research on records and documentation through engaging with users of "R/Socialwork," a subforum on the internet forum Reddit.com. Utilizing a multimodal approach drawing on participant observation, in-depth interviewing, and discourse analysis, this research sought to answer the following research question: How do social workers understand their use of and interaction with records? Findings indicated widespread frustration with documentation paradigms in the profession, with variation based on sub-field and proximity to clinical practice. Users expressed this frustration in a variety of ways, with some utilizing the forum to support entrepreneurial approaches to problems in the field, while others used the site as an alternative form of recordkeeping, documenting their emotional responses.

KEYWORDS

Recordkeeping; Documentation; Reddit; Social Work; Entrepreneurship.

INTRODUCTION

A substantial body of literature has explored recordkeeping practices in various organizational settings and examining documentation has been a core part of archival science and information science literature for several decades. (Drake, 2014; Trace, 2002; Yakel, 1996, 2001) A significant amount of research has also investigated social work professions, which are increasingly studied as key sites for understanding precarity, affective labor, and the future of care work. However, little research has examined recordkeeping practices in social work contexts or explored how those practices are implicated in larger labor questions. This project is a first attempt at shedding light on these practices, by examining the experiences of users of the subreddit "R/Socialwork", an online community comprising over 40,000 members, most of whom self identify as social workers or students interested in the field. The site was chosen for the broad range of social work specializations and geographic regions represented.

METHODS

For the investigation into the recordkeeping practices of the subreddit users, we employed a multimodal approach drawing on digital participant observation, interviews, and discourse analysis. Over the course of several months, we observed and interacted with members of the "R/socialwork" community, taking detailed field notes and writing processual memos. After initial observation, we recruited six participants for in-depth interviews. Participants had a variety of educational backgrounds. Their specific occupations reflected the array of careers under the umbrella of social work, ranging from hospital and social service settings to consultancy and policy work. Similarly, participants reported differing levels of Reddit use and overall comfort with technology. Participants were selected during participant observation through theoretical sampling based on participants forum use. Recruitment prioritized active users who represented a range of social work careers. All participants had to be 18 years of age and members of the subreddit. Interviews followed an interview guide which was modified iteratively throughout the project. The interview data and processual memos were analyzed through qualitative coding using both In Vivo and Concept coding to guide the analysis (Saldana 2013). The data from observation and interviewing was complemented by discursive analysis of three specific media objects. These artifacts (the PHQ9 suicide risk assessment form, a video commercial for the teletherapy service Betterhelp, and a news article about the city of Austin, TX's MyPass blockchain ID project) were identified during data collection. The analysis of these artifacts helps situate the other data in a broader social context. Taken together, this multi-method approach allowed for deeper understanding of the complex social dynamics behind users' recordkeeping practices and forum engagement.

DISCUSSION

Recordkeeping and Entrepreneurship

In our interviews we asked several questions about how our interlocutors thought about recordkeeping and documentation practices. Many of them described documentation as all-consuming or overwhelming. The participants we spoke with generally realize that documenting their work is a core part of their job but had

significant frustrations both with the time dedicated to documentation and the technology and systems required to complete it. One participant noted spending 25-30% of their day completing paperwork, while another noted that of their daily work, “pretty close to 70-75% is record keeping in some way shape or form.” Complaints surrounding this work included having to duplicate information within multiple systems, outdated computers breaking down frequently, and systems logging out in the middle of creating a report and losing information. It became apparent in our interviews and observation that some individuals are trying to minimize these challenges through attaching themselves to an entrepreneurial mindset, echoing findings by Avle et al., (2019). One participant described starting a social work consultancy business focusing on IT as a way of addressing what they saw as problems in the field. They described utilizing the subreddit to “see what kind of questions people were asking,” to help guide their consulting work. Other users also saw frustrations with recordkeeping as challenges to be solved through entrepreneurial solutions and envisioned the subreddit as a source of information and feedback on their ideas.

Subreddit as Informal Recordkeeping

Other participants used the subreddit for expressing frustration rather than brainstorming solutions. This appeared in at least 4 of the 6 interviews. One participant expressed enjoyment in seeing these kinds of posts because as a new social worker it gave them more intimate details of what they could expect from their future jobs. They stated, “Sometimes I like seeing posts about people ranting every now and again... As weird as it sounds I like reading about people and their struggles with that, especially with the field that I’m going into. It’s almost like, ‘okay this is what I have to look forward to,’ but at the same time knowing that there is support there when people do have these issues coming up.” Despite the constant need for documentation as a part of their job responsibilities, there are few opportunities for the social workers to record their own responses to the challenges of their jobs. While many therapy, counseling, and social service jobs include formalized debriefing through individual conversations known as supervision or clinical supervision, these interactions are spoken, not written. Additionally, supervision is often done with one’s supervisor and the manager-employee power dynamic looms over those interactions. With this understanding, the practice of posting an emotive or affective expression became legible as a process of documentation, an insight significantly aided by Cifor’s (2016) writing on archives and affect. This informal online documentation can be understood as a repository where emotions are stored and witnessed, a place for social workers to publicly document their own experiences.

CONCLUSION

Social workers experience widespread frustration with documentation paradigms in the field, with variation based on sub-field and proximity to clinical practice. Users expressed this frustration on “R/Socialwork” in a plethora of ways, with some utilizing the forum to support entrepreneurial approaches to problems in the field, while others used the site as an alternative form of recordkeeping, documenting their emotional responses. Two major themes in these manifestations were a turn towards entrepreneurship and the documentation of emotional experiences. The multi-modal methodology, and the results it produced, are not intended to provide definitive proof of a paradigm that is generalizable to the entire populations of social workers or redditors. Rather, this study offers novel insight into how a particular online forum functioned in its user’s lives, identifying and opening numerous opportunities for further study, including the potential of archival studies frameworks for understanding online communities. Avenues for further study include sustained focus on the design of recordkeeping systems in social service contexts, additional longitudinal analysis of forum post emotional content, and deepened investigation into social service entrepreneurship. As precarious care work proliferates, understanding the challenges these workers face and their responses to those challenges becomes increasingly important.

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Moving Past Metadata: Improving Digital Libraries with Content-Based Methods

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ABSTRACT

The growth of text mining and corpus analytic scholarship over large digital libraries brings to light the issues created by text duplication and variation within collections that are not adequately addressed in metadata practices. The SaDDL project was a study examining text duplication and similarity in massive digital library collections. Using the HathiTrust Digital Library, this project aims to reduce the bias that duplication gives rise to. We present the content-based methods of the project, employing a convolutional neural network classification approach, as well as SaDDL's outcomes. The datasets provided by the project will assist in improving cataloging practice and aid scholars in using large text corpora in research.

KEYWORDS

digital libraries; text mining; natural language processing; classification.

INTRODUCTION

As digital libraries continue to grow, the challenges of inconsistent or incomplete metadata become more apparent. One critical area where metadata is insufficient is in the identification of duplicate, variant, and partially overlapping copies of works. To help identify same-work relationships that are not well represented in current cataloging practice, we present a content-based approach to item identification with expanded classification to include markers of book content to identify similarity. The goal of the Similarities and Duplication in Digital Libraries (SaDDL) project is to identify more complex relationships between works in a digital library, allowing text mining scholars to avoid bias created by duplicate and variant copies of works in the content-based analysis of large-scale collections, while offering additional evidence for cataloging such relationships. We present the methods of SaDDL's relationship classification workflow and describe the project's cumulative dataset. This form of bibliographic work is traditionally done based on cataloging records. SaDDL is novel in that it leverages the actual content of books, available through the various scanning projects collected in recent years by the HathiTrust (HT), into a freely available dataset of relationship inferences.

METHODS

For this study, we focused on 8.7 million English language books in the HT collection, made available through the HathiTrust Research Center's Extracted Features (EF) Dataset (Jett et al., 2020; Organisciak et al., 2017). The EF Dataset provides page-level term token counts for each book, which makes the data accessible in a computationally useful way while avoiding the copyright issues that accompany full-text access. The same- and similar- work classification workflow includes a pre-processing step followed by two discrete classification steps: a fast-pass approximate nearest-neighbor algorithm to search for candidate relationships, and a deep neural network classification model for tagging the nature of those relationships.

Pre-processing entailed reformatting books from term counts to representations of those words as vector embeddings in a language model. Books were represented as smaller chunks to better identify sub-unit relationships, such as partial overlaps between books. The scale of the HT collection as well as the lengths of the documents made contextual models such as BERT (Devlin et al., 2018) intractable; instead, words of the book chunks are embedded into a GloVe-based model (Pennington et al., 2014), and a mean of all word vectors represents the document. This approach has the benefit of having a fairly linear vector space, so embeddings can be directly compared using similarity metrics. For tagging relationships among books, book embeddings are used in a two-pass analytic approach. First, approximate nearest neighbor is applied to identify candidate relationships from among the full, 9-million work English-language dataset in a computationally tractable way, using random forest projections (Bernhardsson, 2013). A nearest-neighbor search is run for every single chunk of a target book, and candidates are

derived from the books that appear in multiple result sets. Subsequently, each target/candidate relationship is tagged using a deep neural network classifier.

Specifically, the SaDDL relationship classifier takes two inputs. Primarily, a chunk-to-chunk similarity matrix is fed into a convolutional neural network, which treats the matrix akin to pixels in an image, looking for relationship patterns. Pooling and dropout are used to reduce the network complexity and make it more robust. A second input takes the full-book embeddings for both books, compares them with mean and difference vectors, and uses them in a multi-layer neural network before concatenating their weights with the flattened convolutional network. Finally, the resulting weights are used in a one-hot encoded classifier.

Training data was derived from metadata when metadata was sufficient to make a relationship assessment. Classes with whole-part relationships (i.e., anthologies or multi-part works) did not have enough training labels, so we generated artificial books to augment the training data. Similarly, we observed a type of relationship in the data without any ground truth—books that partially overlap, such as different anthologies with one sub-work matching—so the Overlaps relationship was trained with full synthetic data. Finally, for book recommendations of different-but-similar books, Goodreads recommendations were aligned with the HathiTrust using the UCSD Goodreads dataset (Wan & McAuley, 2018; Wan et al., 2019). The classification model was trained with a 70/10/20 split.

RESULTS

The resulting dataset offers the best representation of a given work, selected for its proximity to the average of items identified as identical works, and includes metadata for other years, titles, and OCLC numbers of items with that relationship. Following the best representation are the metadata for items that are different expressions of the same work, and items with whole-part relationships. Grouped by relationship, each related work is identified by HathiTrust identifier, descriptive metadata, and a confidence score for the accuracy of the relationship classification. An example of results is shown in Figure 1. The dataset also includes recommendations for similar works that are based on related authors and similar subjects. As seen in the classification performance in Table 1, the project produced reliable outcomes allowing for the de-duplication of the HathiTrust Digital Library for large-scale text analysis.

Metadata
The house of the seven gables : a romance / by Nathaniel Hawthorne., HTID osu.32435003193158
<i>Identical Works (n=36)</i>
e.g., The house of the seven gables, a romance., HTID osu.32435018541201, confidence score 72.
<i>Different Versions, Editions, Etc. (n=115)</i>
e.g., The works of Nathaniel Hawthorne. v.5, HTID coo.31924022152015, confidence score 99.
<i>Whole-Part (n=44)</i>
e.g., The complete writings of Nathaniel Hawthorne. v.22, HTID uiug.30112002694369, confidence score 98.
<i>Recommended Books (year, HTID; n=16)</i>
Legends of ye Province house. (1890, hvd.hnqmks)
Tales. (1881, osu.32435030242135)

Figure 1. Target work: House of Seven Gables. Example Title, HathiTrust ID Number, confidence score.

	precision	recall	f1-score	support
Same Work, Same Manifestation	0.83	0.84	0.83	131320
Same Work, Different Expression	0.86	0.82	0.84	122994
Whole-Part, Different Volume	0.81	0.86	0.83	92926
Part Of	0.91	0.92	0.91	31922
Contains	0.90	0.92	0.91	32040
Overlaps	0.83	0.26	0.40	2167
Different Work	0.89	0.89	0.89	110919
<i>Overall accuracy: 0.85 weighted F1: 0.85.</i>				

Table 1. Relationship classification performance, n= 524288.

CONCLUSION

The SaDDL project and its resulting dataset demonstrate how notably more effective the use of Deep Neural Networks on raw similarity graphs is for relationship classification between books than traditional workflows of feature extraction and classification. The developed methods allow relationships between works that are more complicated than exact duplicates to be identified from content more easily than from metadata. Being able to accurately identify the connections between works suggests that we can teach a computer to find something in a corpus through content-based analysis that we cannot easily find ourselves. The methods for de-duplication and content analysis can be applied to all digital libraries to reduce bias and improve the ability to discover original works and authors within collections.

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Theory into Practice: Information Behavior in Pre-Service Education for Information Service Roles

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ABSTRACT

This poster will present the results of an online survey of instructors of reference and information services courses in North American programs preparing information service professionals for practice. The survey explores instructors' decisions about incorporating information behavior theories, models, and concepts into their courses, as well as their perspectives on the appropriate balance between theoretical and practical course content. The survey constitutes phase three of a study with two previous phases: a content analysis of course syllabi for these courses and interviews with course instructors. Study results to date show that variation in instructors' information behavior expertise, and in their discretion to modify course content, lead to significant disparity in theory content. The findings suggest opportunities to educate course instructors in information behavior content, and to strengthen theoretical content in courses, which would better prepare future information service professionals to provide more effective service.

KEYWORDS

Information behavior; theory; reference services; education for librarianship.

INTRODUCTION AND LITERATURE REVIEW

Librarians and other information service professionals are educated to provide user assistance on the basis of a set of skills, knowledge, and abilities (SKAs), as is the case for any other professional service. To date, there is no consensus on the precise SKAs that should be included in the pre-service curriculum. To varying degrees, there is agreement that professionals should have some knowledge about a number of topics, including the range of information sources available for consultation, how to effectively search for information in these sources, and about a range of customer service and communication skills, among others. There is less consensus about the degree to which information professionals should also understand the theoretical basis for user behavior, i.e., information behavior (IB), defined as how people think about, seek, evaluate, and use information. Understanding theory in general is key to reflective practice (Reason & Kimball, 2012), and understanding IB is key to effective information service (Bawden, 2007; Saunders, 2019). However, courses which prepare information professionals to provide reference and information service are very full with content, and there is significant pressure to add content of a more practical nature, such as technical skills, rather than more theory (Agosto et al., 2010). Previous research shows that the practice of reference services is not well-informed by IB (Kingrey, 2002). In addition, library association competency standards related to reference do not identify information behavior as an area of expertise (Hicks & VanScoy, 2019). O'Connor (2011) examined syllabi for reference courses and found that less than half included the term "information seeking behavior," a concept which is foundational to reference work. Thus, previous work suggests that further exploration of current education for reference and information services is merited, to identify opportunities for strengthening IB content in pre-service education.

METHODS

This poster will present results of phase three of a study examining the degree to which information behavior theory, models, and concepts (IB TMCs) are integrated into basic courses preparing future information professionals for roles as providers of information (e.g., reference librarians). The first phase of the study examined evidence of IB TMCs in 55 syllabi of reference and information services courses in American Library Association (ALA) accredited programs of information and library science in North America (VanScoy, Julien, & Harding, in press-a). That phase used content analysis, a common method for syllabi studies (see Yoon, Murillo, & McNally, 2021). The second phase of the study interviewed 16 instructors of these courses, to explore their decision-making when constructing these syllabi and teaching these courses (VanScoy, Julien, & Harding, in press-b). The third phase of the study is reported here: an online survey of instructors of these courses, teaching in ALA accredited programs of library and information science in North America (n=54). The survey included both quantitative and open-ended questions, exploring the content of these courses, how course instructors decide on course content, how any IB theory content is taught, and instructors' views on appropriate course content. Participants were recruited by email, directly from a list of course instructors created by examining program websites, and indirectly by contacting

program directors and via listservs likely to reach course instructors (i.e., ALISE members list and JESSE). The survey was disseminated between April and June, 2021. Data analysis is ongoing, and includes quantitative analyses, as well as thematic analysis of open-ended questions. Analyses will be complete for summary and interpretation in the poster presented at the conference.

RESULTS

Because the survey results are outstanding, highlights from the first phases of this study are presented here. Results of the content analysis of syllabi from the first study phase found that fewer than half of syllabi included IB TMCs in any of these places. Interviews with course instructors in phase two found that a minority had IB expertise, but most sought a balance between theory and practical course content. Some had significant discretion over course content; others did not. In some courses, IB content was introduced in class discussions, a method not necessarily evident from the syllabi analysis. The results of the first two study phases suggest that there is opportunity to develop IB expertise among course instructors. Significant responsibility for that lies with IB scholars, who can work more effectively to share their work with practitioners, some of whom teach these courses (McKechnie et al., 2008).

CONCLUSION

A clear preliminary conclusion is that there is significant potential to increase the IB-related content in pre-service education for information service roles. While firm conclusions must wait for the full analysis of survey data, which will be presented in the poster, a clear preliminary conclusion is that there is significant potential to increase the IB-related content in pre-service education for information service roles. When professional education is based on research-based theory, in addition to practical skills, more effective service can be expected.

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Extracting the Implicit Search States from Explicit Behavioral Signals in Complex Search Tasks

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ABSTRACT

In a complex search task, users often go through different search states during search interactions under complex search tasks. Automatically identify these search states from observable behavioral measures will enhance our understanding of users' cognitive variations and serve as the basis for state-aware adaptive search recommendations and evaluations. To achieve this goal, this state seeks to extract implicit search states from explicit behavioral signals and explore the possible connection between automatically clustered search states and the existing state typologies developed based on user labeling and expert annotations. The results from our preliminary work indicate that search states and the associated behavioral patterns can be extracted through clustering analysis in multiple datasets, and that the identified clusters/states can be mapped to the states identified via qualitative coding. Our study demonstrates the feasibility of automatically extracting search states and pave the path towards state-aware adaptive search systems.

KEYWORDS

Complex search task; task state; behavioral features; clustering analysis.

INTRODUCTION

The development of interactive information retrieval (IIR) research improves search systems and helps users with more complex search tasks (Li & Belkin, 2010; Ruthven, 2008; Willett et al., 2014). A large body of IIR research focuses on users' states during the search process and supporting them with problems occurring at each state (Asfari et al., 2009; Kelly et al., 2015; Li & Belkin, 2008). Users' search states are implicit in their daily search process and may affect their explicit behavioral features, such as clicks, dwell time, mouse movement, are prevalent to investigate the relationships with the implicit task states (Aliannejadi et al., 2019; Capra et al., 2018; Cole et al., 2015; Li et al., 2016; Liu, 2019; Liu et al., 2019; Liu et al., 2020). However, previous studies usually required research participants to annotate their task states as the label data for the classification, which is resource-consuming and difficult for large-scale experiments (Liu & Shah, 2019). This research employed clustering analysis as the unsupervised method to categorize task states based on behavioral features. Our research questions include:

RQ1: what patterns of search interactions can be categorized using clustering analysis?

RQ2: how are these patterns associated with task states?

METHOD

This study employed three datasets for analysis, including the TiangGong-SS-FSD dataset (1169 sessions, 3874 queries) (Zhang et al., 2020), THU-KDD19 dataset (449 sessions, 1526 queries) (Liu et al., 2019), and TREC-Session14 dataset (1257 sessions, 3644 queries). These three datasets contain records of user behaviors and search results on search engine result pages (SERPs) for each search iteration in search sessions. Users tended to have multiple queries for one topic or complex task and sought to achieve different sub-goals at different points during each search session. For the behavioral features in these datasets, this study extracted the query length, the number of clicks, dwell time, and the distance of mouse movement (except the TREC-Session14 dataset) in SERPs of each query. Then this study used z-score normalization to scale the features before the clustering analysis. For the clustering method, this study used *k-means* clustering with the *elkan* algorithm. The number of clusters is set as four based on the inertia in the elbow method, which is the sum of squared distances of the cluster points to their cluster centers. The clustering results include the behavioral feature distributions in each cluster as the cluster patterns.

RESULTS

Figure 1 shows the clustering results and the distributions of the normalized behavioral features in different clusters. All three datasets include features of the query length (*nor_length*), the number of clicks (*nor_click*), and dwell time (*nor_dwell*) on SERPs of the query. The distribution of the mouse movement feature is similar to the distribution of dwell time in the clustering results in Figures 1a and 1b. Based on these features, four clusters can be recognized by

the variations of feature distribution. These variations among clusters helped us answer **RQ1** that when users have interactions, their search behaviors can be categorized based on different combinations of the query length, numbers of clicks, and dwell time on SERPs. For example, when users initiate a long query but do not have many clicks or long dwell time, their interactions might be categorized in cluster 3, while if they have many clicks and long dwell time, but not so long query, their interaction might be in cluster 2.

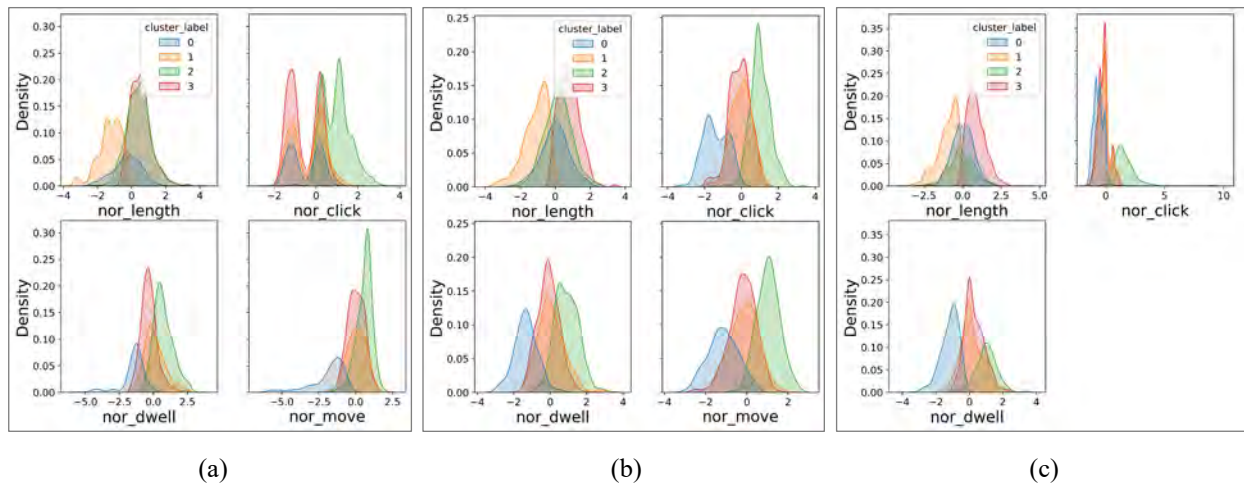


Figure 1. The distributions of the normalized behavioral features in different clusters: (a) TianGong-SS-FSD dataset; (b) THU-KDD dataset; (c) TREC-Session14 dataset

In addition, these variations of feature distributions among clusters highly accord with behavioral variations across problem-help task states extracted in the previous research (Liu et al., 2020). This accordance helps us associate the clustering results with the problem-help task states, which answered **RQ2**. Table 1 displays the details of the connections between patterns of behavioral features in each cluster and the associated problem-help task state. These distribution patterns of behavioral features in the clusters are similar to the behavioral variations under certain task states. For example, cluster 2 covers high click numbers and dwell time, which are similar to the behavioral patterns associated with the ASK-LT-PE state, meaning users with these behavioral patterns are likely to experience the *anomalous state of knowledge* (ASK), *lacking topic knowledge* (LT), and *looking for help from people or experts* (PE).

ClusterID	Patterns	Task State from Liu et al. 2020
0	Low click numbers and dwell time	LT-M/NP: requesting multiple support types/ no explicit search problem
1	Short query length, lower click numbers and dwell time than Cluster 2	SU-QU: not knowing useful information sources, requesting useful query recommendation from the system
2	High click numbers, high dwell time	ASK-LT-PE: anomalous state of knowledge, lacking topic knowledge, requesting support from people experts
3	Long query length, lower click numbers and dwell time than Cluster 2	ASK-SU-M: anomalous state of knowledge, not knowing useful information sources, requesting multiple support types

Table 1. Summary of cluster patterns and the task states

CONCLUSION

This research implemented the clustering analysis to investigate the explicit behavioral features in users' search tasks. The clustering results show clusters with different distributions of behavioral features identified across several datasets. These patterns are consistent with the behavioral variations in several problem-help task states identified by Liu, Sarkar and Shah (2020) and can help associate behavioral clusters with corresponding task states under varying search scenarios. Future work can focus on predicting task states with behavioral features and developing adaptive supports in complex search tasks.

ACKNOWLEDGMENT

This work is supported by the Junior Faculty Fellowship Program award from the University of Oklahoma Office of the Vice President for Research and Partnerships.

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Digital Humanities in the Job Market

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ABSTRACT

This study identifies the degree requirements which employers are looking for and analyzes the common positions in digital humanities job advertisements. Using data from the Digital Humanities Now website from 2012 to 2019, we investigate a total of 933 jobs opening related to the digital humanities field. Total job market demand has been relatively stable, having fallen in the last two years. Our study provides a concrete blueprint for the work needs of digital humanities. We find that internal demand structures of industry and academia is changing over time. Job demands from academia account for about 75%. Most of them needs academic staff and librarians. Data shows that 68% of jobs want PhDs. Digital humanities practitioners should pay close attention to changes in market demand and adjust their professional ability in time. Only in this way can they be well prepared to apply for the job they want.

KEYWORDS

Digital Humanities; Content Analysis; Job advertisements.

INTRODUCTION

A widely shared academic consensus on digital humanities is “the application of technology to humanities work” (Münster & Terras, 2020). It has been argued that digital technology has the potential to not only make our lives easier, but also help us solve new research problems (Berry, 2011). Intuitively, the job advertisements are a good resource in order to understand the instant demand of talents in a particular industry, as they provide information about the market’s educational experience and skills requirements in specific (Todd et al., 1995, Brooks et al., 2018).

In this study, we focus our research on the market demand of digital humanities. Specific research questions include: (1) What kind of job titles are named in the digital humanities job market? (2) What educational backgrounds are required in digital humanities job market?

METHODOLOGY

Data

Digital Humanities Now (<https://digitalhumanitiesnow.org/category/news/job/>) is the largest resource site related to digital humanities practice. It has a small volunteer staff that curates harvested resources related to the digital humanities. We obtained 933 job advertisements from this website for this study. Each data entry has been summarized with a set of features, including time, institute, position, research area, educational requirement, experience requirement, ability requirement.

In order to identify patterns of job demands related to the digital humanities, we analyze the data focusing on educational requirements and job titles mainly. In general, 171 out of all 933 data entries provide explicit educational requirements. According to the certification requirements of each record, we divide the educational qualifications into three categories: Bachelor’s, Master’s, and PhD’s. In terms of job titles, we manually check data entries and divide them into either Academia or Industry, with summarizing each position based on their functions, including (i) academic staff (including faculty members and research scientists), librarians, and supporting staff (administrative matters) in the academia and (ii) librarian, administrative staff, technician, media, and research in the industry.

Preliminary Analysis

Figure 1 shows the job demands across years based on the number of job ads. In general, the number of digital humanities talents demand fluctuates over time, with a dramatic drop of about 50% in 2019. We categorize the data from 2012 to 2019 into Academia and Industry according to the recruitment unit. If the recruiter is affiliated with a university such as an academic department, university library or research center, it is classified as Academia. Otherwise, we classify it as Industry (examples include companies, public libraries, etc.). As shown in Figure 2, Figure 3, Figure 4 and Table 1, Academic category appears the most frequently, which consistently accounts for over 75% of job advertisements.

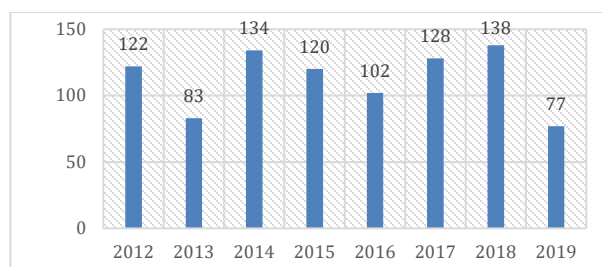


Figure 1. Job demand distribution in the digital humanities (with number of job ads)

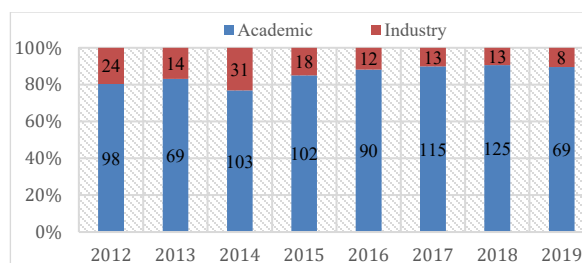


Figure 2. Percentage distribution of jobs in Academia and Industry (with number of job ads)

Figure 3 shows that the demand for academic staff has been on a downward trend since 2012. This situation continues till 2016. On the contrary, the demand for Supporting staff and Librarian increase first and then decrease, which is consistent with the digital humanities incident that Wang (2020) found the number of digital humanities publications has shown explosive growth since 2017. In terms of the industry, Figure 4 shows that the market's demand for media personnel is basically stable. The demand for researchers has fluctuated greatly, but it has shown an upward trend since 2017. We can see that the market's demand for technician and administrator accounted for the largest proportion. However, the demand has gradually declined since 2016. The market demand for librarians is also showing an unstable situation, which accounts for about 20% of the total market demand every year, except for 2016.

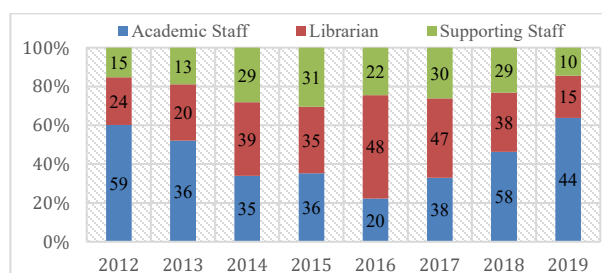


Figure 3. Percentage distribution of jobs in Academia (with number of job ads)

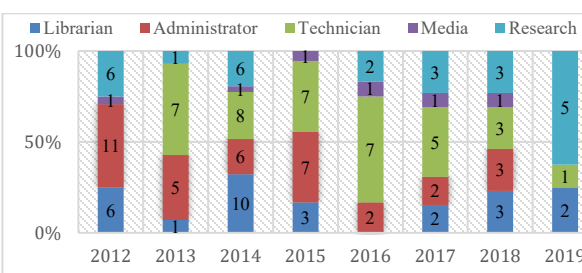


Figure 4. Percentage distribution of jobs in Industry (with number of job ads)

The data shows that 68% of jobs want PhDs. This is in fact in accordance with the job type and the job category—most of the job ads are from the academia. The other 32% job requires Bachelor's and Master's. According to "2016 Academic Library Development Trend," we can know that users are increasingly demanding digital academic support capabilities of librarians. This may be the reason why only 13% of jobs want bachelors.

Degree	Bachelor's	Master's	PhD	Total
Num	23	32	116	171
Percentage	13%	19%	68%	100%

Table 7. Degree requirements for digital humanities positions

CONCLUSION

This study aims to provide a preliminary analysis of job market demand in the digital humanities field. By analyzing 933 advertisements on the Digital Humanities Now website, we find a downward trend in industry demand over the last two years. The career structure within both industry and academia has changed over time, with the latter having a higher demand for talents over 70%. Half of the job advertisements require candidates to have a Ph.D. Therefore, individuals in this field should pay close attention to changes in job and educational requirements and keep up with their own development in preparation for applying for digital humanities-related positions.

ACKNOWLEDGEMENT

The study is supported by the Program for Innovation Research in Central University of Finance and Economics and by the Faculty Start-Up Fund at the City University of Hong Kong.

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Factors for Online Identity Falsification among Israeli Students in the Era of COVID-19

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ABSTRACT

This research investigates the main factors which motivate users to provide falsified details upon website registration, and identifies the types of personal details that are most prone for falsification. In addition, we predict the tendency for identity falsification by examining various factors, such as: privacy concern and socio-demographic factors. We also relate those issues to the contemporaneous COVID-19 pandemic and examine its influence on privacy concerns and the willingness to expose personal details. To this end, a user study was carried out among 245 students of the Israeli academia, via a quantitative method using online closed-ended questionnaires. We found that privacy-related factors are the most prevalent for identity falsification. In addition, the regression showed the higher the privacy concerns rates, the higher chance for identity falsification. It seems that the COVID-19 pandemic increased privacy concerns among online users, which may even increase the tendency of the examined behavior.

KEYWORDS

Identity falsification; privacy concern; self-disclosure; online anonymity.

INTRODUCTION

When faced with a request for personal information, the user has three choices: disclose the information, withhold the information, or provide false information (Miltgen & Smith, 2019). Evidence suggests that many users choose to deliberately falsify information during online exchanges (Fox et al., 2000). This might occur when the users feel a loss of control over their personal information (Hoffman et al., 1999) and that it is being threatened by external parties (Sheehan & Hoy, 1999). Other factors may influence the tendency not to disclose personal details or provide falsified information upon website request include: prior experience (Poddar et al., 2009), level of trust in the website and its operators (Acquisti et al., 2015; Metzger, 2006; Miltgen & Smith, 2019), defensive reaction to perceived unethical conduct by companies (Punj, 2017), or even willingness to protest and take revenge on the website operators (Li et al., 2019; Poddar et al., 2009). In addition, the COVID-19 pandemic which erupted in December 2019 changed the approach towards privacy (Ahn et al., 2020; Kim & Kwan, 2021; Smidt & Jokonya, 2021). While public compliance was found to be vital in the successful containment of pandemics (French, 2011), as the information gathered becomes more sensitive it raises privacy concerns, causing individuals to be less concerned about the social benefit and the greater good (Kwan & Kim, 2021), and less willing to disclose their personal information (Fu et al., 2020).

This study aims to investigate the main reasons and triggers which prompt users to provide falsified information upon website request. We will also explore the types of personal details that are most prone for falsification. Furthermore, we will attempt to predict the tendency for identity falsification by examining various factors, such as: sense of online anonymity, privacy concern, Internet proficiency and socio-demographic factors. In addition, in order to provide a contemporaneous dimension we will relate those issues to the COVID-19 pandemic and examine its influence on privacy concerns and the willingness to expose personal details.

METHODS

This study was conducted among 245 students in the Israeli academia: (52.2%) men and (47.8%) women (age range: 18-60), via a quantitative method, using online closed-ended questionnaires that they were asked to complete during their academic courses of the 2020-21 school year. We chose this specific population group, as most students today are digitally-oriented and familiar with the online environment. Unfortunately, this might also have an effect on the obtained results and limit their generalizability. The participants were given 10 reasons for non-disclosure of personal details or identity falsification upon website registration and were asked to rank these reasons (10 items, 1-5 in a Likert scale): desire to remain anonymous; distrust of the website operators; the registration process takes too much time; concern of being spammed; the benefits of information disclosure do not outweigh the risks; lack of transparency regarding the use of information being collected; concern for the distribution of the information to other entities; desire to take revenge on the website operators for the hassle; tomfoolery; laziness. To predict the tendency of identity falsification upon website registration, a logistic regression analysis was performed, taking into

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account various independent variables: sense of anonymity in websites; sense of exposure to other users online; privacy concern; Internet proficiency; various demographic factors: gender, age, and education.

RESULTS

Among the reasons for identity falsification upon website registration, distrust in the website operators was ranked as the most prevalent ($M=3.79$, $SD=0.96$). The desire to remain anonymous was ranked second highest among all suggested reasons ($M=3.70$, $SD=1.20$). Cochran's Q test indicated significant differences among the suggested reasons, $\chi^2(9)=601.37$, $p<0.001$, with concern for the distribution of the information to other entities and distrust in the website operators having the highest percentage of agreement (most prevalent reasons for falsification). As for the types of personal details prone to falsification, the participants reported to be most reluctant to provide their ID number ($M=4.36$, $SD=1.08$), address ($M=3.97$, $SD=1.01$) and phone number ($M=3.93$, $SD=1.08$). Cochran's Q test indicated significant differences among the suggested personal details, $\chi^2(5)=280.90$, $p<0.001$, with ID number having the highest percentage of agreement (highest falsification rate).

The regression model was found significant $\chi^2(7)=28.57$, $p<0.001$, with the influence variables explaining 11% (Cox & Snell $R^2=0.11$) and 15% (Nagelkerke $R^2=0.15$) of the variance. As shown in Table 1 below, men tended more towards identity falsification compared to women. In addition, it seems that higher education suggests a higher tendency for identity falsification. Finally, we found evidence that privacy concerns positively influence the tendency for identity falsification upon website registration—the higher the privacy concerns rates, the higher the chance of identity falsification.

Factors	B	Bias	S.E.	Exp(B)	BCa 95% Confidence Interval	
					Lower	Upper
Gender	-0.85	-0.04	0.32	0.43**	-1.45	-0.36
Age	-0.05	-0.01	0.03	0.95	-0.12	0.003
Education	0.84	0.05	0.34	2.32*	0.13	1.66
Internet proficiency	0.19	0.01	0.19	1.21	-0.18	0.61
Sense of anonymity in websites	0.08	0.002	0.17	1.09	-0.26	0.43
Sense of exposure to other users online	-0.13	-0.001	0.16	0.88	-0.44	0.20
Privacy concern	0.38	0.02	0.14	1.46*	0.11	0.72

* $p<0.05$, ** $p<0.01$

Table 1. The logistic regression coefficients for the tendency of non-disclosure of personal details or identity falsification upon website registration.

As for the effect of the COVID-19 pandemic on privacy concern and the willingness to expose personal details, 64.5% of the participants ($N=245$) reported it changed their privacy concern levels for the worse (more concerned), and 30.6% reported it changed extensively (Likert scale rates: 4-5). Out of the participants who admitted to falsifying their details upon website registration ($N=195$), 49.2% reported that following the pandemic period they are less willing to provide personal details over the Internet, and 19.5% extensively less willing to do so (Likert scale rates: 4-5).

CONCLUSIONS

It seems that privacy concerns play a significant role in moderating the tendency to falsify personal details online. Identity falsification is applied as a defensive mechanism to protect personal privacy. This corresponds with previous research that found most of the users are concerned about threats to their online privacy and are willing to take action in order to protect it (Paine et al., 2007; Wills & Zeljkovic, 2010). In addition, this trend is expected to grow even further as a result of the COVID-19 pandemic that increased privacy concerns among online users. Therefore, we call on website operators and online marketers to increase their transparency regarding the use of information being collected, in order to increase the trust among the users and eliminate privacy concerns. This will help them maintain good customer relationship, which may benefit them in the long run.

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Understanding New Yorkers' Everyday Life Information Seeking Behavior in the Context of Coping with COVID-19

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ABSTRACT

This poster presents preliminary findings of a study which examines New Yorkers' everyday life information seeking (ELIS) behavior in the context of coping with COVID-19. Based on semi-structured interviews with 10 New Yorkers, this study identified 15 major categories of everyday life information needs, and developed a typology of New Yorkers' preferred ELIS sources. These typologies show New Yorkers' specific ELIS behavior during the pandemic, such as actively seeking information regarding grocery shopping and delivery, health safety guidelines, and current events. Social media became a popular source for immediate, local, and relevant information in New Yorkers' daily lives. These findings could form a knowledge base to inform the development of information services to assist residents of large urban areas in coping with public health crises.

KEYWORDS

Everyday life information seeking; information needs; COVID-19; New Yorkers; New York City.

INTRODUCTION

COVID-19 is a contagious disease that has spread across the world since the initial outbreak in late 2019. New York City (NYC) was an early epicenter of COVID-19, with a peak in cases between March and May 2020 (Thompson et al., 2020). As a result of this public health threat, New Yorkers have faced numerous everyday life problems such as unemployment, business shutdowns, and racism. In response to this pandemic, New Yorkers employ different strategies to cope with it. Seeking information in their daily lives is one of these strategies. Savolainen (2004) defined **everyday life information seeking (ELIS)** as "the acquisition of various informational elements, which people employ to orient themselves in daily lives or to solve problems not directly connected with the performance of professional tasks or full-time study" (p. 156). Prior research has investigated ELIS behavior among different groups of people in various contexts. To the best of the author's knowledge, no prior studies have examined New Yorkers' ELIS behavior in the context of coping with COVID-19. This exploratory study aims to understand how New Yorkers seek, use, and share everyday life information while coping with the pandemic. Specifically, this poster reports preliminary findings on two research questions: (a) What are New Yorkers' everyday life information needs in the context of coping with COVID-19? (b) What ELIS sources do New Yorkers favor when coping with COVID-19? Answers to these questions could form a knowledge base to inform the development of information services and intervention programs to assist residents of large urban areas in coping with public health crises.

The author conducted qualitative semi-structured interviews with 10 people residing in NYC during the outbreak of COVID-19. Convenience and snowball sampling techniques were used to identify and recruit participants. The author developed an interview protocol and an initial coding scheme based on Savolainen's (1995) ELIS model, Dervin's (1976) taxonomy of average citizens' everyday information needs, Agosto and Hughes-Hassell's (2005) topology of ELIS sources, and a literature analysis. All interviews were audio-recorded, transcribed, and analyzed with NVivo 11.

FINDINGS

Based on Dervin's (1976) taxonomy, this study identified 15 major categories (with 68 subcategories) of New Yorkers' everyday life information needs (see Table 1). When asked how their daily information needs differed before and during the pandemic, nine participants noted that they were actively seeking information regarding grocery shopping and delivery services, especially during the beginning of the pandemic. For example, P08 explained, "the pandemic has changed the way that we shop...we do a lot of shopping online. I find that shopping is definitely, like grocery shopping especially, is an important information need during the pandemic." Other emerging information needs raised by participants were related to COVID tests, vaccines, and health safety guidelines. P03 described his information seeking process of determining whether specific hand soap met CDC's guidelines:

I would check the CDC website saying it needs to have this percentage of alcohol for it to be effective to kill the virus. And then I would have to check Amazon to see, do they actually say what chemicals are in this liquid

soap. And then I would use Google to look up those companies to see if they have their own websites...So that is one example where I had to do a lot of external research to verify whether these companies were legit, what was actually in the product they're selling, and whether it met [CDC] guidelines.

Major Categories (with Subcategories)		Preferred ELIS Sources
Childcare: Kids' entertainment, online learning, preschooling Consumer: Business hours, coupons, food/ product availability, food/product info, food/ product ordering & delivery, grocery shopping & delivery services, lost packages, pricing, store reopening, store locations Crime & safety: Hate crime against Asians Discrimination: Hatred & bias against Chinese Education and schooling: Changes to teaching & learning, homework, operational guidelines, school operations, school schedules Employment: Changing jobs, getting a job Financial matters: Handling money, investments, tax filing Health: COVID information, COVID tests, COVID vaccines, health appointments, health insurance, health safety guidelines, professionals Public assistance & social security: Public safety, unemployment assistance	Housing: Buying a house, getting a place to move, rent concession, housing info, mortgages Housekeeping & household maintenance: DIY projects, gardening, making repairs, recipes Immigration: US citizenship, immigration Public affairs & political issues: Current events, travel guidelines, news, passport renewal, political issues & politicians, protests, weather Recreation & culture: Exercises, gyms, live streams, meditation, movies, music, schedules, shows Transportation: directions, flight info, schedules, service changes, traffic	Interpersonal sources: Colleagues, classmates, experts (e.g., medical doctors), family members, friends, politicians (e.g., governors), professors, roommates, teachers Traditional media: Books, flyers, magazines, newspapers, public advertisements, radio, scientific journals, telephones, TV Web-based sources: Email subscriptions, Google, Maps, websites or apps, social media (Facebook, Instagram, Letterboxd, Reddit, TikTok, Twitter, WeChat, Weibo, YouTube) Formal organizations: NYC government, NYC Department of Health & Mental Hygiene, NY State Department of Health, CDC

Table 1. New Yorkers' Everyday Life Information Needs and Preferred ELIS Sources

Unlike other participants, P01 did not actively seek health information during the pandemic as “just walking around the city, taking the subway, I encounter public health information...It's just passively acquired.” Although most participants expressed a greater need for news and COVID-related information, three of them indicated that this need became less intensive with time. P02 even tried to avoid this information:

At the beginning like in March [2020], I paid a lot of attention to the numbers, like how many cases were confirmed every day...but that didn't last long because you got tired and you become almost like numb. So, I just stopped following these...and even stopped paying attention to news...kind of intentionally avoiding.

Information needs related to indoor entertainment were more important than before the pandemic. P08 explained, “because we're indoors so much...you need a bit of leisure to get away from the bad news or the grave news about what's happening with the pandemic...you need that escapism every now and again.” As the pandemic progressed, two participants began to seek information on outdoor leisure activities, such as “places doing outdoor movies” (P07).

This study developed a typology of New Yorkers' preferred ELIS sources (see Table 1) consisting of four facets: interpersonal sources, traditional media, web-based sources, and formal organizations. Breaking from the websites of traditional media and government agencies like CDC, social media became popular ELIS source during the pandemic. Participants attributed this popularity to different reasons and conditions. For example, P01 followed the CDC and some news sites on Twitter as she felt like “any important news would come out immediately on Twitter, and then the actual information would come out later.” Both P05 and P06 were freelancers and mothers who preferred to search Facebook local groups for the convenience of getting local grocery and childcare information. P07 revealed:

Once the Black Lives Matter movement hit in June [2020], I really took a sharp left turn to Twitter for all of my news and guidelines because of the lack of reporting on what was really happening in New York on news outlets...Even with the vaccine rollout, the way I found my locations was through Twitter...the reasons I was seeking out so much information on social media was because these were New Yorkers who were living like me...I trust their very specific recommendations above a more generalized source like CNN or the CDC.

Besides popular social media like Facebook and YouTube, four participants were Chinese immigrants who also used Chinese social media (e.g., WeChat, Weibo) to seek and share information specifically on Chinese grocery shopping, discrimination, and hate crimes against Asians. Two of these participants, including one who earned a PhD in the U.S., cited language barriers as their reason for preferring information sources in Chinese.

CONCLUSION

The typologies developed in this study show New Yorkers' specific ELIS behavior during COVID-19, such as actively seeking information regarding grocery shopping and delivery, health safety guidelines, and current events. As this study is limited with a small sample, more interviews will be conducted to expand and verify the preliminary findings.

ACKNOWLEDGMENTS

The author would like to express her appreciation to the New Yorkers who participated in the study. This research is supported by the PSC-CUNY Research Award (# 64263-00 52).

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Data Mining on COVID-19 Vaccines: Side Effects

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ABSTRACT

COVID-19 is a pandemic disease affecting billions of people worldwide. Taking vaccines is a most effective approach to gain fully control. Thanks to the coordinated efforts from all over the world, several brands of vaccines targeting COVID-19 have passed through clinical trials and been brought to the public. Growing numbers of people are taking vaccines and share their feedback on social media, mostly on Twitter. In this study, we used Twitter data to analyze the side effects on each individual and quantify these side effects in a brand-wise and country-wise manner. Based on Twitter data, we found that the United States has the largest number of people getting vaccinated, Pfizer is the most widely used vaccine brand around the world and the most frequent side effect is cold. From our analysis, the side effects of vaccines are under controllable and are acceptable, and everyone can join the vaccinated camp without hesitation.

KEYWORDS

COVID-19 vaccines; side effects; Twitter; keyword extraction; N-gram.

INTRODUCTION

COVID-19, the most challenging pandemic in the 21st century, has infected over 174 million people and led to the death of 3.7 million individuals around the world (World Health Organization, 2021). Thanks to the development of COVID-19 vaccines, we can gain control of the pandemic. However, there are restrictions and side effects followed by the vaccination. According to the statement of Centers of Disease Control and Prevention (CDC), people should not get the COVID-19 vaccine if they had a severe allergic reaction after a previous dose of this vaccine or had a severe allergic reaction to any ingredient of the vaccine (Centers for Disease Control and Prevention, 2021). A list of side effects has been reported: headache, muscle pain, redness and swelling injection site, cold, fever, tired and sleepy. There is also a remote chance to get severe allergic reaction, and will occur within a few minutes to one hour after getting injection (Centers for Disease Control and Prevention, 2021). Although more and more people are getting vaccinated, a big number of people are still hesitating mainly due to the side effects of vaccines. Our goal for drafting this paper is to dispel concerns of vaccines side effect by making proof with Twitter data.

Many people are sharing their feedbacks in social media after taking COVID-19 vaccines. Twitter data is the most accessible one among them. In this article, we collected tweets from Mar.15 to May 15 of 2021 and using brand names and side effects as unigrams and bigrams to extract the keywords of side effects from tweets and performed brand-wise and country-wise analysis to answer these research questions below.

Q1: What are the side effects for dose 1 and dose 2 according to Twitter data?

Q2: What are the side effects for different vaccine brand based on Twitter data?

Q3: What's the percentage of people taking different brand of vaccines reported in Twitter?

Q4: What's the country-wise vaccination progress based on Twitter data?

METHODOLOGY

Tweets collection & data cleaning. Tweepy library (Tweepy, 2020) is used to collect tweets together with 3 hashtags including #COVID19vaccine, #CoronaVaccination, #vaccinated, brand names are not used as hashtags for fear that it may bias the result. Data cleaning and preprocessing were performed on collected tweets. Retweeted tweets and irrelevant information were removed together with Emoji and special characters.

Data Modeling. After data is cleaned, keyword extraction is performed to extract tweets with both side effects and brand (Sarker, 2020). Extracted data is manually reviewed to delete false positive tweets. We then used filtered data to generate the unigrams and bigrams. Unigrams were generated for performing analysis on Vaccine brands. Since vaccine brands being single words. Bigrams were generated for vaccine reactions observation analysis. The dictionaries were created to represent the datasets generated out of n-gram models which later proceeded with data visualization using Matplotlib & Pyplot.

RESULT & DISCUSSION

In this study, we collected more than 440,000 tweets. After data cleaning and removed retweets and irrelevant info, 178137 tweets were kept for further analysis. Based on user location, country-wise information of vaccinated people are calculated (Figure 1B). United States has the largest percentage of people vaccinated reported on Twitter. Based on the description in tweets, we classified the side effects into 12 categories, counts of each category is shown in figure 1A. Cold is the most reported side effects from Twitter data.

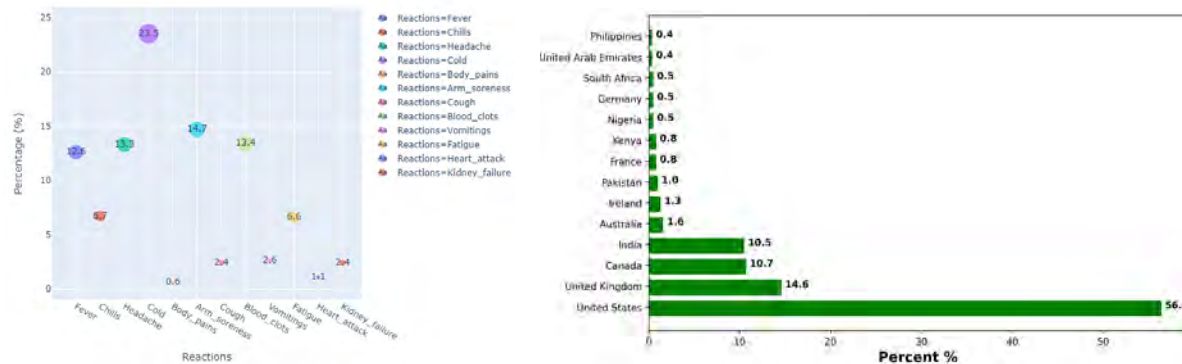


Figure 1. Overall statistics of side effects (A) and country-wise analysis of vaccinated people (B)

We cross-linked the side effects with vaccines brand name to find out which is the most frequent side effect in each brand (Figure.2A). Taking Pfizer as an example, the most frequently reported side effect is sore arm. We also quantified the vaccine usage of different brand around the world (Figure. 2B). Pfizer has the most widely usage around the globe.

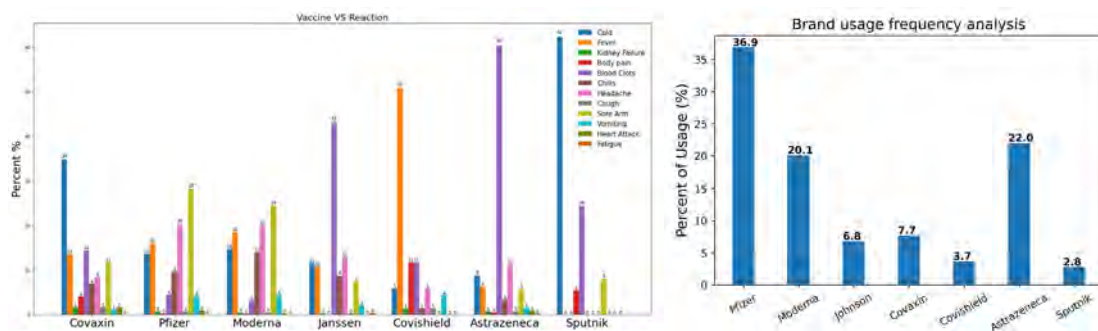


Figure 2. Brand-wise side effects analysis (A) and vaccine brand usage around the globe (B)

These results reported the vaccination trend around the world, and concluded the major side effects reported by people using Twitter. The side effects in each vaccine brand is organized and clear, although not distinguish between dose 1 and dose 2. There is some inevitable bias in data selection, as Twitter is not a mainstream social media in some countries, such as China, and we also deleted the non-English written tweets, so it may not represent the real trend in the world. But the study is meaningful, it reported that side effects of all the available vaccines are acceptable and these results can encourage more and more people to join the vaccination camp and finally save the world from coronavirus.

CONCLUSION

Based on the Twitter data, the side effects of current COVID-19 vaccines are acceptable and under control. There is no need to hesitate about side effects after taking vaccines and everyone should join the group of getting vaccinated to protect themselves and people they contacted with. Vaccines is a key step in fighting against the pandemic COVID-19 disease. No matter getting vaccinated or not, we should still remember to wear masks when attending gathering activities to stay safe and health. It's a long run in the fight against the COVID-19 but we will succeed at last.

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What Does the Literature Tell Us? Reviewing Literature Reviews on Information Behavior

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ABSTRACT

Many reviews on information behavior have been published to date, however little research has been done to understand these reviews. To fill this gap, this poster reviewed 96 literature reviews in this field. The preliminary analysis uncovers several characteristics of literature reviews on information behavior: (1) these reviews have discussed two transformations in the history of information behavior; (2) current literature reviews focus on specialized areas of information behavior; (3) literature reviews have highlighted different issues in information behavior research, such as the quality of information and the practical contributions of research; (4) literature reviews keep summarizing and developing theories and models of information behavior. This preliminary analysis provides an overview of 30 years of literature reviews, showing what existing literature reviews have done. It identifies trends in information behavior research and may inspire what kinds of literature reviews are needed in the future.

KEYWORDS

Information behavior; information-seeking; information use; information practices; literature reviews.

INTRODUCTION

Information behavior has seen a rapid growth of research over a half-century. Literature reviews are one means of synthesizing the findings from a large volume of literature and help identify high-level trends and developments. With renewed interest in publishing literature reviews (ASIS&T, 2020), it is timely to consider the history of literature reviews. This poster presents a preliminary analysis of the information behavior research literature to address the following research question: What do literature reviews on information behavior tell us?

METHODS

A literature search was conducted in several databases (Library & Information Science Abstracts, Library Information Science & Technology Abstracts, ACM Digital Library, Scopus, and Web of Science) in November 2020, for literature reviews on information behavior and related elements (including information needs, information seeking, information practices, and information use), published since 1990. Papers were excluded from the analysis if: (1) they were not stand-alone literature reviews (e.g., research articles, research reports, dissertations); or (2) not directly related to information behavior (e.g., reviews of information programs). Due to COVID-19 restrictions, print materials were inaccessible; therefore, only articles available electronically were able to be included. In the end, 96 documents were obtained for analysis. The research framework comes from works of Noguchi (2001) and Swales (2004) who developed a four-parameter framework to analyze literature review articles: history (a historical view of a field), current work (current developments or the status quo of a field), issue (such as research gap and practical problems), and theory (the theories or models in a field). The coding process, to identify which of the four parameters related to each review article, was conducted by the first author after the four parameters were clearly defined.

RESULTS AND DISCUSSION

Preliminary analysis shows that literature reviews on information behavior tend to focus on one or two of the parameters identified by Swales. Of the 96 reviews, the coverage was as follows: current work (85 articles); issue (72 articles); theory (21 articles); and history (9 articles).

Current Work

Reviews relating to current developments in the field were the most numerous. Given the volume of information behavior research, conducting an overall literature review on this topic is challenging, and “reviews of the information behavior literature grew more specialized” (Case, 2006, p. 294). Literature reviews tend to focus on the information behavior of one group, such as youth (Agosto, 2019; Shenton, 2018), farmers (Phiri, Chipeta, & Chawinga, 2019), professors (Nwone & Mutula, 2019), consumers (Pian, Song, & Zhang, 2020; Zhao & Zhang, 2017), students (Mutula & Majinge, 2016; Oliveira & Greenidge, 2020; Spezi, 2016), parents (Kubb & Foran,

2020), medical or public health workers (Barr-Walker, 2017; González-Teruel, Campos-Peláez, & Fortea-Cabo, 2020; Prakasan, 2013), or people with impairments (Berget & MacFarlane, 2020). Other reviews tended to concentrate on studying one type of information, like health information (Chi, Pian, & Zhang, 2020; Kubb & Foran, 2020; Zhao & Zhang, 2017), musical information (Lavranos et al., 2016), or visual information (Albertson, 2015).

Issue

Many different issues have been discussed in literature reviews; two recurrent issues were quality of information and practical contributions of research. More specifically, literature reviews care about the quality of information on the Internet, “Information quality and authority frequently become the most concerned issue when people consider using the information” (Zhao & Zhang, 2017, p.275). Practical contributions of information behavior research have also been discussed in literature reviews. As Fisher and Julien (2009) stated, “the biggest challenges [of the information behavior field] lies in making itself known and relevant to society” (p. 7-39). Even years later, the practical contributions of information behavior remain an underdeveloped area more recent literature reviews (Alperen, 2017). This issue may come from the communication and cultural gap between researchers and practitioners in information science (Genoni et al, 2004).

Theory

Many theories or models have been developed in literature reviews on information behavior. For example, Wilson (1999) summarized several classic theories and models in information science in his literature review, which has been cited in many literature reviews (Alperen, 2017; Beaulieu, 2003; Berget & MacFarlane, 2020; Shafique & Mahmood, 2013; Suraya et al., 2016). Similarly, Case (2006) reviewed the literature on information behavior and pointed out the long-standing and continuing influence of several leading scholars on theories or models of information behavior. An underlying question that other literature reviews raised is whether these theories and models grounded in traditional resources can be applied directly into a digital environment (Kubb and Foran, 2020; Savolainen, 2009), suggesting that maybe it is time for researchers in information science to expand or adapt their “theory repertoire”.

History

Two historical transformations are reflected in the literature reviews on information behavior. One is highlighted by Dervin and Nilan (1986), who noted that the research paradigm had shifted from system-centered to user-centered. Literature reviews also reflected another transformation in the 2000s with the rise of online databases sparking new generation of research (Khoo, 2014), that shifted the focus from traditional print materials to digital resources (Groce, 2008; Kim & Syn, 2014; McGeachin, 2004).

CONCLUSIONS AND FUTURE WORK

In summary, this poster provides an overview of 30 years of literature reviews and their focus. These preliminary findings contribute to identifying research gaps in literature reviews on information behavior and may inspire the foci or perspectives of literature reviews in the future. More specifically, this poster shows that most literature reviews focused on current work (typically research on particular user communities or types of information) or research/practical issues, literature reviews on theories and history are needed. Findings from this preliminary analysis are limited by the literature included. The next steps in this research will involve expanding the scope to include literature not available electronically, published before 1990, and published outside of journals (e.g., books, conference proceedings), as well as hand searching of core resources (e.g., ARIST). It will also include a more detailed and in-depth content analysis of the literature reviews. Future research could analyze the primary research in information behavior and compare the scope and coverage to what is included in literature reviews.

ACKNOWLEDGMENTS

The first author gratefully acknowledges the financial support from China Scholarships Council.

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An Exploratory Study on Chinese Preteens' Internet Use and Parental Mediation during the COVID-19 Pandemic

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ABSTRACT

The COVID-19 pandemic has led to the closure of schools around the world. When children study online, parents are concerned about the impact of increased screen time on their children's physical and mental health. This poster reports results from a qualitative study of Chinese preteens' Internet use and parental mediation during the COVID-19 pandemic. Through interviews with eight parents of primary school students aged from 10 to 12, we found several problems with preteens' Internet use, posing challenges for parental mediation. Parents have adopted stricter restrictive mediation strategies to reduce the impact of Internet addiction and implemented co-use strategies to help preteens adapt to online learning.

KEYWORDS

Parental mediation; Internet use; COVID-19; Preteens; China.

INTRODUCTION AND RELATED WORK

The COVID-19 pandemic has led to global school closures and forced children to learn online. Along with online classes, patterns of children's Internet use have changed. Their screen time increased significantly and outdoor activities decreased remarkably (Zhao et al., 2020). Surveys show that overuse of the Internet seems to be common during the COVID-19 pandemic with children and adolescents, being the most vulnerable to problematic Internet use (PIU) (Islam et al., 2020). PIU includes excessive or uncontrolled attention to Internet access, impulsiveness, and addictive behavior (Mamun & Griffiths, 2019). Therefore, parents are faced with increased challenges to help with children's online learning (Garbe et al., 2020) and mediate their Internet use (Dong et al., 2020; Zhao et al., 2020).

Parents take various measures to limit their children's use of digital devices. In general, parents manage their children's Internet access through positive mediation, restrictive mediation, and co-use strategies (Austin et al., 1990). Studies have shown that children's attitudes towards social networks and risk perception are strongly influenced by parents (Kristianto, 2017), so parental mediation can effectively reduce the online risks that children may face (Kim & Davis, 2017; Livingstone, 2012). Among them, positive mediation is significantly negatively correlated with problematic Internet use (PIU) (Chandrima et al., 2020). It involves persuasion, which changes children's attitude towards mobile phone self-control through the communication process, leading to changes in children's behavior (Fu et al., 2020). During the epidemic, experts also emphasized the importance of monitoring and regulating children's behavior, encouraging parents to actively participate in their children's online activities (Király et al., 2020).

Preteens aged 10-12 are in the transition period from childhood to adolescence, when the relationship between parents and preteens will gradually change from the unilateral authority relationship of parents to the give-and-take relationship of negotiation and compromise (Collins & Steinberg, 2007; Kim & Davis, 2017). Preteens often have mobile phones, smartwatches, and other social devices (CNNIC, 2020), and they have strong learning and exploration ability when using these network devices. Therefore, parents of preteens are more likely to take measures to mediate their children's Internet use. In this poster, we present an exploratory interview study to understand the challenges that parents faced in guiding and mediating preteens' Internet use during the COVID-19 pandemic. We interviewed eight Chinese parents whose children are between the ages of 10 to 12. We aim to answer the following research questions:

RQ1: What challenges did parents encounter in mediating their preteens' Internet use during the COVID-19 pandemic? RQ2: What strategies did parents employ to guide and mediate their children's Internet use?

METHODS

We recruited parents of children aged between 10 and 12 years old. Since this research was conducted during the COVID-19 pandemic, we were not able to conduct face-to-face interviews and all interviews were conducted

through video-conferencing. The eight interviewees were recruited through an online questionnaire and then through snowball sampling. We collected three types of information through a background survey: the demographic information of parents and preteens, the characteristics of preteens' Internet use, and parental mediation strategies.

The eight participants were parents of primary school students in grade four to grade six from four provinces in China (Anhui, Beijing, Chongqing, and Hunan). All participants developed strategies to adopt their children to online learning during the school closures and adopted a series of mediation strategies during the COVID-19 pandemic. The participants included seven mothers and one father, aged from 36 to 50, all of whom have college degrees and above.

Semi-structured interviews were used to collect data. The interviews lasted from 30 minutes to more than one hour and were recorded. Interview questions are shown in Table 1. We transcribed the interviews and conducted qualitative coding of the data, looking for patterns and themes related to our research questions.

Patterns in Preteens' Internet Use	Challenges for Parents	Parental mediation
What does your child usually do online?	What are the changes in his internet usage during the epidemic?	How do you mediation your child's Internet use?
How long does he usually spend online?	What challenges do you face in mediating your child's Internet use?	What adjustments did you make?
How often does he use the Internet?	What aspects of the network are you still worried about?	How effective these methods have been?

Table 1. Interview Questions

FINDINGS

Increased screen and Internet use during the COVID-19 pandemic. As learning moves from offline to online, preteens had to rely on digital devices to study. To meet the learning needs of children, while taking into account their remote work, parents provided personal devices to their children often for their exclusive use. Online courses undoubtedly significantly increased the time preteens spend on the Internet. The preteens of the interviewed family took at least 2-4 hours of online lessons on a working day. In addition, preteens' online entertainment time had also increased. Due to the inability to go out and the reduction of family outdoor activities, parents believe that “*children also need to relax through digital devices to cope with stress*” (Participant F4), allowing children to use the Internet for entertainment. As Participant M5 said: *Before the epidemic, the (child's) use of the Internet was not very strong, but now it seems to be accustomed to it. More challenges for parental mediation.* Longer screen time had a negative impact. More than half of the parents reported that their children were more dependent on the Internet. For example, participant M5 said: *(the child) has been completely immersed in the smartphone, whether it is eating, sleeping, or going to the toilet, the smartphone cannot be separated from his hand.* This has increased the pressure of parental mediation, a mother (Participant M6) even stated that her child's Internet addiction has reached an uncontrollable level. Three-quarters of the preteens from the interviewed families suffered from myopia or advanced degrees. The distractions of online learning are also an issue of concern to parents. Three parents found their children distracted during online classes and secretly switched screens to play games. However, parents still need to complete their work and have to struggle to find a balance between work and taking care of their children.

Stricter mediation strategies and rules. When asked about the changes during the COVID-19 pandemic, all the interviewed parents mentioned that they spent more time and energy mediating children's internet use. For preteens who had little self-control over the Internet, parents strengthened restrictive mediation, restricting children's device access, duration of use, and types of activities. It was accompanied by a lot of preaching and even the use of force. One mother thought that although she did not want to be too strict with her children, she had to do so to achieve results (Participant M3). A parent cooperated with teachers to cancel children's online check-in tasks and cut off all access to smartphones (Participant M2). Two parents adopted the co-use strategy to accompany their children to learn online. When preteens took online classes, they sat on the side while working on their tasks, or studied with preteens to improve their learning efficiency and helped the children to adapt to the online learning model.

CONCLUSION AND DISCUSSION

Through interviews with parents, this study investigated the impact of the COVID-19 pandemic on preteens' Internet use and parental mediation in China. Due to the closures of schools and more demand for online learning, preteens showed increased Internet use and addictions. Parents have adopted stricter restrictive mediation strategies to reduce the impact of Internet addiction and implemented co-use strategies to help preteens adapt to online learning.

The relationship between children and preteens and the Internet is a long-term issue. Parental mediation cannot be done once and for all. How to transition from parental mediation to preteens' self-moderation is worthy of further consideration. Schools and related APP designers are also obliged to consider the needs of parental mediation and cooperate to ensure that children live in harmony with the Internet.

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Health Information Seeking on Social Apps among Older Adults Living with Chronic Conditions

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ABSTRACT

Older adults living with chronic conditions are assumed to have health information needs which further trigger their health information seeking behaviors. Recently, various social apps are increasingly becoming popular among older adults. However, it remains unclear how these older adults seek and evaluate health information in social apps and how the apps support these users' health information behaviors. By conducting semi-structured interviews, we explore users' health information seeking and evaluation behaviors on a popular social app WeChat among Chinese older adults living with chronic conditions.

KEYWORDS

Older Adults; Health information behavior; Chronic condition; WeChat; Affordance lens.

INTRODUCTION

Older adults living with chronic conditions are assumed to have various health information needs, which further trigger their health information seeking (Pian et al., 2020). There are multiple information sources available in the market that can support their health information acquisition behavior and help them better manage their personal health information to make health decisions (Sheng & Simpson, 2013). In China, an increasing number of older adults consider health information seeking behavior on social media as their daily routine, especially on WeChat (Wang et al., 2020). Reading health information via WeChat is common (Zhang et al., 2017). Most existing articles explored how older adults seek and evaluate health information on websites and search engines (Choi, 2020); however, it is unclear how older adults search for and assess health information in hedonic and social apps. It is also worthwhile to further explore what affordances social apps provide to facilitate health information seeking among older adults. To bridge the gap, this study will employ the lens of affordance (Zhao et al., 2021) and investigate the health information practice (i.e., seeking and evaluation) among the older adults living with chronic conditions based on a widely used social app WeChat in China. Several preliminary findings are presented and discussed in this poster.

METHODS

Data collection and analysis

We conducted semi-structured interviews to explore how older adults with chronic diseases search for and evaluate health information on WeChat. The interview protocol was designed by considering the technology affordances of WeChat. Before each interview, participants were asked to complete a short questionnaire about basic demographics and eHealth literacy, measured by eHEALS (Norman & Skinner, 2006). Each interview lasted about 40-60 minutes. The interviews were recorded and transcribed in Microsoft Word. We use open coding and selective coding methods to identify themes related to health information seeking and evaluation.

Participants

ID	Age	Gender	Education background	Chronic conditions	Self-rated health status	eHealth literacy
P1	51	Female	Primary school	Hypertension and Cervical spondylosis	Very good	2.86/5
P2	55	Female	Primary school	Hypertension and Diabetes	Good	2.00/5
P3	58	Female	Junior college	Chronic Gastritis and Arthritis	Poor	4.00/5
P4	64	Male	Primary school	Chronic Gastritis	Average	2.29/5
P5	69	Female	Junior school	Hypertension	Good	3.57/5
P6	73	Male	High school	Hypertension	Good	3.71/5

Table 1. Basic information of participants

The participants were recruited in a local community. We employed a pre-screening procedure in the recruitment; the eligibility criteria include: (1) aged 50 or above; (2) living with chronic conditions; (3) having experience of using WeChat. A total of six older adults were recruited to participate in the interview, as Table 1.

RESULTS

Health information seeking and affordances

The results suggest that participants scanned both the specific information on chronic conditions and the general health topics about aging. For example, P1 and P5 were interested in diet information related to blood pressure and gastritis. P4 also searched for general health information about how to prevent common diseases in aging. He commented: *"It is easy to get sick when getting old. I read it carefully when I come across some information about disease prevention."*

We found participants utilized multiple affordances on WeChat to obtain health information, including group chatting, moments, top stories, video channels, subscriptions, and searching. Participants expressed different preferences among these affordances. P2 and P4 used video channels more often because the videos elicited more fun and were easier to understand. P2 commented that *"I used to utilize 'top stories' for health information, but now video channels. The recommended content in top stories is similar, but the video allows me to receive different information."* P6 expressed his preference for subscriptions because *"articles provide more details."* Moreover, we found that strong social affordances on WeChat influenced participants' health information consumption. All participants expressed their willingness to read health information shared by their friends and family members. P2 said: *"I often read articles [in subscriptions] and watch videos [in video channels] shared by my friends."* Participant P6 mentioned that he often shares some health articles with his friends via group chatting.

Health information evaluation and affordances

We identified four information patterns of older adults' health information evaluation on WeChat. First, we observed that P2 trusted all health information on WeChat before discriminating against misinformation by further judgment. She commented: *"I considered most of the health information on WeChat to be trustworthy. Nevertheless, I will distinguish low-quality health information based on my own experience when I encountered some."* Second, we observed that P4 initially distrusted all health information on WeChat and selected useful information by further judgment. He believed that the health information on WeChat was inaccurate and based on pseudoscience. Third, participant P5 trust all the health information on WeChat without further judgment. Fourth, older adults may assess health information quality on WeChat by referring to other sources. For example, P6 cross-checked the information by using his books and consulted his children to ensure credibility.

The results suggested that the affordances provided by WeChat may influence not only older adults' health information seeking but also the health information evaluation. Participants commonly mentioned that the social-related affordances influenced their judgment about the credibility of health information. P5 commented: *"I have great faith in the health information shared by friends and family members because I believe they only share relevant and beneficial information."* Similarly, P2 mentioned that *"For health information that my friends have liked, I would consider it more interesting and more trustworthy."* Furthermore, WeChat offers metavoicing affordances that enable publishers to authenticate their identity and allow consumers to like and comment on a publication, which served as credibility cues for some older adults (e.g., P4) to judge the information quality.

DISCUSSION AND CONCLUSIONS

We found that older adults with chronic diseases showed different health information behaviors when interacting with multiple affordances on WeChat. First, we found older adults utilized different channels on WeChat to acquire health information. Furthermore, we identified four distinct patterns of participants' health information assessment. The results suggested that although social apps such as WeChat are not intentionally designed for health purposes, they could be utilized as a platform for health communication. Compared with traditional information sources, social apps allow richer information modalities and generate more interestingness for older adults' health information seeking. However, we also observed some constraints of using social apps for health information seeking. For example, the strong social-related affordances may bias older adults' credibility assessment. The study may enrich health information seeking literature extending the research contexts to older adults' everyday life information practices and may generate some potential practical implications for the designs for aging.

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Research on the Index for Evaluating Academic Activeness of Researchers

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ABSTRACT

Academic conferences can promote academic exchanges among researchers. As the core of academic conferences, they inject soul into academic conferences. Here, we put forward the evaluation of researchers' academic conference active degree from the perspective of participation. This paper mainly proposes to apply the “h-index” and the “p-index” to the active degree evaluation of researchers, which is a particularly simple and useful method to describe the scientific output of a researcher in academic meetings. The relevant indices are extended to the participation indices, forming the p-index of participation. Introduce the participation rate to improve the original h-index and form the h-index of participation. The evaluation effect of each index is analyzed from the consistency, difference and correlation between them. The results support the conclusion that the p(p)-index can well reflect the value of researchers' lifetime contribution, and the h(p)-index can reflect the degree of loyalty of researchers better.

KEYWORDS

Active degree; Academic conference; The h-index; The p-index; Evaluation.

INTRODUCTION

The term “activeness” was first used by network. It is a concept relative to “loss”. For example, the term “user activeness” describes the frequency of users in network activities. It can be used to measure the operation status of the website and the value of the target group in the communication activities (Zhu, 2016). Why put forward the academic activeness? At present, most of the academic influence focuses on the researchers' scientific research achievements, while neglecting the influence of researchers' academic exchanges through papers (Zhao, 2018). The proposal of activeness makes up for this defect. Most of the existing researchers' evaluation relies on citation index, which is based on the influence evaluation after the scientific research output, but ignores the contribution before the academic output. They all evaluate the influence of their research results after they are officially published, but ignore the relevant analysis from the perspective of researchers' output, and do not affirm the contribution and efforts in the paper submission. Then, the existing research ignores the contribution of researchers in the process of academic exchange, which is mainly reflected in the transfer of invisible knowledge, that is, the internalization of knowledge. This paper takes the researchers of academic conference papers as the research object. The output of academic conference papers is the result of peer review. Therefore, the research itself proposed in this paper can be said to be quantitative research on the basis of qualitative research.

METHOD

We have collected papers (including long paper, short paper and poster) published in the conference of American Society for Information Science and Technology (ASIS&T) from 2002 to 2020, which are collected from the ASIS&T website. The relevant bibliographic information must be manually downloaded from the homepage of the journal by visiting each issue of each volume of the website (there is 1 volume). That information includes the number (C) of output published in a certain academic conference over N years, the number of output (C_i) for each year (i), the number of sessions attended by researchers (N), etc. Here, we propose to apply the “h-index” and the “p-index” to the active degree evaluation of researchers, which is a particularly simple and useful method to describe the scientific output of a researcher in academic meetings.

On the basis of previous studies, G.Prathap thinks that the connotation of $(C^2 / N)^{1/3}$ has rich meanings, and puts forward p-index (prathap, 2010b, 2010a). The formula of p-index is shown in formula (1). We apply p-index (expressed by the symbol p(p)-index) to evaluate the activeness of researchers participating in academic

conferences. C represents the total number of papers published in academic conferences, and the average citation rate (C/N) is extended to the average number of papers published in the conference year.

$$p(p)=(C \cdot C/N)^{1/3}=(C^2/N)^{1/3} \quad (1)$$

J.E.Hirsch(Hirsch, 2005) designed h-index to evaluate individual performance of scientists, which is a positive integer, in the case of limited academic conference papers, the h-index is a positive integer which has some defects. In this evaluation, we introduce the participation rate and put forward the h(p)-index. The sum of h-index and participation rate forms the h(p)-index. See formula (2). Among them, the i_{\min} is the year in which an author first attended such an academic conference. The h-index of participation (expressed by the symbol h(p)-index) adds a decimal part to the original h index, so it is completely positively correlated with h-index. The h(p)-index not only has many advantages of the h-index, but also gives new connotation to h index.

$$h(p)=h+N/2020-i_{\min} \quad (2)$$

RESULTS AND DISCUSSION

Then we use SPSS to analyze the correlation between the calculation results of each index. The specific correlation coefficient is shown in Table 1. Through observation, it is found that the two indexes are highly correlated with the total number of papers and the number of participants, that is, they have a certain consistency with other indexes, among which p(p)-index and h(p)-index have a higher correlation.

Spearman's rho	C	N	C/N	p(p)-index	h(p)-index
C	1	.853**	.732**	.971**	.823**
N	.853**	1	.304**	.712**	.628**
C/N	.732**	.304**	1	.867**	.722**
p(p)-index	.971**	.712**	.867**	1	.839**
h(p)-index	.823**	.628**	.722**	.839**	1

Table 1 The Matrix of Correlations between Indices

Compared with the h(p)-index, the p(p)-index also considers the average number of academic papers by researchers. The average annual number of academic papers is a composite index to reflect the academic active degree of researchers, which has obvious sensitivity. So as to effectively curb the pursuit of the number of contributions, without continuing to pay attention to the development of the academic conference itself. The p(p)-index of researchers is similar to the average annual number of academic papers collected by researchers, both of which have high sensitivity. It can improve the contribution of authors to academic exchanges, and transform the quantity and quality of authors' activeness in academic conferences. The p(p)-index synthesizes the quality and quantity of researchers' scientific output, has less influence on time, and has higher flexibility. The h(p)-index proposed in this paper, adding the participation rate, also realizes the effect of reducing the time, and can identify those new loyal researchers, who pay attention to the meeting later, but continue to output from the beginning of contact. Therefore, the improved h(p)-index increases the fairness of researchers' participation active degree evaluation.

CONCLUSION

Generally speaking, the p(p)-index is more appropriate to reflect the value of researchers' lifetime contribution. However, it is susceptible to extreme values, and extreme values can be removed during the evaluation process to reduce the impact of excessive publications in a single year. The h(p)-index reflects the degree of loyalty of researchers more appropriately, and the comprehensive evaluation effect will be better when combined with other considerations, such as the maximum continuous participation.

ACKNOWLEDGMENTS

This research is funded by the National Social Science Found Major Project of China (18ZDA325).

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Gender Disparity in Expressed Emotions within Health-Related Online Support Groups

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ABSTRACT

Online support groups offer a new way to users to communicate with others regarding certain health issues. Taking autism-related support groups on Facebook as an example, we examine whether the expressed emotions differ between female and male users in online health-related support groups and whether such gender disparity varied based on the topics of the groups. Experimental results reveal a significant gender difference of expressed emotions in the groups. We find that female users tended to express more positive emotions in the group discussions than the male group members did. In addition, users appeared to express different sentiments within the groups focused on various topics. Male users tend to convey more negative emotions in the group that related to treatment, while female users were more positive when posted in the research-related group than male users were. This study is beneficial for tracking and moderating the emotional environment in online support groups.

KEYWORDS

Gender disparity; Health information seeking; Sentiment analysis

INTRODUCTION

The prevalence of gender-related disparities regarding how health information is processed and used has been well documented (Lorence & Park, 2007). Women were more concerned about the health communication than men were (Obermeyer et al., 2004), while men tend to be more hesitate to search for sources of health-related information (Courtenay, 2000; Ek, 2015). Moreover, emotional support has been considered as a significant element for the social support that the communities on social media provide to the community members. However, little is known about the gender disparity of expressed sentiments in communicating health-related information in online support groups. Therefore, we aim to explore whether the expressed emotions differ between female and male users in online health-related support groups and whether such gender disparity varied with the different topics.

METHODS**Data collection**

In this study, we selected the autism-related Facebook group as an empirical case of health-related online support groups. The following autism-related terms were used to search the public groups on Facebook: “autism”, “autistic”, “asperger”, “aspie”, and “pervasive developmental disorder”. For each group identified in the search results, a flyer was posted in the groups notifying the process of this study. In order to protect the anonymity and confidentiality of the human subjects, all data collected from the groups were de-identified and safely stored. This study has been granted Exempt Status after review by the IRB at the University of Wisconsin-Milwaukee.

Five public groups, each focused on a distinct topic based on the group name and group descriptions (i.e. Awareness, Treatment, Parents, Research, and Local support), became the data sources. After identifying the sampled groups, data collection for this study centered on the extraction of the interactions and content that appeared in each group.

Data analysis

In this study, Lexalytics carried out the sentiment analysis on the content from each group. All of the initial posts and the replies were combined together as the input data set for the sentiment analysis. The automatic sentiment scoring method scores each text according to the same algorithm, and thus can avoid human biases (Lak & Turetken, 2014). Lexalytics provided sentiment scores in the range of -2 to +2, along with the sentiment categories

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(positive, neutral, or negative) in which the text appeared. Inferential analysis served to examine the differences in sentiment characteristics between different gender groups. The non-parametric test was performed to examine the null hypothesis. The significance level (α) for the test was equal to 0.05.

FINDINGS

Gender disparity of expressed sentiment

The median score of the sentiment presented by females ($Md=0.201$) was higher than by males ($MD=0.148$). The spread of the sentiment scores for males and females were similar. However, more outliers appeared for females. It suggested that the females tended to convey emotions that were more intensive. A Mann-Whitney U tests was conducted to test the overall gender disparity of expressed emotions. The resultant Mann-Whitney U-value was found to be significant ($U=664450.5$, $Z=-2.056$, $p=0.04<0.05$). The resultant effect size r was 0.04, indicating a very small effect size using Cohen (1988) criteria of 0.1=small effect, 0.3=medium effect, 0.5=large effect. It suggests that male users and female users expressed significantly different sentiment in the autism support groups on Facebook, but the effect size would be considered very small.

Gender disparity of expressed sentiment in different groups

Figure 1 displays the means and standard deviations of the sentiment scores of the male users and female users in each group. The means of sentiment scores of males and females in all groups were slightly above zero, which means the average sentiment appeared to be positive in each group. Female users and male users reached similar sentiment scores in Group 1, Group 3, and Group 5. Female users expressed lower sentiment scores in Group 2 than male users did, while female users were more positive in Group 4 than male users were. The standard deviations showed that the male users in Group 1 and Group 5 addressed emotions that varied more than in the other groups. The variations of the emotions expressed by the female users were quite close in all groups. Group 2 focused on the discussions of the treatment. In this group, female users sometimes expressed extremely negative emotions such as “*Very scary!!*” and “*Holy shit!*”. In Group 4, which was created for research focus, 24 out of 26 messages posted by female users were positive or neutral.

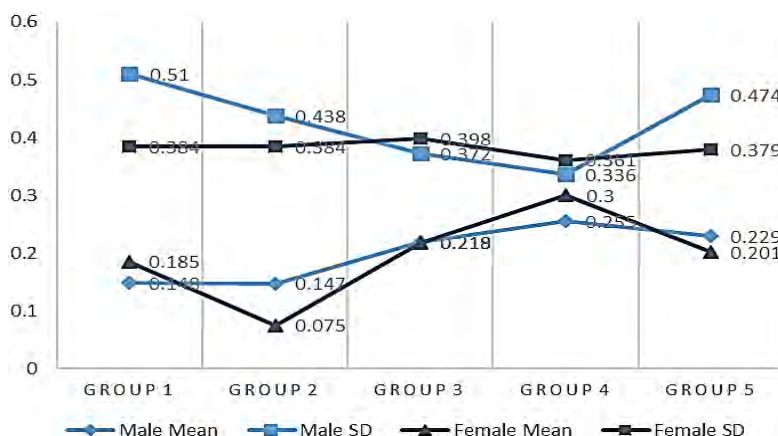


Figure 1. Distributions of means and standard deviations of sentiment scores of males and females in each group

DISCUSSION AND PRIMARY CONCLUSION

It was revealed that the female users tended to express more positive emotions in the group discussions than the male groups members did. Users appeared to express different sentiments within the groups focused on various topics. Male users tend to convey more negative emotions in the group that related to treatment, while female users were more positive when posted in the research-related group than male users were. The overall positive climate reflected by the discussions in autism support groups on Facebook suggest that support groups on social media promised to be a way to provide social and emotional support for users. These findings were consistent to a reported healthy and continuous communication loop uncovered in a stutter support group on Facebook (Raj, 2015).

However, the limitation to this study concerns the sampling and data collection. Facebook groups related to autism were the only health-related groups addressed in this research. Further study could also investigate the gender disparity of emotional support received from the health-related online support groups.

ACKNOWLEDGMENTS

This study is supported in part by the Jiangsu Province Social Science Foundation (#19TQC005), the National Natural Science Foundation of China (No. 72004091), the Humanity and Social Science Foundation of Ministry of Education of China (#20YJC870014).

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