In a Perfect World. Exploring the Desires and Realities for Digitized Historical Image Archives.

AUTHORS SECTION

Late, Elina Tampere University, Finland | Elina.Late@tuni.fi
Ruotsalainen, Hille Tampere University, Finland | Hille.Ruotsalainen@tuni.fi
Kumpulainen, Sanna Tampere University, Finland | Sanna.Kumpulainen@tuni.fi

ABSTRACT

The primary goal of this paper is to explore users' desires for digitized historical image collections, examining their desires based on different use purposes and information interaction activities. In addition, we investigate the image attributes that users wish to search from the collection. To accomplish this, we conducted 21 qualitative interviews with active users of a digitized historical photograph archive. Our findings suggest that users' desires relate to three contexts: tools, collection, and socio-organizational issues. Moreover, our results indicate that users require support for various information interaction activities, not just searching. We found that users' desires vary based on their specific use purposes, and that users prioritize conceptual access points that can already mostly be generated through automated annotation methods. Ultimately, this study contributes to a better understanding of users' real-life image needs and offers implications for improving access to digital image collections.

KEYWORDS

Cultural heritage collections, digital archives, digital images, image archives, information behavior, information interaction, information needs, user studies

INTRODUCTION

The digitization of cultural heritage collections has significantly improved user access to materials, including historical image archives that have been increasingly converted into digital format. However, little is known about information behaviors related to the use of historical images, as existing research on digital collections has focused primarily on textual materials (Chassanoff, 2018). This lack of research has resulted in a limited understanding of how digitized historical image collections are utilized, how well they meet user needs, and what users expect from these collections. Previous studies have revealed that image searching can be challenging due to its reliance on textual descriptions (Roberts, 2001). Yet, creating textual descriptions is resource consuming and challenging as the meaning of an image always depends on the viewer. Thus, the same image may have varying interpretations.

For designing sustainable digital collections, it is important to understand the real-world information behaviors related to the use of the collections (Borgman, 2003). Otherwise, some crucial aspects of work practices that shape the use could get ignored. It has been argued that research on this area lacks qualitative approaches to truly understand the image needs and uses (Cho et al., 2022; Matusiak, 2017). Providing contents openly online is not enough if they cannot be found, accessed, interoperated, and reused, as suggested by the FAIR principles (Wilkinson, et al. 2016).

The aim of this paper is to provide new knowledge about the desires users with different use purposes have for digitized image collection and the relations of their desires to different information interaction activities. Further, we investigate the attributes users wish to search from the collection. Our research questions are:

RQ1: What do users desire from a digitized historical image archive?

RQ2: In which information interaction activities do the desires relate to?

RQ3: How do desires vary across different use purposes?

RQ4: Which image attributes users want to search from the collection?

86th Annual Meeting of the Association for Information Science & Technology | Oct. 29 – 31, 2023 |London, United Kingdom.

Our analysis is based on 21 qualitative interviews with experienced users of digitized image collection containing approximately 160.000 historical images from the early 20th century. This collection was not originally intended for public use but for providing illustration for the propaganda organization during the Second World War in Finland. After its digitation in 2013, the collection has been a popular source of image data for, e.g., genealogists, other hobbyists, journalists, and history researchers.

The paper is structured as follows; First, we provide background about digitized image archives and their uses and possibilities. Next, we present our research setting, including data collection and analyses. After this, we present our findings followed by discussion and conclusions.

BACKGROUND

Image Archives and Their Uses

Digitized image archives are collections of, for example, photographs originally produced in analog format and later digitized. Historical photographs are cultural heritage documenting our past visually. They are used for various purposes and by various stakeholders including scholars, educators, the public, and commercial actors. However, there is a lack of understanding of how and why digitized image archives are used as most of the earlier studies focusing on cultural heritage collections study textual materials as image use has been mainly studied from the perspective of searching.

Information interactions arise out of nothing, but rather are triggered by either leisure or work-related tasks (Järvelin et al., 2015; Toms, 2011; Vakkari, 2001). Earlier studies have analyzed the image use for illustration and information (e.g., McCay-Peet & Toms, 2009). Digital archives are popular sources for collecting images to illustrate publications, social media posts, etc. One example of the use of images for information is their use as research data. Indeed, images are important primary sources for historical research, and images are used for verification, documentation, or corroboration (Chassanoff, 2018). Beaudoin (2014) studied image use among archaeologists, architects, art historians, and artists. She discovered that images were used for various purposes such as for knowledge creation, conceptual modelling, inspiration, cognitive recall, critical thinking, communication, emotion, engagement, marketing, proof, social connection, translation, and trust. In her study, the image use varied between user groups; those in archaeology and art history used images most often for knowledge creation for their lecture presentations and for research and publications as those in architecture and art used images for research and design creation.

Various studies show that although images are visual data they are mostly searched textually (e.g. Matusiak, 2017, 2006; Ménard & Khashman, 2014). Kumpulainen and Ruotsalainen (2022) studied the search tactics used for finding images from digital wartime photograph archive in the context of serious leisure. Based on a survey data they showed that keyword searching was the main tactic used along with filtering and browsing. Further, the study by Late, Ruotsalainen, and Kumpulainen (2023) indicates that keyword searching alone is not often an appropriate search tactic but must be accompanied by other tactics such as filtering and browsing. However, using the image archives comes with many difficulties in terms of discoverability, copyright, size, and quality (Beaudoin & Brady, 2011). Late, Ruotsalainen and Kumpulainen (2023) show that the incompleteness of metadata is the major barrier to the use of a digital image archive. Beyond historical images, literature review by Cho et al. (2022) revealed obstacles in image searching that were related to semantic problems, content-based issues, technical limitations, issues of aboutness, inclusivity issues, search skills, and cognitive overload.

Image Needs and Supporting Them

There is much to be improved in providing images for the users. According to Chassanoff (2018) historians desire original descriptive information, such as captions, keywords, subject headings, original medium, and the size of the images. More generally, earlier studies have outlined key requirements for digital libraries to be easy to learn and to use and deliver reliable search results (Kani-Zabihi, Ghinea & Chen, 2006; Kimani et al., 2009). Matuasik's (2019) study focusing on community archives shows that users value developed interfaces, high quality of objects, good metadata, contextual information, and wide coverage. The design of the systems, as well as the terminology used, should be clear, consistent, and easy to understand (Thong, Hong, Tam, 2002). Other studies have shown that users desire, for example, visual-based interfaces to support faceted searching (Suominen, Viljanen & Hyvönen, 2007) of which a map-based search is only an example (McIntosh & Bainbridge, 2011).

Previous research has also examined the specific attributes that users search from the images. For example, McCay-Peet and Toms (2009) investigated the types of image attributes used by historians and journalists when selecting images for their work. They analyzed both conceptual and descriptive image attributes, drawing on earlier frameworks developed by Jörgensen (1998), Laine-Hernandez and Westman (2006), and Shatford (1986). Participants ranked attributes such as person/animal/object and event/action (conceptual), as well as viewer response

and visual elements (descriptive), as the most important. Interestingly, no significant differences were found in attribute types based on whether the images were being used for information or illustration purposes. The authors recommend further research to explore the relationship between image needs and work tasks, with the aim of developing image retrieval systems that truly meet the needs of users.

User tagging and content-based image retrieval (CBIR) have revolutionized the way accessing and interacting with images, by providing cost-effective and high-density access points. CBIR techniques have already enabled recognition of people, objects, events, and landscapes in images, while newer methods can even identify photographic arrangements, such as distance between objects or camera or orientation, and recognize main characters. Other possibilities are, for example, reverse image search or finding similar images to those already found. (Seker, et al. 2021) However, Beaudoin's (2016) study revealed that while CBIR was found useful by users interested in formal characteristics like color, shape, composition, and texture, it did not benefit users interested in known-items, themes, or locations. Archaeologists and art historians in the study preferred text-based retrieval of images over CBIR methods, underscoring the importance of user studies in determining real-life user needs. Moreover, limited resources may prevent cultural heritage collections from adopting novel methods for digital archives.

RESEARCH SETTING

Case Image Archive

This study explores the use of a digital collection comprising approximately 160.000 unique photographs captured during the Second World War in Finland, between 1939 and 1945. The collection, provided by the Finnish Defence Forces, is available in print as well as digital format and features images depicting various aspects of the war. These include life on the home front, events and operations at the front, the war industry, leisure time at the front, damages caused by bombings, and the evacuation of Finnish Karelia. Most of the photographs were taken by wartime Information Company photographers and were used for wartime propaganda. While the majority of the photographs are in black and white, a small number of color photographs and videos are also included. The collection was published online in 2013 and is openly accessible to users in both Finnish and English via http://sa-kuva.fi/.

The digital images can be accessed using an online search interface that includes keyword search, advanced search with Boolean operators, and browsing options. Users can also filter the images based on predefined stages of the war (Winter War, Continuation War, Lapland War), specific date information, and color images and videos. The search results display 15 thumbnail images per page, and users can click on a thumbnail to view a larger image, access related metadata, and download the image. Users can also submit additional information about the image to the archive at this stage. Guidelines, terms of use, and a description of the archive are provided.

Textual metadata, created by photographers during wartime, forms the basis of the search. This metadata includes the name of the photographer, location, and subject or event depicted in the image. However, due to the chaotic wartime conditions, metadata is partly incomplete, and some photographers were unable to provide detailed descriptions. The metadata may also contain spelling errors and mistakes regarding the date and location. The metadata has not been edited or proofread and is primarily in Finnish, with some in Swedish.

Data Collection

The data for this study was obtained through semi-structured interviews conducted with 21 active users having experience over several years of the digital collection. The participants were selected to represent a range of roles (as presented in Table 1), including researchers (using images for research purposes), amateurs (using images for serious leisure activities such as genealogy and scale model building), journalists/writers (using images for illustration), and information specialists (searching images for their clients and for museum collections). The interviewees were selected through a combination of contacts provided by the research team and outreach to organizations known to use the archive. Each interviewee was also asked if they knew of anyone else (colleagues, etc.) who would be suitable for the interview. The goal was to gather a diverse range of experiences with the collection.

The interviews were conducted online using the conference tool Zoom during November 2021 and April 2022 until saturation was reached. All interviews were video recorded, and the video files were fully transcribed for analysis purposes. The average length of each interview was 37 minutes, resulting in a total of 12 hours and 48 minutes of audio data. Prior to the data collection, informed consents were obtained from all interviewees.

	Number of participants
Age	26-70 years (mean 47.5 years)
Work organization	University (10), private company (5), cultural heritage organization (3), retired (3)
Work role	Academic scholar (10), professional writer (4), amateur (4), information specialist (3)

Table 1. Profile of the participants.

During the interviews, participants were asked a series of questions from the interview guide including background information such as their status, research field, and age. To explore their experiences with the image collection, a variation of the critical incident technique (Flanagan, 1954) was employed, where interviewees were asked to describe how they had used the collection, including searching, selecting, and saving images from the archive for one specific task. In addition, each interviewee was asked "What would be the perfect world searching engine like? What could you do with it?" to collect participants' desires for the system. However, interviews did not necessarily follow the order of the questions in the guide, but the guide was used as a checklist to keep track of the interview. Also, before the interview, the interviewees were told shortly about automatic annotation methods to give them information about possibilities for developing the system. This, however, guided the thinking of the interviewees toward desires for the search engine and possibilities of automatic annotation. Also, it should be noted that participants could express their desires for the system at any point during the interview.

Data Analyses

To analyze the interview data, a combination of Atlas.ti software, Microsoft Excel, and SPSS were used. Firstly, the interview transcripts were uploaded into Atlas.ti and read through multiple times to identify instances where participants expressed their desires for the image collection. By using the concept of desire, we refer to the expectations, aspirations and needs that users have regarding their utilization of the collection. A total of 271 instances were identified from the data. Quotations expressing these desires were then extracted and entered into an Excel spreadsheet for further analysis.

For providing an answer to RQ1 (What do users desire from a digitized historical image archive?), desires were categorized according to their context utilizing categories provided by Kumpulainen and Late (2022). In this specific study, the contexts of *tools*, *collection,* and *socio-organizational* issues were utilized. Next, the subcategories (total of 19) for the contexts were coded data-driven. Regarding the RQ2 (In which information interaction activities do the desires relate?), the information interaction activities provided by Järvelin et al. (2015) were coded for identifying the activity the desire was related to. The theoretical model by Järvelin et al. (2015) is based on the idea of task-based information interaction (TBII) to assess how the information interactions contribute to the goals of task performance. Activities of *searching/selecting*, *working with items,* and *synthesizing/reporting* were applied in the coding. Searching and selecting activities were combined since an earlier study had shown these activities to be overlapping (Late & Kumpulainen, 2022). As all desires were not related to any specific activity an additional category "general" was formed. The context of desires and information activities the desires were related to were cross-tabulated and the Fisher's exact test was run with SPSS software to test for statistical independence between the categorical variables.

To address RQ3 (How do desires vary across different use purposes?), we analyzed the primary use purpose of the digital collection for each interviewee. We identified the primary use purpose from the interviewees' descriptions, following the categorization used by Fidel (1997) and McCay-Peet & Toms (2009) *for information* (users who looked for specific information from the images, such as research data) and *for illustration* (users who looked for images for illustrating publications). We also included an additional category, *information mediating*, for those who looked for images for their clients or for building collections. However, it is important to note that these were the users' primary use types. Users looking for images primarily for information could also use the images later for illustration, and users looking for images for illustration may have gained new information from the images and metadata that affected their searching behavior. To study the differences between different uses of the collection (RQ3), we cross-tabulated the context of desires with the primary use type. We used Fisher's exact test with SPSS software to test the statistical independence between the categorical variables.

Finally, to providing an answer to RQ4 (Which image attributes do users want to search from the collection?) image attributes the users expressed they wanted to search from the collection were coded from the original data. Although we did not ask directly about image attribute needs during the interviews, participants expressed their needs while describing their research problems and image search habits, resulting in 173 expressions. The attributes were categorized either as *conceptual* (image of/about) or *descriptive* (image is) following the categorization used by

McCay-Peet and Toms (2009). Attribute subtypes were formed data-driven but later standardized with subtypes used by McCay-Peet and Toms (2009) when possible. Illustrative quotes from the data were chosen and loosely translated from Finnish to English.

RESULTS

Desires

Interviewees' desires for the digitized historical image collection were related to either *the tools* (N=174, 64.2%), *the collection* (N=82, 30.3%) or *the socio-organizational issues* (N=15, 5.5%). Most desires were related to *searching/selecting* activity (N= 182, 67.2%), while desires supporting *working with items* (N=52, 19.2%) and *synthesizing/reporting* (N=13, 4.8%) activities were less common. A subset of desires that did not relate to any specific activity was classified as *general* (N=24, 8.9%). The results of Fisher's exact test ($p < .001$) indicate a significant association between the context of desires and the activities they were associated with. Generally, desires related to tools were predominantly associated with *searching/selecting* activity. For desires related to the collection, over half were related to *searching and selecting*, while some were related to *working with items* activity. Socio-organizational desires were mostly associated with general issues and not tied to specific activities.

Users' desires related to *tools* supporting *searching/selecting* (see Table 2) concerned most often possibilities for content-based recognition that could help them to identify various attributes they wanted to search from the collection.

> *I think I would benefit a lot from AI-based automatic character recognition that would identify dogs, other animals, people, etc. This would very likely show images that I have missed, and it would open up my research results and bring new points of view already in the search phase. At least it would make it faster.* (P1, researcher)

Participants expressed a desire for more advanced search options, such as recommendation systems and map-based searches. Some also hoped for a system that would facilitate serendipitous discoveries by allowing them to stumble upon unintended images from the collection. Additionally, they sought an improved interface that would enable personalization, visualization of search results, and easy browsing. Researchers, in particular, desired various tools to aid them with *working with items*, such as the ability to further analyze outputs from the system, zoom in on images, and access analysis tools for their own collection retrieved from the system. For *synthesizing and reporting* users wished for functionalities that support image sharing.

Supported activity	Desire	Examples
Searching/selecting (78.7%)	Content-based recognition	Automatically identify desired contents from the images
	Improved search options	Recommendation system, search based on a map, voice search, search supporting serendipity
	Improved interface	Personalization, visualization of results, easy browsing
Working with items (17.8%)	Outputs from the system	Downloading multiple images at once, downloading image metadata to spreadsheets
	Zoomability	Ability to zoom and see full-size images easily
	Analysis tools	Tools for analysing the search results based on metadata
Synthesizing/reporting (3.4%)	Easy sharing	Sharing images in social media

Table 2. Desires in the context of tools according to information interaction activities. (N=174)

In the context of the *collection* (see Table 3) desires supporting *searching/selecting* were about improving and increasing the metadata, that users wanted to be curated and formalized. However, at the same time, they wanted to preserve the original captions within the images. Participants requested also clear guidelines and support for

searching the contents and accessing all the images in the collection. This was related to the decisions to remove some images from the collection because of sensitive content. Regarding the *working with items*, participants expressed a need for high-quality digitization of the images, including capturing the backsides that could contain valuable supplementary information.

> *Definitely the backsides of the photos should be integrated before someone makes up that we have the photos digitized and that is enough. I haven't even once made research without browsing the originals* (P5, research)

In addition, participants expressed a desire to link contextual data, such as information about the events and individuals depicted in the images. Concerning *synthesizing and reporting*, participants emphasized the importance of trustworthy metadata, as they did not want to publish images with inaccurate information. Published images also needed to be of high quality and have clear licenses. Participants expressed a general desire to expand the collection beyond the wartime period and include images from other non-digitized collections.

Supported activity	Desire	Examples
Searching/selecting (54.9%)	Improved metadata	More curated metadata, original captions
	Guidelines/support	Clear guidelines for searching, information about the collection
	Access all contents	Access to censored images
Working with items (24.4%)	Good quality digitation	Good quality images, digitation of the backsides of the images
	Contextual information	Linking additional information related to images
Synthesizing/reporting (4.9%)	Trustworthy metadata	Correct metadata that readers of the publications can trust
	Good quality digitation	Images that can be published
	Clear licenses	Clear licenses and guidelines for publishing
General (15.9%)	More images	More images before and after the wartime, integrating images from other collections

Table 3. Desires in the context of the collection according to information interaction activities. (N=82)

Only a few desires were related to *socio-organizational issues* (Table 4). Researchers using the collection expressed a need for new quantitative research methods capable of handling large sets of historical images. Related to *reporting* activity participants hoped for ethical standards for publishing of the images. This was especially related to inexperienced users and their lack of information about the collection and its origins. General desires were about possibilities to correct and produce image metadata for the collection collectively. One participant also wished for more visibility for the collection.

> *For many photos, there is specific information out there [that is not integrated into the collection]. Mostly about the vehicles, persons or places* (P17, amateur)

Supported activity	Desire	Examples
Working with items (6.7%)	Research methods	Developing new research methods for historical research
Synthesizing/reporting (20.0%)	Ethical use	Publishing images ethically
General (73.3%)	Ability to correct metadata	Resources to integrate corrections delivered by users to the collection
	Visibility	More visibility for the collection

Table 4. Desires in the socio-organizational context according to information interaction activities. (N=15)

Differences Across Primary Use Purposes

The study found that participants used the collection for various purposes, including finding images *for information* (N=12), *illustration* (N=6), or *information mediating* (N=3). The purpose of use was closely linked to the user's work role, with the majority of researchers and amateurs using the images *for information* (81.8% and 71%, respectively), while professional writers primarily used images *for illustration* purposes (100%). Information specialists mainly used the collection *for information mediating* (78.7%) or *for information* (21.3%).

In Table 5, the differences between participants using the collection for different purposes were examined in relation to the context of their desires (The results of the Fisher's exact test (p =.033) indicate a significant association between the variables). Participants using images primarily *for information* or *illustration* purposes expressed more desires for *tools* as those using the collection for *mediating information* had more desires for the *collection* and *socio-organizational issues.*

	Context of desires			
Primary use type	Tools	Collection	Soc-org.	Total
Information (n=152)	67.8	28.3	3.9	100
Illustration (n=75)	68.0	28.0	4.0	100
Information mediating (n=44)	45.5	40.9	13.6	100
Total (N=271)	64.2	30.3	5.5	100

Table 5. Share (%) of desires in different contexts across use purposes.

Desired Image Attributes

Our analyses showed that users were intrigued by the prospect of automated content recognition for images. To delve deeper, we studied the attribute types and subtypes that users wanted to identify from the image collection. Our analysis included a total of 173 attribute expressions, many of them overlapping. Conceptual attributes, which refer to images about something, comprised the majority (77.5%) of the expressions, while descriptive attributes, which describe what the image is, accounted for the remaining 22.5%. Table 6 below displays the various attribute types and their corresponding subtypes, along with examples.

Attribute type	**Attribute subtypes**	**Examples**
Conceptual (about) 77.5%	Person/animal/object	Humans, animals, vehicles, buildings, smoke/no smoke
	Attributes of person/object	Names of person/troops/buildings, gender, age, nationality, role, type of vehicles
	Location/place	Inside/outside, town, forest
	Event/action	A battle, Christmas, staged/real happening, men skiing/standing in line
	Expression, emotion	Tired, happy
	Time/Temporal	Season, time of day
Descriptive (is) 22.5%	Description	Date of the photograph, name of the photographer
	Composition	Distance between people, posture, number of objects/people in the image, direction of activity
	External relation	Images belonging to the same series, information about publication forums of images
	Color/color value	Black and white, color codes
	Image type/ Visual elements	Image genre, orientation (landscape/portrait)

Table 6. Attribute types and subtypes expressed by the interviewees. (N=173)

The majority of conceptual attributes related to identifying specific persons, objects, or animals within the images. Users expressed a desire to search for images featuring humans, dogs, vehicles, buildings, and more. Additionally, attributes of persons and objects were frequently mentioned, with a particular emphasis on recognizing individual people.

> *In the ideal world, there would be a face or shape recognition system that would enable to identify the persons and search them* (P3, information specialist)

Furthermore, users expressed a desire to search for images of specific troops, buildings, or brands. They were also interested in finding images based on characteristics such as gender, age, nationality, and role (such as children or soldiers), as well as images taken in certain locations or milieus, such as towns, forests, or indoor/outdoor settings. The ability to search for certain activities and events, such as battles, Christmas, or parties, was also highly desired. An interesting observation was the propaganda nature of the image collection, with users expressing a desire to determine whether the photographs were staged or based on real events. Additionally, participants expressed interest in images featuring expressions and emotions, such as people who appeared tired, serious, or happy, as well as images depicting temporal attributes, such as time of day or season.

> *I study the history of emotions and it would be interesting to see how for example gender and certain emotions are correlated in the photos. Or age for example. Or can we find the same facial expressions from men and women?* (P15, researcher)

Regarding descriptive attributes, users expressed the most interest in descriptive information about the images, such as the date and name of the photographer. Some users were also intrigued by image composition, including factors such as the distance between people, their posture, and the number of objects or people in the image. Additionally, the direction of activity depicted in the image was important, particularly for those seeking images for use in illustrations.

> *For example, searching soldiers skiing from left to right. For illustration, it is very important to get the direction right.* (P7, professional writer)

Moreover, participants expressed a desire to understand the external relation of the images, such as images belonging to the same photo series or those published in certain forums. Additionally, users expressed a need to identify the color and image type, as well as other visual elements present in the images.

Furthermore, we examined whether there were any significant differences in desired attribute types among users in different work roles or with different intended use purposes. However, no significant differences in desired attribute types were found. It is possible that there may be differences in subtypes, but due to the relatively small size of our data set, we were unable to conduct a thorough analysis on this front.

DISCUSSION

The objective of our study was to analyze users' desires for digitized historical image archives, with a focus on the information interaction activities related to those desires and the intended purpose of image use. Additionally, we examined the image attributes that users sought to search from the collection. Our findings shed light on the contextual factors surrounding user desires and provide insight into the types of support that users require at various stages of their information interaction process. Ideally, image archives should offer a wide range of access points to their contents and provide comprehensive support to users throughout their entire information interaction process.

With respect to RQ1 (What do the users desire from a digitized historical image archive?), our analyses show that user desires were related to the contexts of tools, collection, and socio-organizational issues. We utilized the model by Kumpulainen and Late (2022) that was originally created for studying the context of barriers in information interaction. This model turned out to be useful also for recognizing the contexts of user desires. Desires connected with *tools* were the most frequent in our data, relating, for example, to the automatic annotation of the images, providing improved search options, and developing the interface. Interviewees were intrigued by the possibilities CBIR techniques can offer, such as automatic character recognition. This finding conflicted with the results by Beaudoin (2016) who argued that scholars in archaeology and art history were not interested in CBIR systems but wanted to rely on textual descriptions. However, it is likely that during the six years between the studies, technology has developed and users are more familiar with the supports AI can offer. Furthermore, the tasks behind the image use may also differ between the studies. In addition, as already shown in earlier studies users desire visual search systems such as map-based searching, as the location is an important attribute in images (Suominen, Viljanen & Hyvönen, 2007). Digital services should also support serendipity, which is important in historians' research process (Martin & Quan-Haase, 2013). Desires related to the *collection* discussed, for example, improving the image metadata and the quality of digitation. Indeed, metadata of historical images has been shown to be a major barrier to

image searching (Late et al., 2023). *Socio-organizational* desires were infrequently expressed in our data but brought out important views for the development. One of the issues was the need for new research methods in the historical domain using images as research data.

Regarding the second research question (In which information interaction activities do the desires relate to?) our analyses indicated the association between the context of desires and information interactions identified according to Järvelin et al. (2015). For example, desires for *tools* were typically related to *searching/selecting* activity as desires for the *collection* mixed between *searching/selecting* and *working with items* activities. *Socio-organizational* desires were mostly related to general issues, not associated with specific activities. According to our findings, most desires were related to *searching/selecting* activity. However, this is partly due to our data collection method as the interviewees were asked to describe their ideal world image search engine. However, the finding is not very surprising as information interactions with the collections become less frequent towards the end of the interaction process (Late & Kumpulainen, 2021). It is also obvious that users expect similar functionalities that are provided by commercial search engines such as Google. Thus, it may be disappointing for them to realize the shortcomings of cultural heritage collections that have limited budgets for their development. Despite the limitation in our data collection, some desires related to *working with items* and *synthetizing/reporting* activities were raised. For example, researchers desired outputs from the system to be further analyzed. As the majority of the earlier studies have focused on image searching, we argue that future studies should take the whole information interaction process into account to better understand the information behavior and user needs.

The third research question was about analyzing the desires across primary use purposes, namely *for illustration, for information*, and *for information mediating*. The results showed that user desires varied between those participants using the collection *for information/illustration* and *information mediating*. Also, earlier research has shown variation in image use according to the user's task and profession (Beaudoin, 2014). These observations underline the importance of task-based research settings and confirm that the task behind the user behavior triggers what users want from the system. However, detecting the purpose of use might be challenging as in real-life users have various needs within a single task (Byström & Kumpulainen, 2022). Their use purpose may also change along the process and images that were originally searched, for example, *for illustration* may be used *for information mediating* and/or *for information*. Therefore, we analyzed participants' primary purposes, and this limitation may decrease the reliability of the results.

Our last research question focused on the image attributes users want to search from the collection. The majority of the identified attributes were *conceptual* according to categorization by McCay-Peet and Toms (2009). However, we did not study the importance of the attribute types or their sub-types. Yet, it seems that the frequency of expressed attributes relates to their importance since three out of the four most frequent attribute subtypes were the most highly ranked attribute types also in the study by McCay-Peet and Toms (2009). When comparing the attribute subtypes with the categorization used by McCay-Peet and Toms (2009) we found two new subtypes: attributes of persons/objects (conceptual) and composition (descriptive). As McCay-Peet and Toms (2009), we did not find significant differences in attribute types according to the use purposes.

We used a qualitative interview method to collect critical incidents of digitized image archive use. However, the case system under the study (and its limitations) affects the realities and desires of the participants and we collected only *ex post facto* accounts of the users' experiences. To fully understand the user desires beyond the service level there is a need for more realistic research settings, such as longitudinal ethnographic research to capture real-life information interactions beyond a single system. However, our results provide several practical implications for developing historical image archives. Users desire various tools to help them in using the system and utilizing the images. Although many of the tools are designed for supporting searching, it is vital to recognize that image searching is not only about locating the desired images from the collection, but they are used also as a method for analyzing the data. For the moment, our case image archive gives no means for analyzing one's own subcollections collected from the system. Users conducting, for example, computational humanities research may want to collect multiple images at once and export outputs of the image metadata from the system. So far, all this needs to be done manually. However, there have been arguments that digital humanities researchers would benefit more from providing a palette-style selection of tools with proper interoperability functions, rather than direct pipelines for workflows (Koolen et al., 2020).

Automatic content recognition and annotation have much to offer for historical collections with limited metadata. Our findings provide concrete examples of the image attributes that users desire to search from the collection, most of which can be implemented if sufficient resources are allocated to the development of the archive. However, previous experiences have demonstrated that information needs in humanities research can be highly diverse, making it difficult to create a single unified metadata scheme. Therefore, users may require project-specific metadata (Lund et al., 2013). Another practical consideration for development is the digitization process; valuable

information on the backsides of images should be included in digital surrogates. Moreover, users expressed a need to identify staged photographs in the collection and verify the authenticity of the images, which is particularly relevant for all visual contents.

Users' desires included allowing collaborative metadata production (co-created metadata), as they experienced there is unused information about the images available. For now, users can send additional information to the archive, but the problem seems to be, that the archive has no resources to evaluate and integrate the information. Users are not able to annotate content directly. Behind the decision, there might be a fear of integrating false information into the system. One possibility for solving the problem is to provide co-created metadata as layers on top of the original metadata and let the users decide which to use. Developing cultural heritage collections requires both financial and intellectual resources to ensure the continuation of digital curation (Barbuti, 2018). Keeping on track with developments offered by commercial systems is not easy for publicly maintained services but it is crucial to provide access and support for various user groups and different uses of the collection.

CONCLUSION

While the majority of earlier studies have focused on image search practices or on the use of textual digitized cultural heritage data, this study aimed at providing a more holistic view of the desires users have for digitized historical image archives. We based our analysis on qualitative interviews with active users of an archive containing digitized photographs from the Second World War. Our findings shed light on the diverse desires that users have for image collections, as well as the information interaction activities related to these desires. Further, we analyzed the image attributes users wanted to search from the collection. By doing this, we can better understand user needs and provide implications for improving access points to digital image collections from a human-centered perspective.

Among the key findings are that user desires for the collection are various and support is needed for different information interaction activities, not solely for searching. Our findings suggest that users' desires relate to three contexts: tools, collection, and socio-organizational issues. In particular, desires for tools were the most prevalent, including desires for automatic image annotation. On the image attribute level, our findings highlighted the need for conceptual attributes such as objects, object attributes, location, and events that were often absent from the original image metadata, which was not initially intended for current uses. However, automatic content recognition and annotation offer great potential for historical collections with limited metadata.

Our study raised several intriguing questions for future research, including the need to understand real-life information interactions with image data on a larger scale. While our study addressed some gaps in our knowledge by studying the use of one specific image archive, further research will be necessary to determine how image archives can develop their services to meet various user needs.

ACKNOWLEDGMENTS

We thank all the research participants for their valuable contributions. This research is funded by the Academy of Finland grant number 351247.

The authors confirm their contribution to the paper as follows: conceptualization: Elina Late, Sanna Kumpulainen; data collection: Hille Ruotsalainen; analysis and interpretation of results: Elina Late, Sanna Kumpulainen; writing – original draft: Elina Late; writing – review and editing: Elina Late, Sanna Kumpulainen.

REFERENCES

Barbuti, N. (2018). From digital cultural heritage to digital culture: Evolution in digital humanities. In Proceedings of the 1st International Conference on Digital Tools & Uses Congress (DTUC'18). Association for Computing Machinery, New York, NY, USA, Article 21, 1-3.

Beaudoin, J. (2016). Content-based image retrieval methods and professional image users. *Journal of the Association for information science and technology*, 67(2), 350-365. https://doi.org/10.1002/asi.23387

Beaudoin, J. (2014). A framework of image use among archaeologists, architects, art historians and artists. *Journal of Documentation*, 70(1), 119-147. https://doi.org/10.1108/JD-12-2012-0157

Beaudoin, J, & Brady, J. (2011). Finding visual information: a study of image resources used by archaeologists, architects, art historians, and artists. *Art Documentation: Journal of the Art Libraries Society of North America*, 30(2), 24-36.

Borgman, C. L. (2003). Designing digital libraries for usability. In: Bishop, A. P., Van House, N. A., & Buttenfield, B. P. (ed), Digital library use: Social practice in design and evaluation (pp. 85-118). MIT Press.

Byström, K., & Kumpulainen, S. (2020). Vertical and horizontal relationships amongst task-based information needs. Information Processing & Management, 57(2), 102065. https://doi.org/10.1016/j.ipm.2019.102065

Chassanoff, A.M. (2018). Historians' experiences using digitized archival photographs as evidence. *The American Archivist*, 81(1), 135-164. https://doi.org/10.17723/0360-9081-81.1.135

Cho H., Pham M., Leonard K.N., & Urban A.C. (2022). A systematic literature review on image information needs and behaviors. *Journal of Documentation*, 78(2), 207-227. https://doi.org/10.1108/JD-10-2020-0172

Fidel, R. (1997). The image retrieval task: implications for the design and evaluation of image databases. New *Review of Hypermedia and Multimedia*, 3(1), 181-199. https://doi.org/10.1080/13614569708914689

Flanagan, J.C. (1954). The critical incident technique. *Psychological bulletin*, 51(4), 327. https://doi.org/10.1037/h0061470

Järvelin, K., Vakkari, P., Arvola, P., Baskaya, F., Järvelin, A., Kekäläinen, J., ... and Sormunen, E. (2015). Task-based information interaction evaluation: The viewpoint of program theory. *ACM Transactions on Information Systems (TOIS)*, Vol 33 No. 1, pp. 1-30. https://doi.org/10.1145/2699660

Jörgensen, C. (1998). Attributes of images in describing tasks. *Information Processing and Management*, 34(2–3), 161–174. https://doi.org/10.1016/S0306-4573(97)00077-0

Kani-Zabihi, E., Ghinea, G., & Chen, S. Y. (2006). Digital libraries: what do users want?. *Online information review*, 30(4), 395-412. https://doi.org/10.1108/14684520610686292

Kimani, S., Panizzi, E., Catarci, T., & Antona, M. (2009). Digital library requirements: A questionnaire-based study. In Handbook of Research on Digital Libraries: Design, Development, and Impact (pp. 287-297). IGI Global.

Koolen, M., Kumpulainen, S., & Melgar-Estrada, L. (2020, March). A workflow analysis perspective to scholarly research tasks. In Proceedings of the 2020 conference on human information interaction and retrieval (pp. 183-192). https://doi.org/10.1145/3343413.3377969

Kumpulainen, S., & Late, E. (2022). Struggling with digitized historical newspapers: Contextual barriers to information interaction in history research activities. *Journal of the association for information science and technology*, 73(7), 1012-1024. https://doi.org/10.1002/asi.24608

Kumpulainen, S. & Ruotsalainen, H. (2022). Searching Wartime Photograph Archive for Serious Leisure Purposes. In International Conference on Theory and Practice of Digital Libraries (pp. 81-92). Springer, Cham. https://doi.org/10.1007/978-3-031-16802-4_7

Laine-Hernandez, M., & Westman, S. (2006). Image semantics in the description and categorization of journalistic photographs. In Proceedings of the 69th Annual Meeting of the American Society for Information Science and Technology (ASIS&T 2006), Austin, TX.

Late, E., & Kumpulainen, S. (2022). Interacting with digitised historical newspapers: understanding the use of digital surrogates as primary sources. *Journal of Documentation*, 78(7), 106-124. https://doi.org/10.1108/JD-04-2021-0078

Late, E., Ruotsalainen, H., & Kumpulainen, S. (2023). Searching images from open photograph archive. Search tactics and faced barriers in historical research. To be published.

Lund, H., Bogers, T., Larsen, B., & Lykke, M. (2013). CHAOS: User-driven Development of a Metadata Scheme for Radio Broadcast Archives. In *Proceedings of the iConference 2013 (pp. 990-994). iSchools.* *https://doi.org/10.9776/13510*

Martin, K., & Quan-Haase, A. (2013). Are e-books replacing print books? Tradition, serendipity, and opportunity in the adoption and use of e-books for historical research and teaching. *Journal of the American Society for Information Science and Technology*, *64*(5), 1016-1028. https://doi.org/10.1002/asi.22801

McIntosh, S. J., & Bainbridge, D. (2011). An integrated interactive and persistent map-based digital library interface. In Digital Libraries: For Cultural Heritage, Knowledge Dissemination, and Future Creation: 13th International Conference on Asia-Pacific Digital Libraries, ICADL 2011, Beijing, China, October 24-27, 2011. Proceedings 13 (pp. 321-330). Springer Berlin Heidelberg.

Matusiak, K. K. (2022). Evaluating a digital community archive from the user perspective: the case of formative multifaceted evaluation. Library & Information Science Research, 44(3), 101159. https://doi.org/10.1016/j.lisr.2022.101159

Matusiak, K. (2017). Studying information behavior of image users: an overview of research methodology in LIS literature, 2004–2015. Library and Information Science Research, 39(1), 53-60. https://doi.org/10.1016/j.lisr.2017.01.008

Matusiak, K. (2006). Information seeking behavior in digital image collections: a cognitive approach. The Journal of Academic Librarianship, 32(5), 479-488. https://doi.org/10.1016/j.acalib.2006.05.009

McCay-Peet, L., & Toms, E. (2009). Image use within the work task model: Images as information and illustration. Journal of the American Society for Information Science and Technology, 60(12), 2416-2429. https://doi.org/10.1002/asi.21202

McIntosh, S. J., & Bainbridge, D. (2011). An integrated interactive and persistent map-based digital library interface. In Digital Libraries: For Cultural Heritage, Knowledge Dissemination, and Future Creation: 13th International Conference on Asia-Pacific Digital Libraries, ICADL 2011, Beijing, China, October 24-27, 2011. Proceedings 13 (pp. 321-330). Springer Berlin Heidelberg.

Ménard, E, & Khashman, N. (2014). Image retrieval behaviours: users are leading the way to a new bilingual search interface. Library Hi Tech, 32(1), 50-68. https://doi.org/10.1108/LHT-06-2013-0067

Roberts, H. E. (2001). A picture is worth a thousand words: Art indexing in electronic databases. Journal of the American Society for Information Science and Technology, 52(11), 911-916. https://doi.org/10.1002/asi.1145

Seker, M., Männistö, A., Iosifidis, A., & Raitoharju, J. (2021, October). Automatic Main Character Recognition for Photographic Studies. In 2021 IEEE 23rd International Workshop on Multimedia Signal Processing (MMSP) (pp. 1-6). IEEE. https://doi.org/10.1109/MMSP53017.2021.9733624

Shatford, S. (1986). Analyzing the subject of a picture: a theoretical approach. *Cataloging & classification quarterly*, *6*(3), 39-62.

Suominen, O., Viljanen, K., & Hyvänen, E. (2007). User-centric faceted search for semantic portals. In The Semantic Web: Research and Applications: 4th European Semantic Web Conference, ESWC 2007, Innsbruck, Austria, June 3-7, 2007. Proceedings 4 (pp. 356-370). Springer Berlin Heidelberg.

Thong, J. Y., Hong, W., & Tam, K. Y. (2002). Understanding user acceptance of digital libraries: what are the roles of interface characteristics, organizational context, and individual differences?. International journal of human-computer studies, 57(3), 215-242.

Toms, E. G. (2011). Task-based information searching and retrieval. In Ruthven and Kelly (Ed.), Interactive information seeking, behaviour and retrieval, pp. 43-75. London, UK: Facet publishing.

Vakkari, P. (2001). A theory of the task-based information retrieval process: a summary and generalisation of a longitudinal study. Journal of documentation, 57(1), 44-60. https://doi.org/10.1108/EUM0000000007075

Wilkinson, M. D., Dumontier, M., Aalbersberg, I. J., Appleton, G., Axton, M., Baak, A., ... & Mons, B. (2016). The FAIR Guiding Principles for scientific data management and stewardship. Scientific data, 3(1), 1-9. https://doi.org/10.1038/sdata.2016.18