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Mobile Apps for Visual Research: Affordances and Challenges for Participant-Generated Photography

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Digital Object Identifier (DOI)

<https://doi.org/10.1016/j.lisr.2020.101033>

Notes/Citation Information

Published in *Library & Information Science Research*, v. 42, issue 3.

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The document available for download is the authors' post-peer-review final draft of the article.

Mobile apps for visual research: Affordances and challenges for participant-generated photography.

Barriage, S. & Hicks, A. (2020). Mobile apps for visual research: Affordances and challenges for participant-generated photography. *Library and Information Science Research*, 42(3).

1. Introduction

The integration of participant-generated photography in research can be a powerful means of exploring emic perspectives and experiences. Within Library and Information Science (LIS), researchers are increasingly incorporating participant-generated photography into studies examining topics such as information needs, information seeking, and use of library space. Smartphones have played a key role in supporting this growing interest in participant-generated photography; increasing smartphone ownership (Pew Research Center, 2019) simplifies data collection while the portability of mobile devices facilitates access to a wide range of social and physical contexts. Smartphone usage also opens up visual research to the possibilities of employing apps, which are pieces of software that run on smartphones and other mobile devices (García, Welford & Smith, 2016). Notwithstanding, the need for careful management of participant-centered studies calls for an interrogation of how mobile apps are employed within visual research methodologies. This methodological discussion examines the use of EthOS and PixStori, two mobile apps recently used in research that employed photo-elicitation methods to explore the information practices of children and young adults, to establish a research agenda for the continued exploration of mobile apps within participant-generated photographic research methods.

2. Problem statement

Mobile apps have a long history within LIS; the potential to provide personalized and targeted support has led researchers to develop and promote a wide range of digital portals (e.g., Buchanan, Jardine & Ruthven, 2018). However, while researchers may view mobile apps as producing considerable value for end-users, there are few published discussions of their potential role as a research tool. This oversight is particularly problematic within visual research, which is already underpinned by a number of complex professional, practical and moral issues (Hicks & Lloyd, 2018). Researchers' lack of engagement with the challenges of mobile apps runs the risk of exposing participants to harm by obscuring potential ethical concerns, as well as eliding other technical and social issues. At the same time, researchers' failure to examine the affordances of mobile apps may impede the effectiveness of these tools, including their potential role in addressing the practical management of visual research.

Subjecting mobile apps to critical scrutiny has the potential to produce increasingly dynamic conceptualizations of information practice. The simplicity of apps, as well as the sense of structure that they offer, facilitates data creation by extending visual research methods to groups that may be excluded from traditional approaches to data collection. Additionally, the functionality of apps, including the ability to handle rich, multimodal activity, facilitates data management by providing an efficient way to administer and monitor ongoing visual research projects. The examination of the challenges and affordances of mobile apps explicated here provides LIS researchers with the practical guidance needed to take full advantage of visual research methods. As researchers in fields outside of LIS have also demonstrated a lack of attention to mobile apps

(although see García et al., 2016), this discussion will also provide other academic fields with the level of scrutiny needed for the development of responsible visual research frameworks.

3. Literature review

3.1 Visual research methods

Visual research methods are defined as “methods which use visual materials of some kind as part of the process of generating evidence in order to explore research questions” (Rose, 2014, p. 25). Encompassing the use of a wide variety of media, including diagrams, cartoons and illustrations as well as photography (Pauwels & Mannay, 2019), the origins of visual research have been traced back to the disciplines of geography and anthropology, where researchers employed maps, diagrams and photographs to illustrate scientific reports and provide “unbiased” or realistic representations of social science fieldwork (Prosser & Loxley, 2008; Rose, 2016, p. 15). Representing a positivist approach to visual research, photographic objectivity was challenged in the 1960s by John Collier, who used photographs to reduce misunderstanding between his research team as well as to sharpen participant memories (Collier, 1967). Since critiqued for its “positivist bent” (Harper, 2012, p. 17), Collier’s research has nonetheless been credited with paving the way for a reading of images as social and cultural artefacts rather than “explicit, precise, and matter-of-fact communication[s]” (Wagner, 2001, p. 7). More recently, these interpretive ideas have become crystallized in Douglas Harper’s visual sociology work, which emerges from the premise that seeing is socially constructed (Harper, 2012, p. 4). Gillian Rose has also continued to develop visual research through an examination of visibility and visual culture as well as digital new media (Rose, 2016).

Visual research methods became more prominent in LIS in the early 2000s (see Hicks & Lloyd, 2018 for a more complete review) when researchers started to employ still photography to record everyday and workplace information tools, sources and spaces (e.g. Hartel, 2006; McKenzie & Davies, 2012; Pollak, 2017; Thomson, 2010). Since then, researchers have started to center participant-generated visual methods using drawing (e.g. Hartel, 2014), mapping (e.g. Lingel, 2015) and photography (e.g. Julien, Given & Opryshko, 2013). Visual research has also been embraced within libraries through the work of Foster and Gibbons (2007), who employed mapping and photographic visual research methods within their ethnographic studies of undergraduate research practices. These developments led Pollak (2017), building on the work of Julien, Given & Opryshko (2013), to characterize visual research methods as taking either an emic (participatory) or etic (non-participatory) approach to data collection. An etic approach to data collection prioritizes the researcher’s production and interpretation of images. In contrast, emic data collection methods center the participant’s creation and interpretation of images to position visual data as “socially and technically constructed” (Hartel & Thomson, 2011, p. 2216). These characterizations may further reflect positivist and interpretive approaches to visual data.

3.2 Photographic visual research methods

Photography formed the principal method of documentation within both visual anthropology and visual sociology until the 1960s (Prosser & Loxley, 2008). Recognized for its unobtrusiveness, photography provided social researchers with a useful way to document social change as well as developments over time (Rieger, 1996). Gradually, however, researchers started to grow more reflexive about their role within photographic methods and to question the exclusion of the broader contexts in which images are produced (Rose, 2016, p. 22). These advances led to the development of photo-elicitation and photo-voice methods. Photo-elicitation is defined as the

insertion of photographic images into a research interview (Harper, 2002, p. 13). Developed in the field of anthropology, photo-elicitation works from the premise that images elicit different types of information than exchanges that are uniquely based upon words (Harper, 2002, p. 13). In contrast, photo-voice forms a type of participatory action research that emerged from work with rural female Chinese communities (Wang, 1999; Wang & Burris, 1997). With its roots in feminist theory as well as Freirian inquiry (Wang & Burris, 1997), photovoice has the goal of using photographs to identify problems and solutions to the challenges that communities face (Wang, 1999; Wang & Burris, 1997). While photovoice and photo-elicitation are often conflated, these contrasting research heritages and orientations call for the need to distinguish between each method's different goals and purposes.

Photographic visual methods have started to become more prominently employed within LIS (Hicks & Lloyd, 2018). As with visual research, early use of photographic methods focused on the use of pre-existing photographs, which were used to guide and stimulate research interviews (e.g. Baxter et al., 2015). More recently, however, researchers have turned to focus on the contributions that participant-focused visual methods can make to information research. Photo-elicitation forms one of the most commonly used methods. Typically employed to assess library community needs (e.g., Neurohr & Bailey, 2016), photo-elicitation has also been recognized as providing the means through which researchers can access tacit and nuanced ways of knowing (Hicks & Lloyd, 2018). Photovoice has also been employed within a variety of LIS research projects (e.g. Julien, Given & Opryshko, 2013). Enabling participants to represent their experiences outside of the research interaction, photovoice has most successfully been used by researchers in projects with a strong emphasis on critical dialogue, for instance with refugees (e.g., Lloyd & Wilkinson, 2016). LIS researchers are also starting to engage with the broader implications of visual methods through an interrogation of the role that participant-centered photographic methods play in extending the use of grounded theory methods (Hicks, 2018a) and improving the quality of information behavior research (Cox & Benson, 2017).

3.3 Digital tools for visual research methods

Growing interest in visual research methods as well as technological advances means that participant-generated photography has since become increasingly dependent on digital tools. Early studies that employed participatory photographic research methods tended to rely on disposable cameras (Balomenou & Garrod, 2016). While the use of these simple and cheap devices broadened the scope of participation, researchers also found that the quality of the ensuing photos was poor, particularly in relation to the increasingly sophisticated cameras that could be found in mobile devices (e.g., Lloyd & Wilkinson, 2016). These considerations consequently catalyzed a reliance on participants' own mobile devices as the means through which images are captured within visual research projects (e.g., Plowman & Stevenson, 2012; Shankar, O'Brien & Absar, 2016). Growing usage of mobile devices has also mobilized the development of apps that aim to simplify and streamline data collection within ethnographic research projects, including Speaking Photo (Williams, 2016), the FREE project app (García et al., 2016), and EthnoAlly (Favero & Theunissen, 2018), as well as EthOS and PixStori, the two apps that form the subject of this research.

EthOS characterises itself as an ethnographic tool that is designed to capture rich details of daily life. Predominantly employed in industry, the app has recently started to become more visible within academia, where it has been used by music therapists to capture video of musical development (Voyajolu, Axon & Ockelford, 2017), as well as to record researcher notes in a study

of teacher innovation (Holmes, 2017). In contrast, PixStori is a tool that emerged from oral and digital history projects. The ability to display media means that PixStori has been incorporated into a recent exhibition at the GRAMMY Museum in Los Angeles, California, with attendees invited to create PixStories of their visit and share them with others using the dedicated web portal (“Visitors Share Their Stories,” 2016). Within research contexts, the PixStori iOS app has been used in oral history projects (Campbell, 2017) and in a community-based research study employing photo-narrations of meaningful places (Gillette & Hurley, 2018). PixStori has also been employed in health research as a therapeutic intervention for teens and young adults with cancer (Beaupin et al., 2019) and pediatric palliative caregivers (Levy et al., 2019).

4. Methodology: Mobile apps for participant-generated photography

Two recent studies that made use of mobile apps to facilitate participant-generated photography were reviewed in order to identify affordances, challenges, and practical considerations associated with the use of such apps in visual research.

4.1 EthOS

EthOS (Ethnographic Observation System) is an iOS and Android app for smartphones or tablet computers (for more information, see <https://ethosapp.com/>). Described as a mobile ethnographic research platform, EthOS comprises a client-facing app that enables participants to record, keep track of and share media as well as to respond to tasks that a researcher might send them (see Fig. 1). It also incorporates a cloud-based project-management platform that securely stores and organizes data that is captured by participants (see Fig. 2). Handling photos, text, audio and video, EthOS further allows participants to record metadata about their media capture, including notes and comments.

[Insert Fig. 1]

Fig. 1. Participant’s view of the app at the time of the project.

[Insert Fig. 2]

Fig. 2. Researcher’s view of the back-end workspace at the time of the project.

Hicks (2018b, 2019) employed EthOS in research that explored the information literacy practices of 26 undergraduates who were learning a language overseas. In this study, which examined the role that information interactions play in facilitating transition to and within a new, culturally unfamiliar setting, Hicks explored the activities of 26 undergraduates who were learning a language other than English and who were studying, working or volunteering outside of their home country for a period of at least three months. The focus on an everyday context, as well as the tendency for information literacy research to rely on librarian-defined understandings of practice, meant that photo-elicitation and interviews had already been selected as useful methods to generate situated and participant-generated representations of information activities (Hicks, 2018b). The geographic distances that were involved in this research as well as the lengthy time frame subsequently meant that the EthOS app, which combines a simple interface with project management features, provided a convenient way to facilitate this research approach. High levels

of smartphone and tablet ownership among college students (Pew Research Center, 2013), the popularity of image social networks such as Snapchat, Instagram and Facebook (Pew Research Center, 2015) and evidence that many students travel abroad with their technology devices (Mikal, 2011) meant that a mobile app was also an appropriate tool for this research.

The visual components of the research were introduced after the first interview. The researcher emailed each participant a link to download the app as well as simple directions about how to use it. At this stage, she engaged each participant in a discussion about privacy issues and the ethics of capturing people's faces and actions as well as questions of personal safety, harm, fairness and justice. This information was also sent to the participant by email. The researcher further reminded participants that photos would only be used in the context of the study and that each participant would retain full ownership of all images, as per the study ethics and the participant information sheet. Participants were subsequently instructed to capture photos of anything that had helped them to settle in or to learn more about their target language and their broader community. Media were then reviewed prior to the second interview, when participants were invited to talk about the five most meaningful images to them. The study's constructivist framing meant that the researcher understood the images to be co-constructed between herself and the participant, as well as forming reflexive interpretations of participant information activities rather than accurate representations of reality. Participants recorded 160 photos for an average of seven per individual. As the project ended, the researcher downloaded all data from the EthOS project management system to her file storage systems before permanently deleting it from the EthOS servers. Participants were also given instructions about how to export their own data from EthOS. Participants who did not want to use EthOS were offered the opportunity to email photographs. This enabled students who did not have a personal mobile device to participate in the research.

4.2 PixStori

PixStori is a mobile photography app compatible with iOS devices. Developed by researchers at the University of Buffalo, PixStori combines still images with audio narratives, and also has the option for text-based captions and descriptions (Nealon, 2016; for more information, see <http://www.pixstori.com/>). The user interface of PixStori is simple and straightforward, using icons to guide the process of either taking a new picture or using an image from the device's camera roll, recording an audio narrative, and adding text in the form of captions and/or descriptions (see Fig. 3). Once a PixStori has been created, it is saved to the device and can then be shared via social media or email. PixStori also offers the option of creating a ShareLink through which users can share their PixStories with others (see Fig. 4). ShareLinks are specific to a project and allow participants to upload their PixStories to a web portal that is only viewable by those who know the web portal URL.

[Insert Fig. 3]

Fig. 3. Participant's view of the PixStori app during the recording of an audio message.

[Insert Fig. 4]

Fig. 4. Participant's view of options for sharing completed PixStories, including a research specific ShareLink.

Barriage's (2018a) doctoral dissertation took a child-centered approach to examining the information practices of eighteen 5-7-year-old children within the context of their individual interests. This child-centered approach necessitated the use of methods that "capture the nature of children's lives as lived" (Greene & Hill, 2005, p. 3) and place the child participants in the position of experts of their own lived experiences (Dahl, 2014). Task-centered activities such as participant-generated photography offer a means of collecting data that allow for such a child-centered approach (Barriage, 2018b; James, Jenks, & Prout, 1998). Several methods of data collection were employed in this dissertation research, including a book discussion, poster activity, surveys completed by parents, and participant-generated photography followed by photo-elicitation conversations. The participant-generated photographs were used primarily as a means of eliciting children's perspectives and experiences within this conversational setting, with analytic focus given to the children's descriptions and discussions of their information experiences, rather than the researcher's interpretations of these images.

Determining a means of facilitating the photo-elicitation process with this young population required careful consideration. While young children in the United States are very likely to have access to and experience with mobile devices (Common Sense Media, 2017), EthOS and other similar apps that have been specifically designed for use in a research context rely heavily on the ability to read and write, as well as a certain level of technological literacy. Through pilot testing, the PixStori user interface proved to be effective for use with children in the 5- to 7-year age range (Barriage, 2018c). The researcher introduced PixStori to the participants after they had read and discussed a book together and created a poster about their interests and related information activities. The researcher demonstrated how to use the app by creating at least one PixStori with the child during this initial research interaction. Then, the researcher loaned each child an iPod Touch device that had PixStori and the appropriate ShareLink pre-loaded, and gave them a pictorial instruction sheet explaining how to use the app. The researcher asked the participants to take photographs and to record audio narratives explaining what they had photographed and how it related to their interests and their information practices over a one-week period. As participants created PixStories on the loaned devices and uploaded them using the project ShareLink, the PixStories became immediately available to the researcher on a password-protected web portal dedicated to the project (see Fig. 5). From this web portal, PixStories could be viewed, downloaded, or deleted. When downloaded, the PixStories included an image file, a text file that included metadata and any captions or comments entered by the user, and an mp4 file. The children created a total of 260 PixStories, an average of 14 PixStories per child. The researcher printed physical copies of the PixStories and discussed these with the children during a subsequent photo-elicitation conversation. The children were given these physical copies to keep.

[Insert Fig. 5]

Fig. 5. Researcher's view of the project specific PixStori web portal. The text below each image indicates how long ago the images were uploaded and the participant ID number that the participant entered when uploading their PixStories.

5. Findings: Affordances, challenges, and practical considerations

5.1 Affordances

5.1.1 Recordability

One of the most important affordances of the mobile apps described above is their *recordability*, or the opportunities that such apps offer to capture a rich array of media. Working with a mobile phone's inbuilt camera, microphone and communication features, EthOS and PixStori allow participants to record and upload photos, audio, text, and, in the case of EthOS, video. While both of the studies examined in this study focused on the use of photos, the variety of media that could be recorded through the use of the apps meant that they can document a range of information activities, including dynamic information processes as well as nuanced and contextual information that is hard to verbalize. At the same time, the ability to assign notes and comments and/or record audio at the point of capture, which creates what García et al. (2016, p.521) label as a "one-stop shop," means that these apps also facilitate the production of contextualized data, something that would be far harder to achieve with basic smartphone functionality (see Tables 1 and 2). The inclusion of screenshots in the EthOS study, an affordance valued in previous research with young people (Volpe, 2019; Yi-Frazier et al., 2015), means that the use of apps also helps to bridge physical and digital information interactions in a way that would, again, be hard to achieve through the use of a traditional standalone camera.

[Insert Table 1]

[Insert Table 2]

5.1.2 Immediacy

A related affordance of apps for participant-generated photography is that of *immediacy*. As noted above, apps such as EthOS and PixStori offer participants the ability to add text or audio to their images, supplementing the visual with additional contextual information. With more traditional approaches to PhotoVoice or photo-elicitation, participants typically use disposable or digital cameras and then recount the meaning behind the images later when meeting with the researcher. With the use of an app, participants are able to record this meaning immediately, helping to avoid the possibility that they might forget what the picture was of or the meaning behind it when asked later to discuss their images or the event captured (Plowman & Stevenson, 2012). With both EthOS and PixStori, participants could choose to add this contextual information immediately after capturing their images or at a later time. In the PixStori study, it was evident that many participants recorded their audio messages immediately after taking their photographs. For example, in the background of the audio of several PixStories The Rock created at a hockey arena, the sound of skaters on the ice, hockey sticks hitting pucks, and referees' whistles blowing indicate that he took advantage of this particular affordance in creating his PixStories (as shown, for example, in Table 1). The ability to record metadata was also particularly useful in the EthOS study where some participants took photographs over the course of the six to nine months that they spent overseas (see Table 2).

5.1.3 Portability

The *portability* of smartphones as well as the "embodied visual intimacy" (Palmer, 2012, p. 88) of its handheld touchscreen meant that the use of EthOS and PixStori helped to facilitate access to information activities that take place in a wide range of contexts and locations, including

those that occur in personal and hard-to-reach spaces such as the bedroom (see Tables 1 and 2). In the EthOS study, for example, the capturing of images related to personal spaces helped to reveal themes related to safety and refuge that would play a prominent role in the final analysis. The portability of using an app on a small mobile device also enabled participants to unobtrusively capture relevant images in settings in which documenting their experiences in other ways may have been difficult or impractical, such as a loud and crowded hockey arena (see Table 1). Additionally, participants were able to capture images between locations, too, including on transport systems (see Tables 1 and 2). As Plowman and Stevenson (2012) note, the ways in which portability affords participants the ability to easily incorporate these research activities into their daily routines is advantageous for both the participant, as it makes their involvement in research less burdensome, and for the researcher, as they are able to gain insight into “unexpected, mundane moments” (Favero & Theunissen, 2018, p.163) or aspects of participants’ lives that might otherwise have remained hidden.

5.1.4 Visibility

The EthOS and PixStori apps also offer the affordance of *visibility*. For participants, the visibility of the app on each participant’s device, as well as, in the case of EthOS, the ability to employ push notifications, helped to encourage participation by providing an eye-catching reminder of the research project. The ability to see data as it was created and submitted to the researcher meant that the apps, perhaps, also encouraged participants to submit material from throughout their time in the study, rather than merely from the days immediately preceding the deadline (cf. García et al., 2016, p. 521). For the researcher, the use of the project management platforms associated with these apps additionally allowed for easy and instant monitoring of participant activity on an ongoing basis (as shown in Figs 2 and 5).

5.1.5 Durability

The most prominent affordance of the EthOS and PixStori apps is durability, or the persistent and consistent access they offer to participant-generated data for both participants and researchers alike (see Figs 2 and 5). In providing a mechanism through which data can be captured spontaneously as well as over significant periods of time, these apps facilitate access to aspects of everyday information interactions that might otherwise be overlooked. Features that enable the uploading of data that are produced through the phone’s native media capture options as well as the storage of media for subsequent upload further supports the usage of such apps amongst participants who may not have sufficient data plans or consistent access to wifi. These apps also reduce the potential for data loss by creating a simple and streamlined mechanism for users to upload media. The inbuilt project management system also benefits the researcher; a removal of the need to consolidate data reduces the possibility of data-entry errors while the standardization of data submission creates consistency by ensuring that all data are received in the same format (cf. García et al., 2016, p. 521). The benefit of a secure and easy-to-use storage system can also be seen in Yi-Frazier et al.’s (2015) Instagram-based photovoice study. Beyond data capture, filtering features within the project management system facilitate the discussion of data during subsequent interviews, while the metadata functionality further helps to remind participants who are being interviewed at a later date of the media as well as the original reasons for which they captured it. In this light, both EthOS and PixStori provide a robust support mechanism for collaboration between researcher and participant as well as facilitating interactive opportunities.

5.2 Challenges and Practical Considerations

5.2.1 Data Security & Storage

One challenge related to the use of apps such as EthOS and PixStori is data security and storage. The use of a third-party cloud-based app for research necessarily raises a number of issues related to how study data are processed and saved. For example, EthOS' security policy, which was provided to the author upon request, details that data captured using the EthOS app are stored at a secure, access-controlled data center that provides a high level of network, host, physical and environmental security. Data and file attachments are encrypted, and EthOS employees cannot access this data unless they are required to do so by law. While these provisions are comparable with other digital tools that may be employed during research, for example Dropbox, the researcher chose to reduce these potential risks even further by deleting data from the EthOS project management system after the research terminated and reminding participants how to download their own data should they wish to do so. The researcher also reached out to the parent company, Everyday Lives Ltd, who talked through some of these concerns. However, the storage of EthOS data on the Amazon Web Service (AWS) infrastructure located within the United States may prove problematic for researchers from other countries, as there are important legal implications related to cross-border data storage and privacy (de Jong-Chen, 2015; Woods, 2018).

5.2.2 Device Failures

An unexpected challenge of the EthOS study related to the use of participants' own phones. While participants did not demonstrate any problems using EthOS, the context for this research meant that the study's use of an app posed a number of issues. Perhaps unsurprisingly, lost or damaged phones proved to be one of the most common complications that participants faced during this study. One student described how they lost all their photos when the computer on which they were backing up their photos crashed, although they were able to describe the images in lieu of showing them to the researcher. Along the same lines, security concerns meant that two students decided not to travel overseas with a smartphone, preferring, instead, to rely on what they termed as a 'festival' phone, or an older and more basic model of phone that would be less likely to be stolen, as well as less expensive to replace. A handful of participants also ran into issues when they came to download the app; as financially insecure students, an inability to afford an upgrade to their phone meant that they did not have enough memory on their phone to install the EthOS app. These issues demonstrate the complexity of carrying out research in overseas locations as well as with populations who may not enjoy access to the latest technological developments.

5.2.3 App Failures

In addition to technological failures associated with the devices used by participants to capture data, failures of the app and any associated online collection mechanisms can also be a cause for concern. In the PixStori study, the researcher experienced a temporary technical problem with the web portal that made it appear as if all data collected up to that point had been lost. Fortunately the issue was quickly rectified upon contact with the parent company, Talking Pictures LLC, and only impacted the researcher's ability to view data collected in the web portal temporarily. The technical problem did not result in the loss of any previously existing data nor hinder participants' ability to continue to generate new data. This issue, though, highlights the challenges associated with relying on a third party for facilitation of the data collection process. If the technical problem had been more significant, all data collected for this project via the PixStori web portal could have been lost. A second technical difficulty encountered in the PixStori study

involved video playback issues. A handful of PixStories (three of the 260 PixStories created by participants for the study) would not play once uploaded to the web portal. While the image components of the PixStories were still accessible, the accompanying audio recordings were not. This was a problem with the web portal specifically, and not with the devices, and the audio recordings were recoverable from the iOS devices. Stringent protocols for backing up data on a regular basis may help to mitigate this particular challenge. An additional fail-safe in the context of the children's interests study was that the data were saved on the iPods loaned to the children for the purposes of the study, in addition to being saved in the web portal. Once participants returned their devices, the researcher was able to access all PixStories created during the study period. This option would not have been possible if participants had generated data using their own devices.

5.2.4 User Instruction

An additional consideration that researchers must consider when incorporating apps to facilitate participant-generated photography is that of user instruction (Garcia et al., 2016). While EthOS and PixStori were both fairly intuitive and easy for participants to use, not all users will find them to be so. Additionally, participants may require instruction regarding the specific ways in which researchers expect them to make use of the apps for research purposes. In both the EthOS and PixStori studies, the researchers provided the participants with instructions on how to create images and share them with the researcher. In addition, in the PixStori study the researcher demonstrated how to use the app by creating at least one PixStori with each child before sending them home with the iPod for the duration of the study. In the PixStori study, participants predominantly came from highly educated and high-income households; they all had access to technology in their homes, and all were comfortable using touch-screen devices. Similarly, participants in the EthOS study used their own devices in completing the research activities, and therefore had experience using these devices generally and apps more specifically. The amount of instruction that they needed might have been different if they were not already comfortable and accustomed to using such technology in their daily lives.

5.2.5 Cost

The impact of using apps in research on project cost is largely dependent on the specific app being used, as well as the population under study. As with any research endeavor, there are a variety of costs and cost-savings that must be weighed before determining the feasibility of implementing a particular app. In the past, researchers making use of participant-generated photography have incurred costs related to purchasing enough disposable or digital cameras for participant use, as well as the costs associated with developing film or printing physical copies of digital images. When compared to these methods, the use of apps has the potential to be a "cost-effective" approach to data collection (García et al., 2016, p. 509). For example, for research that focuses on individuals who are likely to own their own smartphones, researchers are not required to provide these or alternative devices to their participants for data collection purposes. Using an app that has already been developed also saves researcher time and effort in designing an equivalent data collection mechanism. The resultant savings of the researcher's time may also, as García et al. (2016, p. 519) point out, make the financial costs of the app more worthwhile.

In the EthOS study, the use of this app incurred several costs that would not typically be budgeted for within visual research using more traditional photographic methods. As a proprietary app, EthOS charges a fee for use of its app, providing pricing options per day or per participant. However, they also offer a reduced rate for students and suggest that they may be able to provide

free usage for unfunded academic or student projects (EthOS, n.d.). In the PixStori study, while the app and associated web portal were free to use, the researcher purchased multiple iPod Touch devices to loan to the participants in order to enable participation by children who did not own their own iOS device. Additionally, the researcher provided each participant with physical copies of their images; in this case, use of the app did not eliminate the expense of photo printing. Additional costs for both the EthOS and PixStori studies included participant compensation, which was appropriate in both studies due to the time participants invested in the research, as well as an investment of the researchers' time in learning how to use the app and associated data management tools.

5.2.6 Ethical Considerations

One of the most common challenges of visual research more generally refers to the researcher's ethical considerations and obligations (Rose, 2016), and the use of an app for research only heightens these concerns. The commonplace role that mobile phones and apps play in everyday life as well as increasingly photo-centered communication norms (Pew Research Center, 2015) means that it is vitally important to discuss questions of privacy as well as personal safety and harm with participants. This discussion was also particularly necessary within the context of the EthOS study given that participants would be taking photographs in settings that might not share Western norms of photography. Questions of privacy also meant that this study limited media capture to the use of photography and still images, even though EthOS has the capability to store audio and video files. The need to seek permission from people who are featured within media, as well as fears that the app could be used to inadvertently capture private conversations proved to be challenging to overcome, although video-mediated research is increasingly starting to become more visible within LIS research and beyond (e.g., Barriage & Searles, 2015; Bhatt & de Rooch, 2013; Given, Cantrell Winkler, Willson, Davidson, Danby & Thorpe, 2016; Lundh, 2011; Polkinghorne, 2018). Issues were also muddled within this research due to the number of laws about filming in public places around the world (Mok, Cornish & Tarr, 2015, p. 317). See Table 3 for an overview of the findings.

[Insert Table 3]

6. Research Agenda

An exploration of the roles that apps play within participant-centered photographic research methods raises a number of avenues for future research (see Table 4).

[Insert Table 4]

6.1 Effects of mobile apps on data quality

In terms of participant-generated photography, this study illustrates the need for research that compares the use of mobile apps to other established methods of photo-elicitation. The move from print to digital photographic practices has already been credited with creating more spontaneous personal photography, as well as enabling a greater focus on the everyday and the mundane (Rubinstein & Sluis, 2008, p. 9). Further research should build upon these ideas to explore whether the use of a mobile app impacts a study's participant retention rate or participants' experiences of engaging in research in some other way (see Plowman & Stevenson, 2012; cf. Garcia et al., 2015). Future research could also examine the specific images that participants take

within photo-elicitation studies to determine whether the use of an app impacts the scope of photos and media captured as part of the study. Research could further investigate whether the employment of mobile apps changes or helps to increase the contextualization provided for each image compared to studies that rely on data that is sent through email or similar. Moving beyond apps, research should also examine the role of image-based social networks such as Pinterest and Instagram within photo-elicitation studies. While these tools are used extensively by certain research participant demographics (Pew Research Center, 2018a; Pew Research Center, 2018b), there has been a lack of engagement with the ways in which they could be adapted for use within participatory photographic research methods (although see Volpe, 2019; Yi-Frazier et al., 2015).

6.2 *Co-production of knowledge*

The use of apps such as EthOS and PixStori also demonstrate the importance of continuing to reflect upon the ways in which LIS researchers both construct and access their field of study. As Beaulieu (2010) points out, increasingly distributed systems of knowledge production mean that researcher co-location can no longer be the only requisite for ethnographic fieldwork. Instead, researcher *co-presence*, which foregrounds interactions and relationships rather than (necessarily) physical proximity, is increasingly being considered as a way to facilitate contiguity as well as reflexive and ethical accountability (Beaulieu, 2010, p. 460). Future research should examine the ways in which apps such as EthOS and PixStori facilitate the production of co-presence between researcher and participant while further reflecting on how the decentering of space and the ocular-centric concept of testimony (Beaulieu, 2010, p. 457) impacts information research. The ability to capture and create multimedia means that future research should also explore whether apps such as EthOS and PixStori could replace the use of manual diary and check-in research methods within LIS. As Cox, McKinney and Goodale (2017, p. 186) point out, paper diaries can be cumbersome as well as difficult to use outside the home or on the move. And, while digital diary and check-in tools have become more prevalent, the need for sustained diligence means that data-loss is common (Corti, 1993). A reliance on email reminders could further disenfranchise users who do not use this technology as frequently as other groups, such as teens (Perez, 2016). In contrast, the ability to push notifications as well as to create a dedicated phone-based portal for a project means that research should explore whether apps, which store text as well as multimedia, could help to improve response rates amongst certain user groups as well as to provide a more reliable platform for this type of research.

6.3 *Scope of information research*

Future research should also examine the role that apps can play in extending the scope of information research. The ability to record audio as well as photographs and texts, for example, means that the use of apps such as EthOS and PixStori could build upon the recent focus on the body within LIS research (Lloyd, 2010) to explore sensory aspects of information activities in more detail, including working with voice audio as research data in itself rather than merely as “a precursor to transcription” (Gallagher, 2019, p. 1). Sound has not often formed the focus of LIS research, which has tended to emphasize text-based formats of information (Lloyd, 2010). However, as automated voices become employed as coercive forces within urban settings (Power, 2014) and the use of voice-controlled assistants such as Alexa continues to rise (Pew Research Center, 2017), it is clear that sound as well as speech play an important role within everyday information interactions. Future research could explore the important role that apps, which provide simple and intuitive access to the audio-recording features on a mobile device, could play in

facilitating this new area of study. Along the same lines, studies could also specifically explore the role that apps could play within health information research; as Cox et al. (2017) point out, the ability to track data means that apps open up information research to a range of new ways to capture and analyze health interactions. At the same time, concerns over surveillance as well as increased understanding of the role that m-health apps can play in contributing to “techno-utopian” (Morley & Floridi, 2019) narratives of patient empowerment means that scholarship should also examine the ethical implications of adopting apps for these research purposes. Lastly, the rise of mapping apps means that future research could also examine the role that these tools play in creating qualitative responses to places and built environments (cf. Headrick Taylor, 2017, also see Favero & Theunissen, 2018).

6.4 Mobility and information practice

Beyond photo-elicitation methods, this study raises a number of questions about the impact of mobility upon information practices. While LIS research has engaged with concepts of space and place (e.g., Savolainen, 2006), far less attention has been paid to the ways in which expanding mobility as well as possibilities for learning on the move shape emplaced understandings. As Headrick Taylor (2017, p. 534) points out, the success of games such as Pokemon Go and workout mapping tools such as MapMyRun demonstrate that mobile apps are being used “to engage with places in a personally meaningful way” as well as to address practical needs. Future research should examine how apps such as EthOS and PixStori support the creation of “bodies in place” (p. 538) as well as interconnections with affective experience, social justice and community change. Along the same lines, research should also examine mobile apps as material objects. While studies have explored the impact of smartphones (e.g., Howard & Bussell, 2018) and tablets (e.g., Burford & Park, 2014) upon information activities, there has been little focus on the ways in which apps, as physical artefacts, enable and constrain the enactment of information practices. Future research should examine the sociomaterial dimensions of mobile information practices in more detail, including the ways in which apps function as boundary (Star & Griesemer, 1989) or epistemic objects (Knorr Cetina, 2001) that shape or coordinate information activities.

7. Conclusion

As the use of visual research methods continues to grow within LIS, it is vital that researchers continue to think carefully about the ways in which methods that were established in a pre-digital age are recreated and used within technology rich environments. Along these lines, this study has provided a detailed and critical interrogation of the role that mobile apps can play within visual research methods. Noting that a failure to examine apps in any great detail has limited the researcher’s ability to recognize their value, this study extends visual research by illustrating how the use of EthOS and PixStori resolves many of the logistical and practical challenges of working with participant-generated photographic data. At the same time, the recognition that visual research is subject to several important ethical considerations means that this study also establishes a useful framework through which LIS researchers can make more informed decisions about the role that apps can play within image-centered methodologies. Importantly, the study further sets the scene for the continued growth of visual and participatory research through the establishment of a research agenda that pushes at the boundaries of the complex information worlds in which we live.

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