

Frame of Mind: Bringing Family Photo Interaction into Speech-Enabled Digital Spaces  
to Support Older Adults' Reminiscence

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### **Abstract**

Social technologies allow people to connect both locally and across the globe, but seniors are often left out of the research and development of these new technologies, despite evidence of the positive health benefits for older adults. Digital storytelling is one such emerging application, which in its traditional format has been shown to decrease social isolation in older adults by increasing reminiscence. Social platforms and other applications of digital storytelling are rapidly evolving, but still do not support traditional and current reminiscence activities comparable to sharing memories from family pictures that draw on older adults' knowledge of family history. Additionally, motivation is especially difficult for seniors who will often not see their input as desired and so will not share or socialize. Little previous research in family digital storytelling has focused on older adults as the intended user, and that which does has largely not considered how photos can be interacted with in a digital space in a way that supports sharing more detailed memories across several photos. In this work, I propose a new interface that incentivizes seniors to reminisce from family photos by supporting natural picture interactions. The proposed authoring tool allows for the creation of unstructured, free-flowing oral stories by older adult users and is intended to be a digital equivalent to traditional storytelling activities, while moving those activities into the space of social platforms by creating shareable, multimedia outputs that preserve family memories. In this thesis, I show that this new interface is enjoyable to use by seniors and can produce more robust memories than traditional methods. For this, I conducted a Contextual Inquiry into current reminiscence practices followed by a user acceptance study of the new interface.

*Keywords:*

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## 1 Introduction

Older adults are at much higher risks for social isolation (Nicholson, 2012). This has been shown to lead to serious health problems in seniors including higher risks for cognitive impairments, coronary disease, and even death, while higher rates of social activity have been shown to protect against dementia (Biordi & Nicholson, 2011). This isolation can be exacerbated by the common feeling among older adults that they have nothing worth sharing (Thiry & Rosson, 2012), and there is further research showing that seniors want to document their family knowledge and stories, but the currently available analog options often require too much effort and time (e.g. writing accurate captions onto photographs) which limits motivation (Lindley, 2012).

In an increasingly digital world, communication is more available than ever to more people, but digital spaces continue to exclude older adults, and seniors are not considered when designing new technologies. Reminiscence, however, has been shown to reduce social isolation in seniors (Harrand & Bollstetter, 2000), which includes activities such as sharing memories prompted by family pictures. Increased recent awareness of issues related to social isolation for older adults and the demonstrated positive effect of seniors' storytelling demand that efforts be focused on the usability aspects of authoring tools that support older adults' interaction with pictures and the creation of multimedia stories as supported by those photos.

### *1.1 Research Context*

Digital storytelling can be found everywhere in today's world. Using the most common and simple definition, digital storytelling uses digital media (including but not limited to video, audio, and photographs) to document and share a story. So every set of photos on Facebook or personal video on YouTube uses digital storytelling, and millions of stories are created and shared each day. These types of social platforms, however, allow for sharing pictures for a brief moment

before they are replaced by new content rather than supporting continued reminiscence. The casual use of technology to document lives has thoroughly permeated society, but is often held back from senior users because of cultural stereotypes that say they cannot or will not use new technologies. Digital storytelling research has investigated opportunities to enhance existing storytelling spaces with new abilities that can support a senior's storytelling in a variety of settings ranging from readily available tablets to tabletop displays and digital pen and paper. These projects are not only trying to enable seniors to create digital stories, but are also opening pathways to the health benefits associated with seniors' reminiscence. Although, that which has been targeted at seniors has largely focused on brief documentation or memory strengthening and not the act of interacting with digital pictures or the overall storytelling and authoring experience. As this was not the focus, these resulting tools may limit a senior's independence in sharing stories or overlook the importance of the process of authoring.

My research presented here investigates another dimension of digital storytelling, namely how existing analog photo interactions and the resulting reminiscence can be translated into a digital space. Creating positive digital storytelling experiences to encourage seniors to share their stories can decrease social isolation and strengthen their communication with family both by allowing them to tell their stories on their terms and by supporting a process analogous to sharing stories from analog photographs. In my research, seniors' current storytelling activities are explored and analysed. Then, based on those initial results, I investigate their storytelling processes in a digital space. This includes the role of pictures as prompts for storytelling, the role of the interface as a motivation for storytelling, and the design and interface requirements to create a positive storytelling experience around photos as a means of managing social isolation.

Seniors needs in terms of a digital storytelling interface are not yet well understood and have not been thoroughly investigated. Generally, digital photo storytelling is still a largely unexplored area for older adults, especially as a way to reduce social isolation. Existing solutions impose structures that limit the user's stories and reminiscence and can remove the senior from the role of narrator. These designs often enforce a structure to the telling or authoring of stories that does not match how families reminisce without technology.

As such, this research investigates the needs of older adults with respect to supporting casual interactions with digital pictures as well as the capture of oral storytelling from these pictures. The first, ethnographic study explores and defines requirements for a free-flowing, speech-enabled solution that does not enforce any strict story structure, and is designed for user independence so the senior can own the storytelling and authoring processes along with using it on their own. The new digital picture interaction presented here uses a table top metaphor for the display of pictures based on the demonstrated desire for freedom of movement between pictures. It is also supported by the observed improvement in memory detail, seen in both studies, when viewing multiple pictures that maintain a larger context for memories than is possible when viewing one picture at a time. The longer term goals are to use these principles to guide the design of interactions that will support and enhance seniors' current storytelling activities and also motivate seniors not only to tell and share their stories, but to encourage them to continue their storytelling beyond an initial prompt to create a larger narrative arc.

## ***1.2 Digital Storytelling and Reminiscence***

Reminiscence through digital storytelling is a growing area of research within the field of human computer interaction and already covers an impressive range of applications and solutions. Common focuses include use with populations that often have less access to technology, including



seniors and developing communities, and with digital or digitized family photographs. The existing research that has specifically focused on digital storytelling for older adults provides these users with new methods of storytelling including digital postcards (Ludlow, Chen, & Ladly, 2014) and collaborative table top storytelling (Apted, Kay, & Quigley, 2006).

The general theme of this varied body of research, however, is prompting or documenting brief stories or reminiscences digitally, and has not yet investigated interactions with digital pictures. With this intention, there are two areas for improvements in the existing research in order to support natural digital picture interactions. First, these projects are often intended as tools for the caregiver or family to use for the senior, removing the senior's control over their storytelling. Examples of this include the work of Piper, Weibel, and Hollan (2014) using digital pen and paper to create photo albums for seniors with dementia, and that by Lee et al. (2014) creating a tablet memory game using family pictures. This removes a senior's independence and ownership of reminiscing, which can prevent them from interacting at all.

Second, the authoring process is often directed or limited by the tool. As one of the major motivations for storytelling and photo documentation is preserving family history (Lindley, 2012), limiting the act of storytelling or not preserving the story will limit users' motivation and the tool's usability. For example, Kim & Zimmerman (2006) use digital photo frames to prompt stories, but there is no aid in documentation as the tool offers no authoring capabilities. Lee & Hsu (2016) create a memory prompting tool that collaboratively builds stories, but only using one photograph, which prevents a senior from sharing anything more than a brief memory.

### ***1.3 Response***

Picture storage and documentation continue to move more and more into digital spaces, but at this point there has not been work done to create a digital method supporting the simple

interactions with pictures, such as flipping through albums. This missing element limits motivation to use digital storytelling tools. Previous research shows that seniors want ownership of their storytelling process and over the resulting artefacts, and this must include the interaction that causes the reminiscence. In response to this, this research investigates seniors' needs as to digital picture interaction and storytelling, how to design free-flowing, independent, speech-enabled digital storytelling interfaces for older adults that use their own family photographs, and how these interactions can be supported using natural modalities. The research is completed in two phases: first an investigation into older adults' current storytelling and photo organization practices using a Contextual Inquiry approach, which defined the design of the digital picture interactions for reminiscence, followed by a usability and user acceptance study using the completed tool with each user's own family pictures compared to their current picture artefacts and reminiscence experiences.

The first phase was designed with the following research questions: how do seniors organize their photographs and how can that organization be incorporated into a guided digital storytelling tool using family photographs for senior users? what modalities do seniors use to interact with their family photographs while telling a story (e.g. speech or touching a person in a photo) and how can these modalities be incorporated into a guided digital storytelling tool using family photographs for senior users? what are the design requirements for a guided digital storytelling tool using family photographs for senior users? The second study investigates the question how does the proposed storytelling interaction and users' experience of it compare to traditional methods? and tests the hypothesis that the new app will provide a more agreeable experience for storytelling than existing physical methods as measured by the amount and quality of stories produced and by users' perceived experience.

In the next chapter, a detailed review of relevant literature is presented including the works cited here. Following that, the ethnographic study methodology and results are presented along with the resulting design of the app. Then the methodology and results for the user experience study are detailed. Finally, future directions to continue this research and concluding thoughts are shared.

## 2 Review of Literature

Across the broad and growing field of digital storytelling, many different modes for photo-supported stories have been explored. These include tablets, projected tabletop displays, cell phones, and digital paper and pen, to name a few. Meanwhile, the role of family narrative and sharing family stories has been researched for many decades in the fields of psychology and sociology, and, along with showing that reminiscence decreases social isolation, the research provides insight into how we share stories and what the motivations or limitations are around reminiscence activities. There is an opportunity within digital storytelling to leverage this knowledge and ease the work of the traditionally physical documentation of family stories for seniors while providing the much needed motivation for that group. Though family digital storytelling has been a common area of research, examples of digital storytelling specifically for seniors are lacking and supporting a senior's digital picture interaction is rarely the goal; with caregivers or family members often targeted as the primary user.

### *2.1 Photo Storytelling for Seniors*

Several projects have already explored the area of digital storytelling with family photographs specifically for seniors. These solutions aim to increase socialization or strengthen memory in their older adult users, and as such often are not focused on the interaction with the pictures that are used as prompts for storytelling. Most work concentrates on creating a brief digital memory that can be shared as part of an ongoing communication or reused for memory strengthening activities.

Postcards are a common approach to encourage communication as they are familiar and provide a single image for a user to focus on. Ludlow et al. (2014) have created a mobile application that is useful in encouraging seniors with early-stage dementia and their families to

create and share short digital or physical postcards. These postcards use individual photos annotated with a written, typed, or spoken message, which the recipient can respond to in kind, to enhance communication between generations. Users reported that the ability to add speech and video media to the postcards was the most meaningful feature, suggesting that seniors may benefit from multimodal interfaces for storytelling.

Lee and Hsu (2016) also use individual photographs to investigate cross-generational storytelling between grandparents and grandchildren using PicMemory, a tool that similarly uses individual family photographs to prompt memory sharing using either voice or text input in order to document family memories one photo at a time. Basic keyword extraction uses any nouns from the text and transcribed speech as tags for these photos, allowing for natural language searches within the set of photos. As with many other works cited here, PicMemory presents the user(s) with one picture at a time, so does not explore interactions between pictures.

The SharePic table top (Apted et al., 2006) is very explicitly designed for senior users and intends to support the creation and sharing of digital postcards through a digital experience like that of collaboratively viewing and organizing physical photographs on a table to build a photo collage. SharePic is focused on assessing new touch gestures for pictures by comparing the experiences of young adults and seniors. One noteworthy finding from their cross-generational evaluation is that two-handed gestures were noticeably harder to learn for older users than for younger. While SharePic is inspired by photo-prompted reminiscence, the study was designed to assess touch interactions, and so was not interested in how the new interface and interactions supported production of stories from the collages, and they did not include the use of participants' own photographs as part of their experiment, so the users were less likely to produce their own memories.

The In-TOUCH project (Ceriani, Bottoni, Ventura, & Talamo, 2014) also uses a collaborative table top and proposes a collaborative multimedia content creation system for older adults that may include biographical storytelling, but is not the research's purpose. Their co-design process builds the design of the table top system from seniors' input, and they encounter problematic elements common to senior technology interaction including complaints of cluttered interfaces and unexpected modal changes. As this research is ongoing, there has not yet been a formal evaluation of the interface.

Other research has explored tools designed for family and caregivers, still with a focus on improving a senior's socialization or memory, but while these tools focus on photographs and reminiscence, they do not support a senior's storytelling. One such original and intuitive approach by Piper et al. (2014) researches a digital annotation system using paper photos and a digital pen that enables family and caregivers to collaboratively create to create an interactive photo album for a senior family member comprised of audio-enhanced photos. Family members can annotate family photos for the senior, through both written text and recorded audio, with memories of the photo or other details. Seniors are encouraged to socialize and share their memories by going through the album and playing the recordings. The use of pen and paper is familiar to seniors, but limits how far the system can go compared to using a tablet or other similar technologies, and since the process is not managed by the senior, they may lack the motivation to use it and the documented memories are their family's, not theirs.

Picgo (Lee et al., 2014) is another system designed for caregivers and intends to simplify the work of annotating family photos by prompting for answers to five general questions (who, what, where, when, and why) about each photo and adding tags that correspond to the answers. It is designed to be used by a caregiver and senior together, but driven by the caregiver in order to

design and implement reminiscence activities for the senior. It uses a storytelling situation (talking about a family photograph) in order to gather the information for the game, but the five basic question prompts limit the older adult to stating simple facts about the picture rather than more complex story arcs.

Storytelling with seniors is a common approach to supporting memory strengthening and increasing socialization and communication, and these examples demonstrate and build on that well. Most of them (with the exceptions of In-TOUCH and SharePic, which have not been evaluated for storytelling) focus on brief messages or memories around a single photo. They enhance communication and socialization in a back-and-forth conversation or allow for memory reinforcement, but are not interested in the experience of interacting with the pictures and how storytelling may be encouraged beyond simple facts or prompted responses. In my research, digital storytelling is explored without limiting the structure of the interaction or act of reminiscence, and builds upon these projects to specifically investigate digital photo interaction to motivate longer, more detailed narratives.

## ***2.2 General Family Digital Storytelling***

Family storytelling is a cross-generational activity, so whether an intentional focus is placed on seniors or not, digital family storytelling will involve them as users, and often as narrators. It is also a more common area of research within digital storytelling, relative to senior-specific projects, and has been active in exploring alternative interfaces beyond computers or tablets, but much of this research is over a decade old and needs to be continued and brought up to date.

A very early digital storytelling project done by Balabanović, Chu, and Wolff (2000) uses a tablet-like device, built especially for this research, for creating and viewing stories out of family

photos. They ask users to select photographs and place them in order before storytelling commences, or in reverse, to tell a story and then select an order of photos to match, and found that users were generally drawn to the former. This device also supports audio recording for an individual photo or a set of photos, but this was not widely used by their participants. The most common usage of this was not to document a story, but to add a personal message when a photo or set of photos was to be sent digitally to a friend or relative. Since this tool was designed before touchscreen tablets were readily available, the prototype that was built used manual buttons and an external, wired microphone mounted on the device, so issues such as how to hold the constructed device or how to work with around the wires tethering it to a table will simply no longer be an issue with modern tablets.

Similar to the table top displays designed for seniors that were presented above, the Personal Digital Historian project (Shen, Lesh, Vernier, Forlines, & Frost, 2002) uses a projected circular tabletop interface and stylus interaction for storytelling around a collective past with emphasis on natural conversation and flexibility of story sharing, but because of technological restraints at the time, only one person could interact with the surface at a time. Their initial analysis only assessed an office environment, and has not investigating how a family might interact with this tool.

Another example that does not use computers or tablets is the Cherish system (Kim & Zimmerman, 2006) which uses digital photo frames as a, perhaps, more readily available and familiar interface, since framed pictures already fit in the social spaces where stories are told. This research encourages storytelling by programmatically changing the photos displayed in a digital photo frame based on who is visiting the home, the time of year, or the type of event (e.g. a birthday). This system allows all interactions, such as setting the type of event, to occur through



the digital photo frame, keeping the use in the family spaces and not limited to a computer. The research is focused on what images to display in order to trigger family storytelling, and does not investigate storytelling, photo interactions, or documentation of stories.

The living memory box (Stevens, Abowd, Truong, & Vollmer, 2003) is unique in this field in that it aims to document memories not only from photographs, but from all sorts of family artefacts, including childhood artwork and three dimensional artefacts. They find that these items are more expressive to parents than photographs, though photographs better preserve the stories to outsiders. The design proposes a physical transparent box, into which a user can place a physical artefact, and a screen to document the memories using natural speech interaction. While they did not develop this tool completely, focus groups with a simplified prototype responded positively to the idea of natural interaction and the potential to document any artefact. This unique approach to memory documentation shows a need for more diverse options for storytelling including memories outside of photographs, especially those that could be easily digitized such as 2D artwork and family documents.

Though these previous examples support storytelling between two or more people, reminiscence can be an individual activity. The iTell project (Landry & Guzdial, 2006) researches a tool that guides an individual, novice storyteller to create a digital, retrospective story as an expert screenwriter would. This tool, motivated by research at the Center for Digital Storytelling in Berkeley, California, runs on a desktop computer and uses four steps, starting with answering prompting questions, to aid the user to develop and document the story. Unlike other works presented here in which photos are selected first to outline the story, iTell requires users to develop and even write their story before selecting the photos or other media that will accompany it, removing the interaction with pictures entirely from the process of reminiscence. While an

interesting approach to producing stories, the framework of a screenwriting process is one used to create fictional stories and may not be a logical choice for creating digital stories from memories, and using a computer is often seen as an uncomfortable interface for reminiscence.

Many of these studies are older, and their search for alternate technology may have been motivated by what was available at the time, which is likely no longer relevant now that tablets are common place and have more prevalence and functionality in a home setting than digital photo frames or projected displays. Additionally, regardless of interface used, all of these works still lack an emphasis on the interactions with digital pictures, often because that is not the motivation behind the project, but this still limits the usability of the tools. My thesis shares the common inclinations seen here: to encourage motivation to reminisce and ease the work of documenting stories, but the motivation will come from creating a usable and enjoyable interaction with digital pictures before attempting to prompt storytelling.

### ***2.3 Context-Specific Digital Storytelling***

Other research into digital storytelling has focused on applications for specific situations. These can take advantage of cultural norms, expectations, or realities to design tools that cater precisely to the needs of those subpopulations, not only bringing digital storytelling to larger audiences and furthering our understanding of global storytelling, but also revealing what about storytelling is shared across cultures and how that can be used to create more universal experiences.

One such example is the rural community photo display (Taylor & Cheverst, 2009) based in the United Kingdom, which presents public photo displays for whole community. These are intended to be used either by a single user or by a group to view the photos and share memories from them. Users can upload their own photos as well as comment on or tag pictures using the public touch interfaces. The focus is on public access to digital community photos and knowledge,

as well as enhancing the photos through that shared history. The display can also be moved to different locations, so can be used both in general settings (e.g. a public library) or moved for specific events (e.g. a town fair), allowing for the content to be diversified and giving access to a larger audience. The display encourages storytelling through its public location(s) and specifically leverages the collaborative aspect of memory sharing, but, as with many other examples, it does not save the stories that are told while viewing the photos.

A very different example is specifically for use by rural communities in South Africa. Bidwell, Reitmaier, Marsden, & Hansen (2010) design and investigate a system that uses cell phones to generate stories using audio and pictures. The research is largely focused on the relevant cultural differences in storytelling, and finds that storytelling in this setting is often a way of documenting cultural history and performed knowledge that is not easily explained in writing. The design therefore strives to create an accessible storytelling system on a cell phone so that the interface can be very mobile and stories can be recorded as they happen, without interruption. The system limits the users to three photos per story and offers two approaches to storytelling: a story-driven approach where audio is recorded first and a photo-driven approach where stories are chosen in order first, both of which were used in their user study. These are similar to the “select then narrate” and “narrate then select” methods seen in the work of Balabanović et al. (2000).

A similar project also uses customized cell phones to target a specific population. Frohlich et al. (2009) create StoryBank for a rural community in India in order to document and share local stories. The stories had a similarly small limit of up to six photographs and two minutes of audio and also presented the options of creating a stories audio-first or image-first. This research very intentionally avoided the use of written language as their expected users were largely illiterate. Completed stories could be sent to other individual's phones, but were also generally available

from a popular large screen in a community centre. Their users enjoyed creating the stories and found the simple pictographic interface easy to use.

My research investigates flexible storytelling that can be used by a diverse set of users, but these examples of digital storytelling customized to a specific culture or purpose show that these differences cannot be ignored and general digital storytelling research should be carefully aware of cultural biases in designs and strive for cross-cultural usability. These findings can be compared to the family narrative work from the social sciences presented next that reveal universal similarities and major differences across the world. There are commonalities in the storytelling methods across these projects' different settings, including using pictures as a starting point and supporting tool for storytelling and using recorded speech as an easy means to document those stories, but there are still the regular limitations in these projects, especially imposing a structure onto a story. As my research attempts to create as universal a storytelling interaction as possible, these insights into potential differences inform how important a thorough understanding of the larger systems of storytelling are.

#### **2.4 *Family Narrative***

Outside of computer science, much research has attempted to define how family narratives are structured. Whether defined by the ordered components (Labov & Waletzky, 1967) or by the dimensions included (Ochs & Capps, 2009), these definitions all indicate what we culturally consider to be at the heart of telling a story: a narrator conveys an event, or several, to an audience and together they make sense of the action. Understanding the roles and rules of family narrative in a broader sense allows for better design and research for digital storytelling.

Regardless of how a narrative's structure is defined, in order for a story to be told, it must be of a tellable event and must have an audience that accepts the telling (Ochs & Capps, 2009, p.

33), as well as being successfully started or launched (Ochs & Capps, 2009, p. 114). Story launch can often be aided by a trigger or prompt (Thiry & Rosson, 2012) and these triggers can take many forms (written questions, vocal prompts, one or more photographs, sounds, video, or even objects), and act as reminders to narrators of potential stories, supporting them in starting the story. Ochs and Capps also find that story structure is not always planned and narratives are often launched without knowing where they will lead (p. 2).

This family narrative research has set the groundwork for digital storytelling research. Analysing how family stories are told without technology allows for a broader understanding of what is expected of a digital storytelling tool, which can guide designs that encourage users to use the technology and even could improve on potential problems in traditional storytelling. Much of the existing digital family storytelling research does not yet thoroughly consider the existing role of storytelling within our lives and, in some cases, may even limit the tellability of stories. Further analysis of the systems of family narrative and storytelling can reveal important concepts that, when applied to digital storytelling, will create better experiences for family storytelling in a digital space. This research considers the different proposed structures of storytelling and the factors in launching and telling stories in order to create options for digital storytelling that fit within our current understanding of family narrative and what best supports these sorts of reminiscence.

## ***2.5 Digital Storytelling Design for Seniors***

Including the target population in the process of research is always essential. In order to create meaningful, useful tools for seniors' storytelling, their needs and wants must be thoroughly understood, and this knowledge can only come from them. Thiry and Rosson (2012) determine guidelines for designing for seniors' reminiscence using input from senior users, and, as discussed above, find that seniors do enjoy reminiscing in the form of storytelling and that, though they often

do not feel like they have knowledge worth sharing, a trigger helps them to recall and makes them more comfortable in telling. This research also finds that when seniors create physical artifacts from their storytelling, it is with the purpose of constructing a narrative around a particular story and calls for simple and minimalistic software without “too much going on” and an interface that must appeal to different generations together. However, these guidelines have yet to be tested and the data analysis was ongoing at time of publication.

Similarly, Lindley (2012) conducted a field study into the different ways that older adults are recording memories with the intent of saving stories for future generations. They discuss the themes across different means of recording or documentation (e.g. memoirs, scrapbooks, or collections of letters) and what is motivating their users to document their stories. These users spend a lot of time and effort on the creation of these artifacts and want to create “standalone, accessible artifacts that convey a clear narrative”. The research identifies a need for a malleable way to create stories that allows users to have control over their own content, and that technology should be used to create a space supporting the formation of a story arc.

More generally focused on uses within a family, the research of Frohlich, Kuchinsky, Pering, Don, and Ariss (2002) define design requirements for digital photoware based on research with families and their print photographs. This research is heavily influenced by the then current photoware technology using desktop and laptop computers, but they attempt to look ahead to future options and their findings are still relevant to today's digital storytelling research. One of their key findings is that storytelling from photo sharing is prompted more frequently with loose photographs than with photo albums and is more likely when the audience was not present for the memories.

Including older adults and any intended users in the process of design and research is essential. It is the only way to understand their needs for these solutions and allows researchers to better understand how seniors interact with technology. These previous studies find that seniors do want to document their stories, but may lack the motivation, are frustrated or held back by the currently available options, and that the time and effort currently required is often the main deterrent in creating rich documentation of family stories. This could be exacerbated by current digital storytelling options that limit how their stories are told and documented, so my research includes seniors in the process to create an unstructured interaction that supports what they desire out of digital storytelling as well as encourage and maintain their motivation to reminisce.

## **2.6 *Statement of Contribution***

Digital storytelling research is broad, investigating different interfaces, modes, and applications of storytelling, and it provides many new interfaces for family reminiscence and continues to explore new opportunities. From options to document three dimensional artefacts (Stevens et al., 2003), to group storytelling on tabletops (Shen et al., 2002), to simple in-home prompts for storytelling (Kim & Zimmerman, 2006), the variety in settings and projects, along with the nearly two-decade history, show what an important and fascinating field this continues to be. Further, research into seniors' requirements for digital storytelling shows a desire for ownership and flexibility in storytelling, as well as a need to aid older adults in having the motivation to tell and document their stories.

In this large area of research, I have identified two major areas for further research that I begin to address in this thesis. Research that aims to leverage storytelling for another purpose, such as memory strengthening, often can cause more roadblocks to storytelling than intended in creating and enforcing a structure that the user must follow. Limiting the user's ability to tell a

story can in turn limit a story's tellability and their motivation, which ultimately will discourage reminiscence. Many others do not intend the senior to be the primary user and instead expect a caregiver to use the tool and instruct or direct the senior in its use. This too can be harmful to a user's motivation, especially in seniors who are often infantilized and have shown that they need to own this process themselves. Based on the previous work surveyed here, it is hypothesized that a flexible, free-flowing, and independent interaction with pictures will match older adults preferred storytelling methods by giving them more control over their stories and artefacts.

A third area for improvement, but one that is not included in this thesis, is the scarcity of options for saving stories and reminiscence or for curating story output. The current abilities for output, if included at all, are either played back exactly as is (Balabanović et al., 2000; Bidwell et al., 2010) or are created, as directed by the tool, as part of the activity (Apted et al., 2006; Ludlow et al., 2014). As found by Lindley (2012), part of the motivation to tell stories is so that their memories can be saved. Creating simple and customizable, yet not limiting, options for presenting and preserving reminiscences will add another source for storytelling motivation and further expand on what digital storytelling adds to existing family narrative that is not yet possible with analog options.

In this thesis, I show that seniors' motivation to reminisce is positively influenced by free-flowing and unstructured digital photo interaction when compared to current paper and digital options. Additionally, I show that, while a saved version of the share memories that can be played back is desired, there is further research needed to create a robust and flexible editing and curating process for such an output that can give older adults the same control over the output that they are looking for in the process of authoring and storytelling.



This research was done in two phases using a mixed methods and grounded theory approach. In the first phase, CI interviews were used to investigate how older adults currently organize and interact with their photographs and tell stories, to determine the needs of seniors for a digital photo interaction and storytelling tool, and to inform the study design for the second phase. The second phase consisted of a user study comparing storytelling using the new method of digital picture interaction to users' current storage interactions using each user's family photographs along with a general evaluation of both the new digital picture interaction and a basic option for unedited story playback in order to understand user acceptance and experience of the interaction and resulting output.

### **3 Understanding the Design Requirements to Support Seniors' Storytelling Practices**

In order to accurately design a guided digital storytelling application for older adults, it is necessary to get input from the intended users. This builds an accurate understanding of their needs and desires from such a tool. Therefore, this study was designed to reveal seniors' current storytelling activities with their physical family photographs and their requirements for digital storytelling interactions in order to apply that knowledge to the design of proposed new interactions. This study explores current photograph and storytelling practices in an effort to determine design requirements for digital picture interactions, specifically for seniors, that support independent and unstructured interactions for oral reminiscence. This was done through a combination of observed storytelling and interview questions.

A Contextual Inquiry approach was chosen for these interviews as it was believed that the most accurate data on family storytelling would come from observing and prompting that activity in its natural setting. Individual interviews were performed in each user's home and they shared memories from their existing photograph artefacts (e.g. albums, boxes, wall frames). Holding the interviews in their homes lets them feel at ease in their environment, and using the photograph artefacts in that environment allows for users to share naturally without having to gather and move these items to a lab or other location, which may cause them to rearrange them ahead of time or curate the provided set, whether intentional or not. This approach was intended to closely mimic the normal activity of storytelling with a family member or friend so that the research reflects accurate data on family storytelling with photographs. The interview questions were designed to gain an understanding of why different storage and organization options were chosen and how reminiscence is seen by the participants in order to understand the motivations behind their storytelling activities.

### 3.1 Participants

Nine older adults participated in the study, five women and four men. Their ages ranged from 60 to 88 (M = 71.1, STD = 8.3). Table 3.1 contains a break down of participant demographics. Participants were recruited through flyers posted in senior community centres or distributed by community partners working with older adults. Only cognitively able adults were recruited for this study. This was determined by their ability to notice the flyer, chose to participate, contact the researcher, set up a time, and be present at that time all on their own. All participants were compensated \$40 (CAD) for their time, and participants could withdraw at any time during the study with full compensation. Two researchers present at each interview: the primary investigator to carry out the interview, and a supporting researcher to manage the video recording and other logistics of the experiment. All interviews were conducted in the participant's home, and were all with individual seniors except for one case where a married couple was interviewed together.

Participant ID	Age	Gender	Primary storage	Secondary storage	Organization
P0	60	Male	Albums	Wall	Events
P1	80	Female	Albums	Printed books	Events
P2	88	Male	Frames	None	None
P3	67	Female	Albums	Box	Events
P4	70	Male	Digital	None	Events
P5	70	Female	Albums	None	Time, none
P6	71	Male	Albums	None	Events, time
P7	69	Female	Digital	Printed books	Time
P8	65	Female	Albums	Digital	Time

Table 3.1: Participant demographics

### 3.2 Contextual Inquiry Interview Procedure

The study was designed in two sections to take a total of 90 minutes to two hours. Because this was longer than average focus groups and other similar studies with older adults, there was an option for a 15-minute break in between the two sections. [Appendix A1](#) contains the research protocols for this study. The interview began with an overview of the research and an oral review

of the consent form ([Appendix A3](#)), as well as addressing any questions the participant might have before starting. The main interview then followed in two sections, both of which were recorded for later analysis. See [Appendix A2](#) for the semi-structured interview guides.

In the first section, the participant was asked to produce a story from their artefacts. Starting with storytelling, rather than the interview, was an intentional choice in order to keep the process as natural as possible and to avoid the participant over-thinking their actions. If the interview were to start with questions into their storytelling practices, it is likely that the storytelling that followed would be heavily influenced by this recent activity of analyzing their own practices. The storytelling was video recorded in order to document both the context of the stories told and the participant's physical interactions with their photographs and storage. The researcher avoided recording the participant's face for anonymity and focused on the physical interactions with the photo artefacts. Participants were informed of the purpose for the recordings, that their faces would not be included, and that recordings could be paused at any time during the process as they requested.

The participant was allowed to select any subset of their photos that they wanted to share without researcher input. This could include multiple albums or a mix of different sources, such as an album and an iPad. The only guideline given for the story was that they should only share that which evokes pleasant memories so that the participant and the researchers both would not be distressed by the content discussed. Because the researchers are strangers to the participant, the stories told were expected to have differences from what would be told within the family or with friends (Ochs & Capps, 2009, p. 60). These differences are not a concern as the intent of this study was to determine how photographs are organized, what interactions are used with them, and what stories or memories are prompted by different artefacts.

This storytelling was prompted by a simple and open request for them to share a story from their photographs. If the participant was unsure where to start, the researcher would provide a vague prompt based on the selected photo set such as “Could you talk us through this vacation?” to help to trigger a story. The researchers did not participate in the storytelling other than being active listeners and an audience for the narrator. That is, the researchers did not prompt for specific details or offer specific opinions on the story and were largely silent during the telling besides non-verbal or brief responses such as laughter or “OK”. When the participant indicated that they had completed their stories, they were told that there could be a short break before continuing to the interview and that if they thought of any other pictures or stories that they wanted to share later, it was possible to return to storytelling as they wanted.

The semi-structured interview was not video recorded, but was audio recorded for later coding and analysis. The interview was intended to build off the recent memory of storytelling and was organized into four sections: photograph storage and organization, family story documentation, general family storytelling, and technology and digital photographs. As this was a semi-structured interview, the order of the questions was not set and could change based on how each participant responded. This allowed for natural conversation and for the researcher to encourage the participant to continue on a current thought even if it took the conversation away from the next question.

Each section targeted different aspects of the overall process of family storytelling and the role technology currently plays or could potentially play in the future. The current photograph storage and organization questions were used to understand why a particular storage method was chosen, to inform the digital display of pictures, and to determine what picture metadata defined each photo for different individuals (time period, location, people, event, etc.). There was also a

desire to understand how sets of photos are edited in their current physical storage and what would prompt that activity in order to guide the design of an editing interface for completed digital stories.

The family story documentation section sought to understand how story documentation was viewed by participants and how family picture storage fit into that. This information decided what features were necessary for digital interactions and what must be avoided or prevented. This section also investigated the motivation as to why stories are documented as this motivation is key to encouraging users to document their stories.

The general family storytelling questions were intended to understand what types of stories are shared from photographs and what other factors, such as audience, has a perceived impact on these stories as well as the differences between generations in terms of family storytelling according to the participants. Each participant was also asked to provide thoughts on how their current storytelling or photo organization practices could be made easier or what they would want to change in order to design the tool so that it offsets these frustrations and simplifies the overall process. This gave participants a chance to voice specific areas for improvement in their picture interactions that could be focused on when designing the app.

Finally, they were asked a few questions about technology use in order to understand how that might affect their current photograph interactions and their likelihood to try a tablet app for digital storytelling. This included general questions such as their access to and familiarity with various technologies and whether they currently have access to and share digital photographs. The interview was followed by a debrief that allowed the participant to volunteer any additional information and to ask any questions they had about the research. The interview data were fully transcribed before being coded (verbatim principle) and fully anonymized. The coding and

thematic analysis of each interview was ongoing in between interviews, and the interview guide and questions were updated in between interviews based on this continuing analysis.

### 3.3 Results

The transcribed interviews were analyzed using coding and inductive thematic analysis to interpret the raw data and understand how participants currently reminisce and their needs for digital storytelling. Themes were determined from analysis of all the coded interviews. Figure 3.1 shows the themes and related codes.

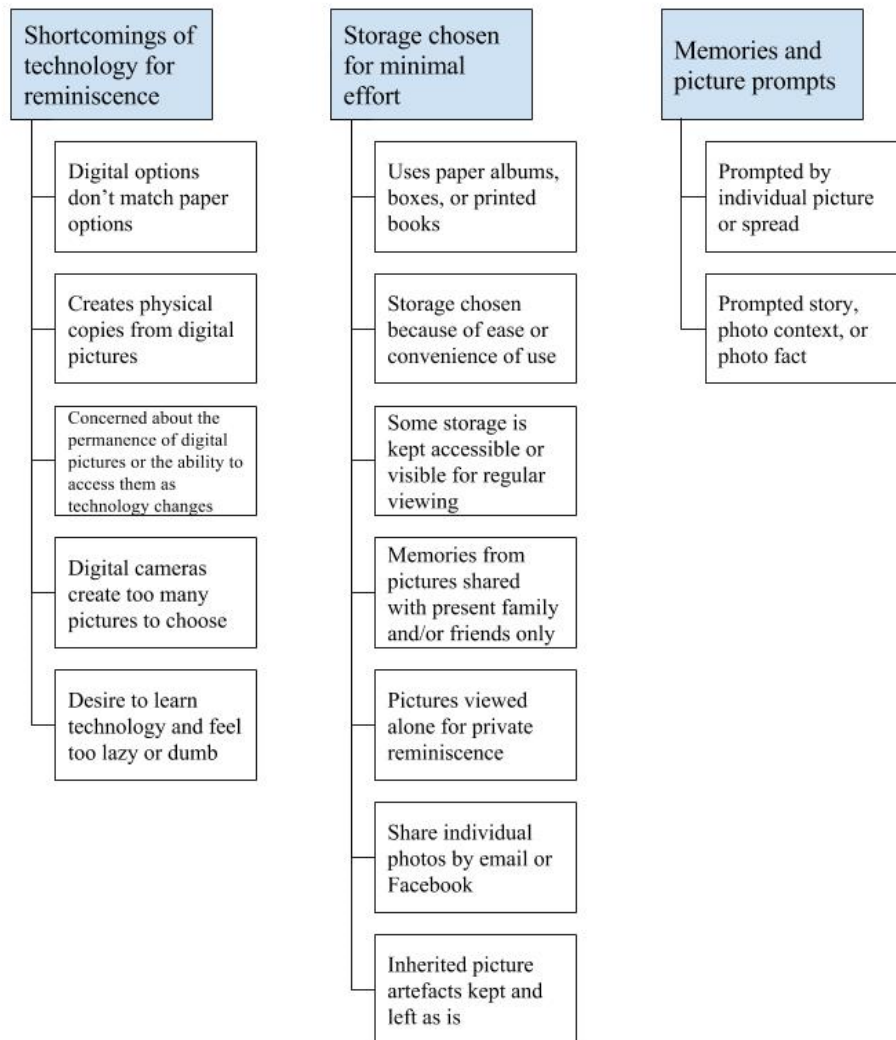


Figure 3.1: Coding and thematic analysis of CI interviews

### 3.3.1 Storage Chosen for Minimal Effort

Of the nine participants, the majority of them used photo albums as their main form of organization ( $n = 6$ ). The other three participants either used mainly digital storage ( $n = 2$ ) or had only framed photos ( $n = 1$ ). Additionally, the participant who only used frames for photo storage used no intentional organization. The eight participants that used some form of organization for their pictures all used two levels of organization. The higher level determined which pictures went into which album, folder, or other storage, and the lower level determined the approximate order of the photos within that storage. At the higher level, the most common form of organization was by event, such as a wedding, retirement party, or a single trip or vacation, which was preferred by five participants. The other three participants used a chronological organization, such as keeping all pictures from one calendar year together. Two of these participants used primarily digital storage where chronological organization is done automatically, and one of these expressed that she would prefer to organize by event, as she had done before moving to digital, but that the software available did not make that reasonably possible, saying:

*“They used to you know just be so easy to put them in events and so easy to put them in all these things. Whereas now ... it just doesn't work as well. ... I used to keep them very much you know in their categories and stuff like that but once Apple decided they weren't going to provide all these other little things that it just became more trouble than it was worth.”*

The lower level was generally unintentional and imprecise and always roughly followed the timeline of when the photos were taken because that is the design of both film and digital cameras; to provide pictures in the order they were taken.

Nearly all participants ( $n = 6$ ) expressed that their main form of storage was chosen for either convenience or ease of use. The other two could not explain why they chose their



organization and included the one participant who had no intentional organization. On the convenience of his chosen photo storage, P0 said:

*“It’s just a handy way of accessing the whole thing you know when you’re pulling out a memory it’s like oh yeah you know like you wanna remember all those things together and it triggers other memories as well right? So I dunno I just find it’s convenient you know? For remembering.”*

Five either had large displays of framed pictures (n = 2) or kept albums in commonly used spaces (n = 3) in order to view family pictures regularly. P6 described this, saying:

*“I do get a lot of satisfaction out of having the photo albums, having the pictures there. And when people come over and visit you know our children and grandchildren. They do like to look in the photo albums so I get a lot of satisfaction out of it.”*

and P1 said of a hallway wall covered in family pictures:

*“I can walk up and down that hall everyday and look at these pictures which is really you know I quite like- cause these indeed were the best pictures I had of the family.”*

Approximately half (n = 4) make changes to their physical storage (e.g. adding or removing pictures to existing storage). P3 explained that:

*“in the dead of winter ... every so often I get this thing where I think ‘Oh I’m gonna send somebody some photos’ so now that I’ve seen those ones of that wedding I think I’ll just pull those and send them to [my cousin] because um my [son] won’t want those you know. And-and I figure as long as I have one picture of my cousins or something you know I don’t need them all and- Cause that’s- I guess that’s my concern they’re gonna end up in a garbage. If you don’t give them to the people that really want them.”*

Most participants ( $n = 6$ ) had received or inherited photo artefacts from their parents or grandparents and incorporated them, without changes, into their existing collections. Photos and memories were most often viewed with family ( $n = 5$ ), often specifically children or grandchildren ( $n = 4$ ), or alone ( $n = 5$ ), followed by with friends ( $n = 2$ ).

Physical interaction with storage artefacts was consistent across participants. Those participants that use albums all tap on photos to provide or reinforce context for what is being said and flip back and forth between pages during storytelling to reference previously seen pictures. Three of the five also flipped through a whole album, usually just before storytelling, to confirm that they have the correct artefact or remember the content correctly. Digital photo viewing, however, never involved tapping on a picture unless it was accidental or if the picture was shown as a small icon and contained too much to be understood at that size as tapping would open the picture in a larger view. It was rare that participants interacted directly (e.g. tapping) with pictures stored in frames and hung on walls ( $n = 2$ ), but were sometimes pointed at from a distance ( $n = 4$ ).

### 3.3.2 *Shortcomings of Technology for Reminiscence*

Of the participants that use digital storage to some extent ( $n = 8$ ), three used tablets and seven used laptops or desktop computers to interact with their pictures, six were self-reported novices with technology or used it rarely and three reported or demonstrated being comfortable with technology. Six participants had shared pictures digitally, either through email or using social networking sites including Facebook. Six found that there was not yet a digital equivalent for their preferred physical storage and of those six, three had either made or received printed photo books made from digital pictures. P6 described his frustrations using a desktop computer to view pictures:

*“I just think the software is just not very good. You should be able to look at the picture. A picture from your camera. Screen size look at it and make a decision. So that's sort of ridiculous.”*

Including those three, seven participants make or keep printed copies of some their digital pictures, either as individual photos or in printed books.

Several participants (n = 4) expressed concern at the speed of technological changes and worried that their photos would be lost in the transition to the next technology or format. P8 said:

*“I think people are just throwing kinda them on [the Internet] and sharing them? And then what happens to them? So that's what I'm wondering because you know I think this is important to chronicle and to you know keep track of family and friends and all that stuff ... So what's going to happen to all these digital photos? They're just kinda out there and then they're not.”*

Five participants, made up of both technology novices and regulars, said that they would like to understand the available technologies more, and that effort or time was the main reason that they had not yet done that.

### 3.3.3 *Memories and Picture Prompts*

The memories produced by participants were coded for what prompted them as well as their complexity. Three categories of memories were defined as follows: 1) photo facts that state a simple fact about the contents of a single picture, 2) photo contexts that provide more information beyond the facts of a picture or pictures, but don't have a passage of time, and 3) stories that provide more information beyond the facts of a picture or pictures and cover some passage of time. These were developed both from existing definitions and from the body of memories produced in this study. See table 3.2 for examples of each type of memory. Memories could be prompted by

a single photo, a spread of photos, multiple photos viewed in a sequence, an artefact that was not a photo, or a mix of photos and non-photo artefacts (e.g. a collage).

Photo fact	<i>“That was my dad” -P8 or “That’s my graduation.” -P4</i>
Photo context	<i>“This is my granddaughter on her 10th birthday this is the invitation they sent out. She's very into- is it Reea in Star Wars? That's what this is. Star Wars.” -P1</i>
Story	<i>“And uh this guy was an Egyptian guy named [name]. And uh. I was thinking about him the other day you know with all this stuff about terrorists. And we brought him to our home town in [town] and of course the neighbours all looking out the window cause there was two Egyptians with us in the car. So you know that's the kind of- You think about well how would they have reacted today if two Egyptians had shown up or Middle Easterners.” -P3</i>

Table 3.2: Examples of different types of memories

The participants produced a total of 126 stories, 132 photo contexts, and 410 photo facts. Of those stories, 59.8% (n = 76) were prompted by a single photo, followed by photo spreads (24.41%, n = 31), and photo sequences (11.02%, n = 14). Non-photo and mixed prompts were least common, representing 2.36% (n = 3) and 1.58% (n = 2), respectively.

	Number Told	Mean	STD
Stories	126	14	8.46
Photo Contexts	132	14.67	7.17
Photo Facts	410	45.56	29.62

Table 3.3: Distribution of types of memories

Photo contexts were also prompted more often by a single photo (71.21%, n = 94) or photo spreads (23.49%, n = 31). As with stories, non-photo prompts were rare (3.03%, n = 4), but sequences of photos were less common than non-photo prompts making up only 2.27% of photo contexts (n = 3), and there were no mixed prompts for story contexts. By definition, all photo facts are prompted by a single photo. In this study, when a memory was prompted by a single picture, 70.64% of the time it was a simple photo fact. 16.24% of single picture memories were photo contexts, and

13.13% were stories. Memories prompted by photo spreads were split evenly between stories and photo contexts.

	Single Photo	Photo Spread	Photo Sequence	Non-photo	Mixed
Stories	76	31	14	3	2
Photo Contexts	94	31	3	4	0
Photo Facts	410	0	0	0	0

*Table 3.4: Distribution of memories across different prompts*

### 3.4 Discussion

This study showed that **older adults choose a method of picture storage that requires as little time and effort as possible while supporting both viewing and reminiscing activities** either alone and with family or friends, which were the most commonly reported settings for reminiscing. The organizations used also kept effort to a minimal by leveraging pre-existing structures, such as the chronological organization provided by cameras. Keeping major events or time periods together and ordering them by time allow pictures to be kept generally in the same order as they were on the camera and to be split into groups simply between major chronological events. These findings are supported by previous research, across different fields, that also finds that there is too much effort involved in keeping up with photo organization and documentation, so simple options are more likely to be chosen (Frohlich et al., 2002). Pictures or artefacts were often kept in common spaces so that they would encourage reminiscence and sharing. There was not a strong attachment to keeping the pictures in the artefacts as they were, re-organizing could even be seen as a positive activity, and inherited storage was added to collections without changes.

Although albums, as the most commonly seen choice for storage, allow for a small spread of photos to be seen at once (generally between four and eight pictures on two pages), **participants demonstrated that they desired a larger context for their stories by flipping back and forth**

**between pages during storytelling.** Tapping on a photo was used to provide context to a specific part of the picture or to clarify that that picture was the current focus, but most digital album tools treat a click or a tap as a selection that will cause that picture be opened, losing the larger context of the photo spread and interrupting the narration.

The majority of participants, whether they are regular technology users or novices and regardless of how much they use technology to store their pictures, agree that **there is not as of yet a digital equivalent to physical picture storage**, and, in some cases, had compromised on their storage and organization in order to use digital options. Also across different levels of technology use, there was an observed desire to learn more about digital picture technologies, such as scanning pictures or slides and photo book printing, but time and effort are a barrier, just as they are for physical options.

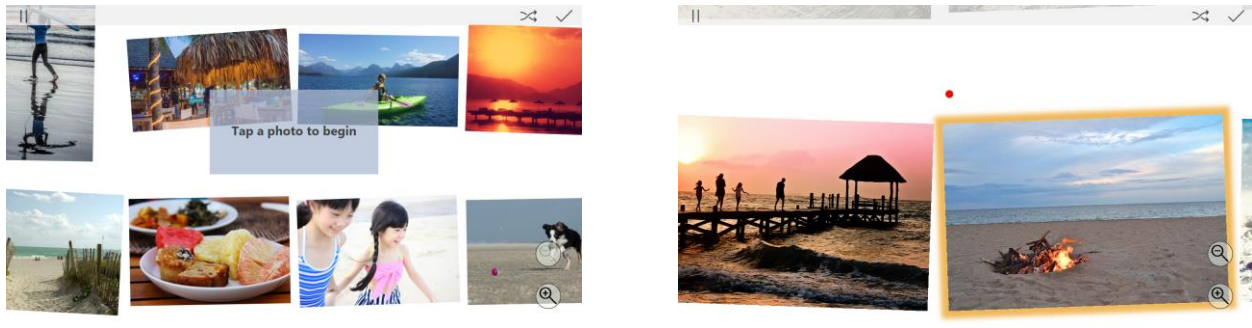
**The participants also showed that they continued to want physical pictures even if they had switched over to digital storage.** This was likely due to a combination of mistrust that the digital pictures would last and a lack of an enjoyable way to show and share pictures on a screen. The mistrust stems from having seen the preferred digital storage technology change often in recent history (e.g. from CD to thumb drive to internal storage to cloud storage) and a misunderstanding of how digital pictures are stored and interpreted by modern technologies, such as worrying that the format the pictures were stored in (e.g. JPEG) would be obsolete one day without a way to convert them to the new format. In terms of sharing memories digitally, though some participants did share digital pictures remotely, they preferred physical pictures over digital for in-person sharing and reminiscing. This is likely because commonly available software is not currently designed with in-person sharing in mind.

The data also show that, while individual pictures can prompt stories, they are more likely to prompt a simple fact. **Spreads of photos that allow someone to see and move freely through the larger scope of their story seem to allow for a more consistent story prompt.** In fact, pictures are rarely used in a sequence to tell a story or for any reminiscence, despite the fact that pictures in an album are consistently stored in a chronological sequence and viewed in order.

### ***3.5 Resulting Design***

The data and results above led to the following design for new options for picture interaction using a tablet app. The proposed tablet app, Frame of Mind, has been designed in order to support the desired baseline for photo interaction and reminiscence in a digital space, as albums do in a physical space. The app was developed as a Windows 10 universal app using WinJS, HTML5, and CSS. This allows the app to be easily ported to a platform-independent website in the future. The story data is stored in a mongoDB database, local to the tablet, and the app uses nodeJS to communicate with that database.

Frame of Mind uses a table top metaphor in place of an album to avoid the structure of a sequence that is often unused (figure 3.2). The speech of reminiscences is saved and synced with the viewed photos, allowing stories to be replayed and shared in person or digitally. The main view is a digital table top with personal pictures displayed in a grid with each image pseudo-randomly rotated slightly to reflect how pictures would be laid out imperfectly on a table. This table top can be scrolled infinitely in any direction, with the finite grid of pictures being repeated in a larger infinite grid, so users can easily move between any pictures without “flipping” back and forth between pages or views.



*Figures 3.2, 3.3: Table top view and zoomed view*

The grid of images is designed to be a square or nearly-square rectangle, so the scrolling is not interrupted on the edges, and when a square or rectangle is not possible or practical for the number of pictures, the remainder is kept as close to row size as possible. Photos start shuffled, so users are not pressured to follow a chronological order and can be shuffled again as desired. This is to challenge the cultural norm that pictures need to be kept chronologically in order to produce stories as the first study found that photo sequences were rarely used for storytelling and previous work that supports this as well (Frohlich et al., 2002). It also uses a multi-level zoom so users can change the scope of their viewing as desired (figure 3.3).

In order to begin telling a story, a user is prompted to select a single picture as a starting point. Once selected, the audio recording begins and will continue until the story is completed. The recording can be manually paused and restarted so that, for example, a phone ringing or a siren passing would not disrupt the storytelling or interfere with sound quality. Pausing the audio will also pause the selection of pictures until the recording is restarted.

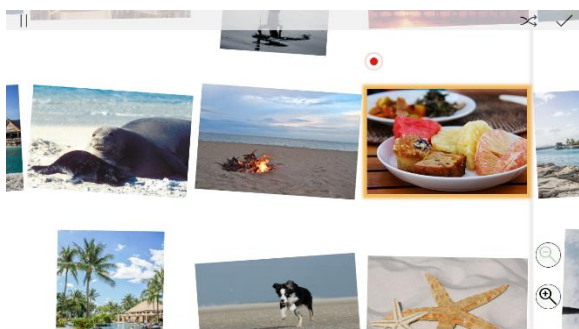
The selected picture is indicated with a border, and a blinking recording light appears next to the selected picture to ensure the user that recording is active and functioning (figure 3.4). This light stops blinking when the recording is paused. The user then selects pictures individually as they reminisce by tapping and the border and recording light follow their selection. After the first required tap, there is no limit to how many pictures can be part of a story and images may also be



selected multiple times within one story. When complete, the user selects the done button to complete the story.

A training view used only for the user experience study mimics the interaction of the main storytelling table top, but does not include audio recording nor does it write anything to the database. Instead of the user's pictures, it displays a small deck of stock vacation photos (sourced from pixabay.com). This allows users to become familiar with the interface and the interactions before seeing their own pictures and before creating a story.

Once a story has been completed (by selecting the done button), a user can watch an animated slideshow of their story (figure 3.5). The playback plays the recorded speech and displays the pictures in order and matching the times that each picture had been selected. The current picture moves to the left and fades out as the next moves in from the right to create a continuous flow of pictures matching the playing audio. The previous and next pictures are partially visible behind the current picture to maintain the larger context. All saved stories can also be viewed as one list and can be played back from there as well. From here, stories can be shared with family or friends who were not present at the original telling. This also enables users to re-watch stories on their own, as they like.



*Figures 3.4, 3.5: Recording light and story playback*

There are many more features to be added to this app in the future. For the purposes of this study, the functionality was kept intentionally basic so that the evaluation could focus specifically on the experience of interacting with pictures and telling stories in this new way as well as the general quality and desirability of a simple saved output. The following section explains the study designed to evaluate this app with seniors and the results of that user experience study.

#### **4 Assessing Digital Picture Interactions Compared to Currently Used Photo Storage**

With the interface resulting from the ethnographic study, a second study was designed and carried out in order to assess the acceptance of the interaction and to understand how it compares to their traditional storage and memory sharing as well as how potential saved story outputs are perceived. This study tests the hypothesis that the app will provide a more agreeable experience for storytelling than existing physical or digital methods as measured by the amount and quality of stories produced and by participants' perceived experience. The use of the app for this study was piloted with 12 graduate students, each using the training deck of pictures. This was to find bugs in the app and to get initial feedback on both the app and the structure of the study.

This study followed a similar structure to the first; interviews were carried out in users' homes, though it was possible to meet in the researchers' lab if participants reported owning only digital pictures and were more comfortable with that meeting place, and their reminiscence was done using their existing picture artefacts. Their current reminiscence activities were compared to their experience reminiscing using the app. Again, by using their artefacts and pictures in their homes the stories and experiences will be more authentic to the reminiscence activities they do with their family or friends.

##### **4.1 Participants**

The second study was made up of seven participants; four female and three male. Their ages ranged from 67 to 76 ( $M = 69.14$ ,  $SD = 4.60$ ) and three of these had participated in the previous study as well. See table 4.1 for participant demographics. Users were recruited in the same way as the first study; using flyers and recruiting through the community, and again, only cognitively able adults were recruited for this study. The compensation was the same as the previous study (\$40 CAD), as were the rules for withdrawal. Two researchers were present at each

interview: the primary investigator to carry out the interview, and a supporting researcher to manage the video recording, app setup and training, and other logistics of the experiment.

Participant ID	Age	Gender	Storage used	Organization	First Mode
PA	67	Female	Album	Events	Tablet
PB	69	Male	Album	Events, Time	Traditional
PC	61	Male	Digital	Events	Tablet
PD	76	Female	Album	Time, Events	Traditional
PE	70	Female	Printed book	Events, Time	Tablet
PF	72	Male	Albums	Events, Time	Traditional
PG	69	Female	Digital	Events, Time	Tablet

*Table 4.1: Participant demographics*

**4.2 User Experience Comparison Procedure**

The format for the study and the consent form were reviewed orally before beginning the study and the participant had a chance to ask any questions before they begin. The protocols and consent form for this study can be found in [Appendix B1](#) and [B4](#), respectively. The study asked the participant to identify two distinct sources of photos that preferably had some relation (e.g. they are organized around the same theme, like weddings, or contain many of the same people, such as two different years of their child’s life, but that contain distinct events and pictures). They were welcome to choose any pictures they wanted within those guidelines, and these guidelines were flexible in order to accommodate different standards and methods of storage as well as different amounts of photos kept by different participants. As with the first study, they were asked to only share pictures and memories that they were comfortable with sharing and that were not distressing to protect both the participant and the researchers.

Using a coin flip, one artefact was chosen to be digitized and set up on the tablet app and the other was left as is. The picture digitizing was done using OfficeLens, a free Microsoft app that squares off and flattens documents, similar to scanning. If participants asked about the digitization process, they were briefly introduced to the app and given instructions on how to get

it, if they wished. While the assisting researcher digitized the selected pictures, the participant filled out a brief questionnaire including basic demographics and their comfort and familiarity with as well as access to technology ([Appendix B3](#)) and the primary researcher reviewed the process of the study with the participant. The user was then asked to share stories and memories from both artefacts separately, and the order of these activities were counter-balanced across users. Counter-balancing the two activities was intended to correct for the experience of the app being influenced by the recent activity of storytelling and vice versa. As with the first study, storytelling was prompted only by general questions, such as “Why don’t you talk us through this album?”, and the researchers were largely silent during storytelling other than being active listeners and answering questions about the app functionality, as needed. As in the first study, because of the longer than average duration of the whole interview (90 minutes to two hours), there was an option to take a break between the two storytelling activities if desired by the participant.

Directly before the storytelling using the tablet, the participant had a short training on the tablet using a generic set of photos. The assisting researcher demonstrated the various basic functions of the app including scrolling, selecting a picture, pausing/playing recording, zoom, shuffle, and completing a story by making up a brief story about the example deck of pictures and answering any questions the participant had about interaction. Playback was not demonstrated to the participant at this time, and any questions the participant posed around output or the purpose of audio recording were deferred until after the reminiscence and initial interview were completed. The participant then had a brief chance to experiment with the dummy deck of photos before continuing onto their own pictures.

Both storytelling activities, including the app training, were video and audio recorded. Video recording allows the gestures used to be captured and maintains the context of the story (e.g.

by clarifying who the participant is pointing to), and the participant's face was excluded from all recordings for anonymity. Audio recording was used throughout the study including during storytelling with the app even though the app included audio recording. This was to act as a backup in case, for example, the user placed a finger over the tablet's microphone, and to save the audio from the training session which has no audio recording. The participant was informed that these recordings could be paused at any time.

After both activities were completed, they were asked to compare the experiences and answer questions about how they could see themselves using the tablet for reminiscence moving forward including a verbally administered system usability scale (SUS) questionnaire and questions more generally about their thoughts on family storytelling and reminiscence some of which were repeated from the first study. The SUS questionnaire was done verbally by asking yes or no question versions of the standard questions and assigning a 1 to 5 value based on the answer. This approach was selected because of previous research supporting that seniors do not accurately respond using Likert scales (Neves, Franz, Munteanu, Baecker, & Ngo, 2015). See [Appendix B2](#) for this semi-structured interview guide. Unlike in the first study, there was not the option to return to storytelling after the two activities were completed or during the interview. This was because the interview was largely structured around a comparison of the two distinct experiences and adding further storytelling during the interview would confuse the data. That said, they were not stopped from offering stories or reminiscences during the interview as long as they did not get another photo artefact to support it.

After the interview, they were shown how the app can playback the story they had just told and briefly interviewed about this output ([Appendix B2](#)). This was left until after the initial interview and SUS questions so that the main comparison of the two options for storytelling would

be based solely on the comparable acts of storytelling in order to get a more accurate comparison of the two activities, and because traditionally sharing stories from albums, loose pictures, or even tablets or laptops does not currently create a permanent output.

The interview was followed by a debrief that allowed the participant to volunteer any additional information and to ask any questions they had about the research or the app, including any improvements or added features they would want to see. They were informed that while the app was not currently available, they could be kept informed of the progress and if it ever became publicly available. The transcription and coding of each interview was ongoing in between interviews, and, based on this coding and participants' responses, interview questions could be updated as well.

### ***4.3 Results***

The interviews were analyzed in the same way as the first study, using coding and inductive thematic analysis to understand users' opinions and experiences with the new interaction as compared to their current methods. Figure 4.1 shows the themes and related codes.

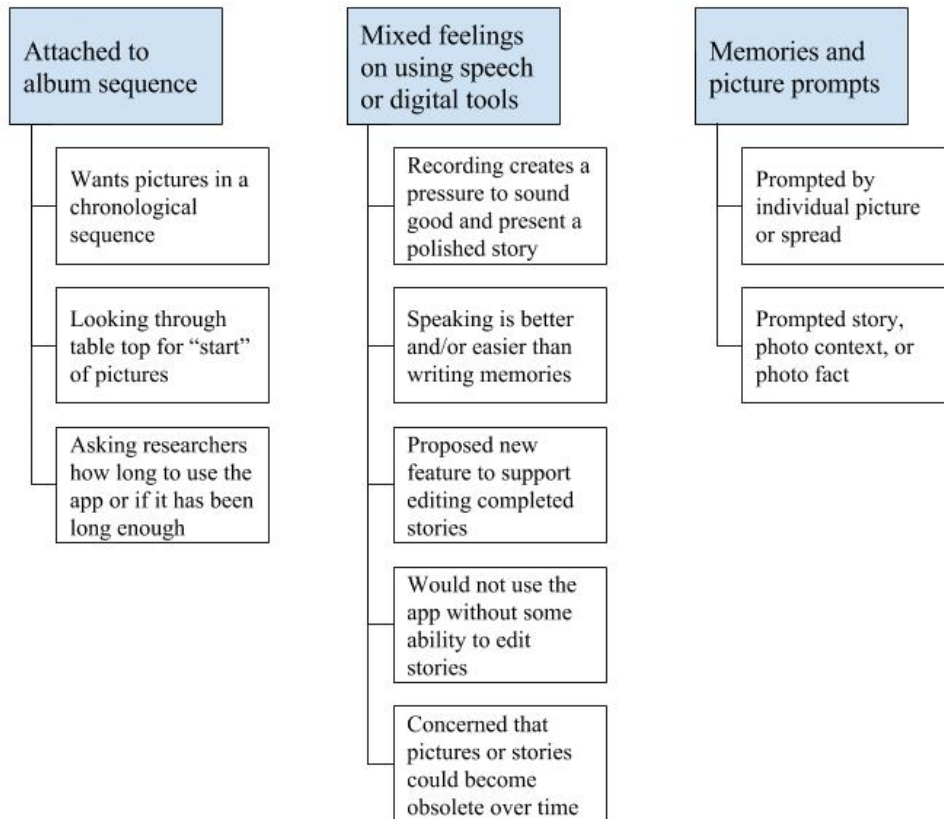


Figure 4.1: Coding and themes

#### 4.3.1 Experience with Technology and Overall Impressions

Four participants used albums as their main form of storage and the remaining three preferred digital storage. Two of the participants who used mainly digital storage came into the lab space for the interview as it was more convenient for them and their pictures were portable. All participants organized their albums or other storage either by events (n = 2) or by a mix of events and time (n = 5). All participants owned a computer as well as a smartphone and/or a tablet, and the majority (n = 5) reported using their tablet or smartphone daily. All participants use their computers for family picture storage with one exception who uses an external drive. All participants reported using email to communicate with family, both near and far, and all but one,



who does not share pictures digitally, use email to share family pictures. Four participants reported using Facebook and all of those four use that platform for sharing pictures.

When using the interface for reminiscence, four participants used the zoom buttons, three of whom also tried to use a pinch-to-zoom gesture first, and three used the pause button during storytelling to think about what they would say next or to try and remember a detail. The shuffle button was never used by participants. The modified SUS questionnaire resulted in a score of 78.57, well above the average score of 68. PC explained the interface saying:

*"It's a great, beautiful way to kind of make looking at pictures fun and record things about the pictures."*

#### 4.3.2 Attached to Album Sequence

The largest concern with using Frame of Mind was the pseudo-randomized order of the presented pictures. Five participants expressed wanting to have a chronological order to the pictures and to know where the "start" of the pictures was. As PG said:

*"But so much of life is done chronologically. That would drive me nuts to have it all mixed up like that without some sort of framework."*

And PD commented:

*"I didn't like having to look all over the place to find the order of the pictures."*

Three of those five participants swiped through the pictures on the interface before beginning in an effort to find where the pictures started. After the training session, where the infinite scroll had been demonstrated, and before storytelling PB asked:

*"So how do I find where it actually started? Will it be at one end or the other?"*

Since there is no start or finish when using the app as there would be in an album or photo directory, several participants (n = 4) asked if they had done enough storytelling while using the tablet.

#### 4.3.3 *Mixed Feelings on Using Speech or Trusting Digital Tools*

Users expressed that they enjoyed being able to speak memories instead of having to write or type them (n = 4). PA said:

*“It's a nice idea that I can sit at that and ... make a comment on it and tell you who's in the picture. And actually that would be an advantage because then you don't have to write it which is a lot more time consuming then writing on the back of every picture.”*

There were concerns, however, with speaking such as the pressure to avoid filled pauses (e.g. “um”) and to sound professional (n = 3). As PF explained:

*“You're really doing it off the cuff in a way and you might remember interesting things and speak coherently or you might forget important stuff and just wind up mumbling and jumbling and getting all confused about things. ... So I guess there's some pressure to speak coherently and sensibly about things.”*

PD saw both the pros and cons of voice recording saying:

*“It's easier than spending hours pasting stuff into an album ... and if you put them in a box you know you still have to write on the back if you choose to do that. But this you can just talk to it. It's easy and fast!”*

And also:

*“When you're doing it this way [in an album] you're not as pressured to remember what you want to say? Because it gives you time? Whereas with this [Frame of Mind] because it's recording and there's a little red light there I think that pushes you know sometimes you*

*forget some of the key things you'd like to say because you feel that you don't want to waste air time."*

Participants also suggested many features that they would like to see added to an app such as this one; most common was various ways to edit the saved story (n = 5) including writing captions, typing further information or metadata such as dates, rearranging pictures before, during, and after storytelling, and collaborative editing including a history of each story. PG proposed:

*"Could you have the words printed out as the story that goes with it because if you read it then someone will say 'Oh I can add to that story.' So the story can become embellished."*

And PC suggested a timeline for editing the structure, saying:

*"You know some of these movie makers they have this place for each snapshot? So then I'm thinking you could go and edit. I want to move the snapshots around ... If I see the timeline I could move them around."*

Other proposed features included using keywords to search for pictures, zooming in to see one picture full screen or out to see all pictures, and some way to navigate between all of a large collection of pictures or between all of the recorded stories.

Four participants expressed concern with using digital pictures because they may be lost or may be obsolete with new technologies. PA said:

*"I just worry that you put all that into the technology and then the technology changes and you can't use it anymore the app's no good or you've saved all those photos to a certain place and then so what happens if your computer dies?"*

Five participants would use something like the app to make recordings and the remaining two were unsure because they first would want the ability to edit. When asked about how they could see

sharing the recorded output, the most common choice was for in person sharing (n = 4) or by email and Facebook (n = 4) and one participant was unsure how they would share the recordings. Five participants said they would share the recorded stories with family; one specified siblings and another, children or grandchildren. Outside of family, one participant would share with friends, one would share with the people in the picture, and one had no preference as to who they would be shared with.

4.3.4 Memories Produced Compared Between Modes

	Frame of Mind	Traditional
Stories	36	32
Photo Contexts	49	36
Photo Facts	52	120

Table 4.2: Distribution of memories

When using the tablet, participants used between 33 and 101 pictures and included between 8 and 50 of those in their storytelling. In their current format, they chose sources containing between 15 to 224 pictures of which between 8 and 46 were included in their storytelling either by selecting them in the app or by specifically indicating the picture when using their current storage. On average participants included 45.9% of the presented photos when using the app, but only 33.6% in their traditional methods.

Participant	Frame of Mind			Traditional		
	Duration (mm:ss)	Total # Photos	# Photos Included	Duration (mm:ss)	Total # Photos	# Photos Included
PA	4:42	45	19	4:02	191	17
PB	3:12	36	13	5:03	135	26
PC	16:11	101	33	4:15	15	15
PD	2:16	33	20	1:29	18	8
PE	13:23	60	50	6:21	148	26
PF	3:04	70	8	6:27	114	28
PG	6:06	40	22	15:26	224	46

Table 4.3: Use of pictures in reminiscence

Using the same definitions of photo fact, photo context, and story defined in the previous chapter (see table 3.2 for examples), stories and contexts were more frequent when using the tablet while facts were more common in traditional methods. The tablet app produced an average of 2.02 stories and/or contexts per minute and 1.32 photo facts per minute, and the respective values for users' current methods were 1.64 and 2.71.

	Frame of Mind	Traditional
Stories	0.79	0.90
Photo Contexts	1.23	0.74
Stories and Contexts	2.02	1.32
Photo Facts	1.32	2.71

*Table 4.4: Average memories per minute*

#### 4.4 Discussion

This initial study assessing the proposed picture interaction had very positive results. **Participants gave positive reviews and expressed interest in using the app themselves.** One limitation of this study is that, at this point, only seniors who already own tablets or smartphones have participated. It is likely that only technically savvy participants volunteered for the study because new methods of organizing and interacting with pictures digitally would be of most interest to those seniors that have already tried, and been frustrated with, currently available digital options. This is an understood selection bias and future studies will specifically target irregular or novice technology users. **Despite their familiarity with technology, a common worry among participants is that digital pictures could be lost or their format could become unusable.** This can partially be solved through education; for example, teaching users how cloud storage works and how their contents are backed up or how, unlike previous physical storage like VHS or CDs, modern digital photo formats are very unlikely to become unusable in the future. This could be done in training sessions before distributing the app or by including a written manual including

descriptions of how storage and backup work for the app and how that protects their pictures from being lost.

**The recorded playback of the story was seen as very valuable**, especially since albums and similar options cannot record. The many suggestions around editing and creating completed stories to be shared, however, show that while this is a desired functionality, **it will need to be a more robust offering before it will be usable**. Email being the preferred method to share this digitally is expected considering that all the participants already share pictures that way, and similarly the interest in sharing the stories with family is expected as reminiscence from pictures is largely an in-family activity.

**The tablet app was better at producing more detailed reminiscences from participants, as demonstrated by percentage of overall pictures selected and number of stories and/or photo contexts compared to photo facts in both mediums**. It encourages users to give more details about more pictures by supporting unstructured movement around the table top to prompt different memories, and produces more stories because the freedom of movement between the pictures and their unstructured presentation produce spontaneous memories without requiring a story to follow a sequence. **Despite these benefits of the pseudo-randomized layout, however, participants expressed discomfort and frustration with the lack of starting point and sequence**. This frustration stems from a cultural norm that stories and reminiscence have beginnings and endings and that memories are organized chronologically. Despite these expectations, prompted memories cannot be guaranteed or even expected to come in a chronological order. This poses a large problem for design: to create prompting and supporting storytelling environments, while challenging the common standard of chronologically sorting pictures, without deterring the user.

## 5 Conclusion and Future Work

### 5.1 Conclusion

The Frame of Mind app proposes a new way to interact with digital pictures that supports storytelling and reminiscence and begins to explore how digital technologies can capture memories and present them in a sharable format. Existing digital storytelling research explore the potential for digital storytelling to support communication and memory strengthening in older adults, but has not yet investigated how digital picture interaction compares to existing analog options. Previous work in digital storytelling with families has also demonstrated that seniors are looking for new options for picture organization and memory documentation, but want flexibility and ownership in these activities. This research worked with senior users in order to understand how they interact with and share memories from their pictures now as well as what they would want out of a digital tool for picture interaction.

The results of this first study showed that older adults are held back from moving their picture interactions into a digital space because there is not a digital equivalent of their current use of physical artefacts. Users demonstrated their desire for larger context by flipping between pages, and generally showed that more detailed memories are produced from spreads of pictures than chronological sequences. These results created a design that centred around free-flowing interactions with the pictures using a table top metaphor, so that the users would not be limited by an arbitrary structure. The table top space was made to be infinitely scrollable, again to support free movement between pictures and avoid imposing a structure onto them. It also included audio recording so that the stories told orally could be saved and to spare the user the work of typing or writing captions. Finally, the combination of the pictures and audio were saved as a sharable output in the form of a simple slideshow that could be replayed anytime.

Based on the resulting design, the second study was designed to complete an initial usability assessment of the proposed interface and see if such a tool had the potential to increase reminiscence in older adults. The structure of the study compared their experience using the app to their preferred picture viewing method using a counter-balanced approach. The interaction with digital pictures and the saved story output were reviewed positively and participants proposed several additional features they would like to see added to it, especially in the space of editing completed reminiscences. The endless table top display of pictures produced memories that were generally more detailed than those prompted by the current methods and led participants to include more of the available pictures in the reminiscence. Although the choice to present the pictures without an intentional order was deliberate so as to prompt free-flowing stories, users expressed frustration at the random nature of the pictures and the lack of apparent starting point. This juxtaposition between producing more detailed memories, likely because of the unstructured nature of the pictures, and rejecting the need for a sequence will require further research to understand how this interaction can find a balance between users' cultural expectations and prompting detailed memories.

There is still much work to be done in this area and many improvements to the app presented here. The ability to edit completed stories and to navigate between a larger set of pictures, for example, are necessary before the app can be useable outside as specific a setting as the one this study created. These preliminary studies, however, demonstrate that there is currently a lack of support for digital picture interaction and proposes a solution to this problem that is well-received by users and supported by the demonstrated storytelling that it prompted.

## ***5.2 Future Work with Frame of Mind***



Though the initial results with Frame of Mind were positive, it is still in a very early phase and there are many necessary features that need to be added and investigated in order to support storytelling and digital interactions with entire collections of pictures. Mainly, more needs to be understood of the conflict between users' desire for sequence and a clear start and finish in their interactions and the evidence that reminiscence is better prompted by unordered pictures. Second, at this time Frame of Mind table top view is intended to be used with a selection of approximately 20 to 100 pictures, or around one album's worth. Below that there is not much to view, so it is likely that memories shared will be brief, and above that, many pictures could easily be missed or skipped. In order to fully support digital picture interaction, it will be necessary to include navigation between all pictures and selection of a desired subset, as several of the participants stated. So, since most family picture collections regularly contain thousands of pictures and can span many albums, there must be a higher level of interaction with the larger space of photos that allows for navigation among and selection of subsets or metaphorical albums of pictures before the table top view. Participatory design will be beneficial in understanding and creating solutions for both the areas of picture sequence and selection of picture subset. Seniors will understand best how they would like to move through and select pictures based on their experiences using both physical and digital options.

By recording the speech prompted by and associated with their pictures, a robust understanding of the larger context of each picture and the larger subset is gained. At this point, the speech data collected has not been leveraged for any further purpose than documentation. Recognizing this speech, however, will allow for more complex relationships to be built between pictures and create an automatic, multi-dimensional organization of the pictures. This can go beyond keyword extraction and tagging to use the whole body of speech, not just spoken exactly

for a picture, but the surrounding context as well, and leverage existing natural language concepts including topic modeling. Once the picture organization is supported by speech, the app will be able to go beyond the initial organization that is expected to be brought over from albums to support, for example, intelligently presenting subsets of pictures based on determined commonalities and using natural speech to filter and find pictures (e.g. "Show me pictures of Toronto.").

Once the app has the ability to support larger collections of photos and navigation between them, it will need to be more thoroughly assessed. The initial evaluation was a one-time interaction between a participant and a researcher. This introduces several artificial aspects to the interaction including being directly prompted to tell a story using the app and sharing that story with a stranger. In order to get a larger picture of how the app would work in a home setting, the next step will be to run a longitudinal study. The app will be deployed in participants' homes for at least one month after being set up by researchers (including digitizing pictures as needed and creating an initial basic organization or structure). This gives users a chance to use the app naturally, with whomever they want to share their stories with, and the results from such a study would show how effective this sort of interaction is to encouraging and supporting reminiscence.

It has been well-established that storytelling should be comfortable and natural, but there should also be support for an editing process of some sort. The many options for editing were suggested by the participants without any prompting from the researchers support the need for this. Some of these would be simple operations such as manually correcting transcription errors, but there are more complex opportunities for editing as well, such as changing the orders in which the photos appear. This would require rearranging the speech as well without losing the context, quality, or meaning of the whole story. Another option would be to support inserting pictures to

a completed story to provide further context. This especially applies to when a story contains a digression from the displayed picture, and one area to explore would be suggesting pictures that could accompany a digression, pulled either from their personal collection or from free images on the Internet.

Along with editing the saved stories, the app will need to support sharing final products. This can take many forms including simple sharing in person or online using email or Facebook, telling and sharing a story remotely and live (similar to a video call with a shared presentation), using the transcribed speech to create rich multimedia newsletters that can be shared digitally, and even supporting a printable output similar to the printed photo books available now from businesses like Cosco and Shutterfly. The printed output is important as it creates a permanent record that can be physically passed around and shared in any setting.

### ***5.3 Other Applications for Frame of Mind***

Expanding the space currently researched with Frame of Mind opens up new opportunities for research as well. First, and most similar to the current frame of the research, would be to investigate supporting conversational reminiscence and storytelling. This interface currently supports a single narrator to an audience of one or a few present people, but storytelling in a family setting is often a conversation involving multiple narrators building the story collaboratively (Ochs & Capps, p. 8). Supporting multiple narrators would require a larger space for interaction; this could be simply a larger tablet screen, a TV screen that is synchronized to a tablet, multiple synchronized tablets together, or a combination of these options. The understanding of the speech would also need to be more intelligent in order to support, for example, people talking over each other, sharing different overlapping memories, and even presenting conflicting memories, such as disagreeing about the location of a particular photo. Conversational digital storytelling could

further decrease the social isolation of older adults since it can create a larger social interaction and a larger group will be responsible for the motivation to share stories, thereby removing some of the pressure to contribute and to find motivation from being solely on an individual older adult. Another limitation of the current solution, and most family digital storytelling solutions, is that it only supports using pictures or other 2D objects. A novel project would investigate how interaction with 3D objects could be supported in Frame of Mind or a similar app using perhaps augmented reality or 3D object scanning.

Since the future directions of this project go further into the areas of natural language processing, there are opportunities to explore using the speech prompted by the app. Storytelling and reminiscence produce a lot of natural speech which makes it an ideal method to build language corpora. Frame of Mind, in particular, uses very little language, so has almost no dependency on the user's literacy, and could be adapted to be completely language independent. This would create a tool that could build corpora for rare or endangered languages by prompting speakers of these languages to produce and record longer segments of natural speech as triggered by their pictures.

Frame of Mind is still in early stages of development and design, so it is still flexible in where it will go and what it can become. These different ideas stay close to the current research's motivation of family storytelling and digital picture interaction and could push the boundaries of what digital storytelling has been able to achieve thus far.

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## 7 Appendices

### 7.1 Appendix A1a: Contextual Inquiry Study Protocol (Primary Researcher)

- Greet participant, introduce yourself
- Describe TAGlab and your research
- Ask participant how they heard of the study and why they chose to participate
- Make conversation, allow participant to get comfortable
- Review consent form with participant (read aloud)
  - Confirm consent to audio and video recordings
  - Remind that these recordings can be turned off at any time
  - Remind participant that they should only share what they are comfortable sharing
  - Review options for interruption/withdrawal
  - Remind that this study can be done in multiple parts if desired
  - Remind that there is no way to withdraw after the study is over
- Review format for storytelling and interview
- Ask if participant is comfortable and ready to begin
- Storytelling:
  - Remind participant that they can withdraw at any time
  - Remind participant that recording can be paused any time
  - Ask R2 to start video recording, begin audio recording
  - Ask participant to share a story (following Storytelling prompts)
  - Ask R2 to stop video recording, stop audio recording
- Break:** Ask if participant would like to take a break
- Interview:
  - Remind participant that they can withdraw at any time
  - Remind that this study can be done in multiple parts if desired (stop now, give compensation, and reschedule)
  - Remind participant that they should only share what they are comfortable sharing
  - Remind participant that recording can be paused any time
  - Begin audio recording
  - Interview (following Post-storytelling interview guide)
- Debrief:
  - Ask if participant has anything more they want to contribute
  - Ask if participant has any questions about the study
  - Stop audio recording
  - Remind that they cannot withdraw after leaving
  - Provide participant contact information for follow ups
- Thank participant for their time
- Give participant compensation
- Ask participant to sign receipt of payment
- Ask participant if they know anyone who might be interested in participating (leave flyer)
- Gather documents: consent form, receipt and notes
- Post Study:
  - Transfer audio and video files to encrypted computer
  - Delete files from audio recorder and camcorder and charge devices
  - Place consent form and receipt in one locked cabinet, and notes in the other

## 7.2 *Appendix A1b: Contextual Inquiry Study Protocol (Secondary Researcher)*

- Greet participant
- Introduce yourself
- Set up voice recorder and camcorder
- Make conversation, allow participant to get comfortable
- Prepare 2 sets of notes with:
  - Participant ID, Age, approx. English ability, storytelling setup, etc.
- Storytelling:
  - When asked, start audio and video recording
  - As needed, adjust camcorder to keep documenting
  - When asked, stop video recording
- Break:** Pack up camcorder
- Interview:
  - When asked, start audio recording
- Debrief:
  - Stop recording
- Thank participant for their time
- Pack voice recorder
- Gather documents: consent form, receipt and (separately) notes
- Post Study:
  - Transfer audio and video files to encrypted computer
  - Delete files from audio recorder and camcorder
  - Place consent form and receipt in one locked cabinet, and notes in the other
  - Charge voice recorder and camcorder



### 7.3 Appendix A2: Contextual Inquiry Study Semi-Structured Interview Guide

#### Storytelling prompts

1. Can you tell me a story from your photographs that you have here?
2. (If prompt needed)
  - a. Could you find a single photograph that you like and start by describing that picture to me?
  - b. Is there one photograph that stands out to you in your memory?
3. (To continue/refocus story)
  - a. What happened next?
  - b. What about this next photo?
4. (To wrap up story)
  - a. What did you take away from that?
  - b. Why is that story important to you?

#### Post-storytelling interview guide

##### Photograph Storage and Organization

1. How do you store your photographs?
  - a. E.g. albums, boxes, in frames or on walls
  - b. (If mixed) How do you decide which way to store which photographs?
2. How do you organize or order your photographs within that storage?
  - a. Are they ordered based on time, events, people, locations, for example or none of these?
  - b. Why do you organize by \_\_\_\_? Did your parents do the same?
3. Do you ever go through your photograph storage to re-organize or remove photos? Why? What motivates that?
4. If you came into more photographs (say, from a relative) how would you add them to your storage?

##### Family Story Documentation

5. What ways do you currently document your family history and stories?
  - a. e.g. photo albums or scrapbooks, writing photo captions, writing family stories or memoirs
6. How did your parents document family history and stories? How did that impact how you document stories?
7. What do you feel is the most important reason to keep and organize family photographs?
8. What kinds of family stories are most important to document to you?

##### General Storytelling

9. How often do you tell stories around family photographs? To whom do you tell these stories? When do you tell these stories?
  10. Can you tell me about what sorts of stories you tell?
  11. Are there stories that you tell over and over? How do you refer to these stories? Do they have names?
  12. Are there certain types of stories you only would tell in certain settings or to certain people?
-

13. Is there anything about photo storage and organization that you wish were easier or you wish you could change?

#### Technology and Digital Photographs

14. Do you share or receive any photographs through email or digitally (for example, from your children)?
15. Do you store any of your photographs digitally (e.g. on a computer or tablet)?
  - a. How do you interact with those photographs?
16. Do you use a smartphone or tablet? How often have you used those devices in the past week?
17. Do you have any thoughts on how technology could improve your storytelling experiences?

#### 7.4 Appendix A3: Contextual Inquiry Study Consent Form

**Researchers:** Benett Axtell<sup>1</sup>, Cosmin Munteanu<sup>1,2</sup>

**Affiliation:** 1. TAGlab, Department of Computer Science, University of Toronto

2. Institute of Communication, Culture, Information and Technology,  
University of Toronto Mississauga, Mississauga, Canada

Date: \_\_\_\_\_

Researcher's Initials: \_\_\_\_\_

##### Information & Consent Form

Study Name: Exploration of design requirements for a potential digital storytelling technology to help seniors tell stories around their family photographs

You've been invited to participate in a study that aims to understand how to design senior-friendly digital storytelling technologies that aid in storytelling from family photographs. Based on previous research into digital storytelling with older adults, we are investigating a new independent and free-flowing tablet app to aide the storytelling process. We would like to gather information and feedback on this potential tablet app that makes it easier to share and document family stories. You can help us by showing how you organize your pictures and how you tell stories about these pictures.

The study involves the following:

- A 30-45 minute time to show how you sort, organize, or select your photos and tell one or more stories about them. Audio and video will be recorded including video of family photographs and interactions with them.
- A 15 minute break
- A 30-45 minute interview to discuss your current storytelling practices and your desired storytelling experience and outcomes. Audio will be recorded.
- A 15 minute debrief to answer any questions you might have about the study.

I am aware of the following:

- I am participating in this on my own free will – nobody, including the researcher, has pressured me into participating.
- I am free to skip any activities that I am not comfortable with, and I do not have to provide an explanation for this.
- This study is designed and intended to only research stories that bring up pleasant memories, and I will not be asked to share any unpleasant or uncomfortable memories. If I feel uncomfortable or in distress, I can tell the researcher immediately so that I may stop the activity. The researcher may also pause the interview if I appear distressed in order to ensure my well-being.
- I am free to stop the study at any time without any negative consequence should I feel uncomfortable answering any question or completing any task. In this case, or if the researcher pauses the interview, I have the options to continue, to resume at a later time or date, or to withdraw. If I choose to withdraw or to resume at a later time or date, I will receive the full compensation at the moment of interruption.

- I (and my photographs and photo storage) will be audio and video recorded as indicated above, but the recording may be paused if at any time I am uncomfortable or want a short break from being recorded. For example, to avoid recording any specific photo or photos.
- All data collected about me (including audio and video recordings) will be kept secure and completely anonymous by replacing my name with a random identifier (e.g. Participant 1) and through video editing to remove any identifying features. Only the researcher involved in this study will have access to the information I provide, and all data collected will be destroyed 5 years after completion of the study.
- Because the data will be completely anonymized, I will not be able to withdraw once I leave the study as my data will not be tied to me in any way.
- Data collected may be used in research journals, conferences, or other scholarly activities, and in these cases my identity will be kept completely anonymous.
- The research study I am participating in may be reviewed for quality assurance to make sure that the required laws and guidelines are followed. If chosen, (a) representative(s) of the Human Research Ethics Program (HREP) may access study-related data and/or consent materials as part of the review. All information accessed by the HREP will be upheld to the same level of confidentiality that has been stated by the research team.
- I am at least 60 years of age.
- I am free to ask questions about the process and study at any time. I can ask questions in person, by contacting Benett Axtell directly by email (benett@taglab.ca) or phone (647-225-4776), or by contacting TAGlab by email (inquiries@taglab.ca) or phone (416-946-8763).
- If I have questions about my right as a research participant, I can contact the University of Toronto Ethics Review Office at 416-946-3272 or ethics.review@utoronto.ca.
- I will receive a copy of this form for my records.

The points above have been clearly explained to me and I wish to proceed with participating in the study  Yes  No

Participant's Printed Name \_\_\_\_\_

Participant's Signature \_\_\_\_\_

### 7.5 Appendix B1a: User Experience Study Protocol (Primary Researcher)

- Greet participant, introduce yourself
- Describe TAGlab and your research
- Ask participant how they heard of the study and why they chose to participate
- Make conversation, allow participant to get comfortable
- Review consent form with participant (read aloud)
  - Confirm consent to audio and video recordings
  - Remind that these recordings can be turned off at any time
  - Remind participant that they should only share what they are comfortable sharing
  - Review options for interruption/withdrawal
  - Remind that this study can be done in multiple parts if desired
  - Remind that there is no way to withdraw after the study is over
- Review format for storytelling and interview
- Choose artefacts to work with, help start digitizing
- Give demographics questionnaire
- Storytelling A:** ( 1 or 2 )
  - Remind participant that they can withdraw at any time
  - Remind participant that they should only share what they are comfortable sharing
  - Remind participant that recording can be paused any time
  - Ask R2 to start video recording
  - Ask participant to share a story
  - Ask R2 to stop video recording
- Break:** Ask if participant would like to take a break
- Storytelling B:** ( 1 or 2 )
  - Remind participant that they can withdraw at any time
  - Remind participant that they should only share what they are comfortable sharing
  - Remind participant that recording can be paused any time
  - Prototype training
  - Confirm they are ready to try using the prototype
  - Ask R2 to start video recording
  - Ask participant to share a story
  - Ask R2 to stop video recording
- Interview:**
  - Remind participant that recording can be paused any time
  - Begin audio recording
  - Interview (following Post-storytelling interview guide)
  - Show output
  - Post output question
- Debrief:**
  - Ask if participant has anything more they want to contribute or any other thoughts about the app
  - Ask if participant has any questions about the study
  - Stop audio recording
  - Remind that they cannot withdraw after leaving
  - Provide participant contact information for follow ups
- Thank participant for their time

- Give participant compensation
- Ask participant to sign receipt of payment
- Ask participant if they know anyone who might be interested in participating (leave flyer)
- Gather documents: consent form, receipt and notes
- Post Study:**
  - Transfer audio and video files to encrypted computer
  - Delete files from audio recorder and camcorder
  - Place consent form and receipt in one locked cabinet, and notes in the other
  - Charge voice recorder and camcorder

### 7.6 *Appendix B1b: User Experience Study Protocol (Secondary Researcher)*

- Greet participant
- Introduce yourself
- Set up tripod and camcorder
- Make conversation, allow participant to get comfortable
- After consent form signed, digitize all selected pictures
- Confirm that digitized pictures are showing up
- Storytelling A:**
  - When asked, start video recording
  - As needed, adjust camcorder to keep documenting
  - When asked, stop video recording
- Break**
- Storytelling B:**
  - Prototype training:
    - Scroll to see all photos, can scroll forever
    - Tap to start (explain recording dot)
    - Tap other pics
    - Play/pause
    - Shuffle
    - Done
  - Hand tablet to participant to try
  - Reset app to storytelling with their pictures
  - Hand tablet to participant
  - When asked, start video recording
  - As needed, adjust camcorder to keep documenting
  - When asked, stop video recording
- Interview:**
  - Be ready to video record again, as needed
- Debrief**
- Thank participant for their time
- Pack voice recorder, camcorder, tripod
- Gather documents: consent form, receipt and notes
- Post Study:**
  - Transfer audio and video files to computer
  - Delete files from audio recorder, camcorder,
  - Charge voice recorder and camcorder

### ***7.7 Appendix B2: User Experience Study Semi-Structured Interview Guide***

#### **Post all Storytelling: Comparing Storytelling**

1. How does Frame of Mind compare to how you usually tell stories, share memories, and view pictures?
2. Do you think you would use something like Frame of Mind frequently? 1 2 3 4 5
3. Did you find Frame of Mind complex or overly complicated? 1 2 3 4 5
4. Did you find Frame of Mind easy to use? 1 2 3 4 5
5. Do you think that you would need assistance to be able to use Frame of Mind? 1 2 3 4 5
6. Did you find that the various tasks in Frame of Mind were well integrated? 1 2 3 4 5
7. Did you find that there was too much inconsistency in Frame of Mind? 1 2 3 4 5
8. Do you think that most people would be able to learn to use Frame of Mind quickly? 1 2 3 4 5
9. Did you find Frame of Mind cumbersome or awkward to use? 1 2 3 4 5
10. Did you feel confident using Frame of Mind? 1 2 3 4 5
11. Do you feel that there were a lot of things you needed to learn before you could get going with Frame of Mind? 1 2 3 4 5
12. What are your general thoughts of this form of storytelling?
13. Who do you most see yourself using Frame of Mind with?

#### **Photograph Storage and Organization**

14. Can you describe a bit why you store your photographs this way?
  - a. (If mixed) How do you decide which way to store which photographs?
15. Why do you organize or order your photographs by \_\_\_ within that storage?

#### **Family Story Documentation**

16. What do you feel is the most important reason to keep and organize family photographs?
17. What kinds of family stories are most important to document to you?
18. What ways do you currently document your family pictures and history or memories?
  - a. For example, photo albums or scrapbooks, writing photo captions, writing family stories or memoirs
19. How did your parents document family pictures and history or memories? How did that impact how you document?
20. Is there anything about photo storage and organization that you wish were easier or you wish you could change?

#### **Post Output:**

21. Would you use this tool to share and save your memories and stories?
22. Who would you share these memories and stories with?
23. How do you think you would share them?
  - a. For example, later in person, facebook, email
24. Is there anything else you would want something like Frame of Mind to be able to do?

## 7.8 Appendix B3: User Experience Technologies Questionnaire

### Family Pictures Study Questionnaire

Age: \_\_\_\_\_ Gender: \_\_\_\_\_ Participant ID: \_\_\_\_\_

Which of the following do you own?

- Tablet (e.g. an iPad)
- Smartphone
- Laptop or computer

If you own a tablet or smartphone, how often do you use them weekly?

- Multiple times a day
- Daily
- Weekly
- Less than weekly

How do you communicate with **nearby** family using these technologies?

- Phone calls
- Texting
- Video calls
- Email
- Facebook or other social media
- Other: \_\_\_\_\_
- None

How do you communicate with **distant** family using these technologies?

- Phone calls
- Texting
- Video calls
- Email
- Facebook or other social media
- Other: \_\_\_\_\_
- None

Do you currently share or receive any pictures digitally? How?

- Email
- Facebook or other social media
- Other: \_\_\_\_\_
- I don't share or receive pictures digitally



Do you store any pictures digitally? How?

- On a computer
- On a tablet or smartphone
- On Facebook
- On a cloud (e.g. Microsoft OneDrive or Apple iCloud)
- Other: \_\_\_\_\_
- Yes, but I don't know how they are stored
- I don't store pictures digitally

**7.9 Appendix B4: User Experience Study Consent Form**

**Researchers:** Benett Axtell<sup>1</sup>, Cosmin Munteanu<sup>1,2</sup>

**Affiliation:** 1. TAGlab, Department of Computer Science, University of Toronto  
 2. Institute of Communication, Culture, Information and Technology,  
 University of Toronto Mississauga, Mississauga, Canada

Date: \_\_\_\_\_

Researcher's Initials: \_\_\_\_\_

Information & Consent Form

Study Name: Exploration of design requirements for a potential digital storytelling technology to help seniors tell stories around their family photographs

You've been invited to participate in a study that aims to understand how to design senior-friendly digital storytelling technologies that aid in storytelling from family photographs. Based on previous research into digital storytelling with older adults, we are investigating a new independent and free-flowing tablet app to aid the storytelling process. We would like to gather information and feedback on this potential tablet app that makes it easier to share and document family stories. You can help us by showing how you organize your pictures and how you tell stories about these pictures.

The study involves the following:

- A 30-45 minute time to show how you sort, organize, or select your photos and tell one or more stories about them. Audio and video will be recorded including video of family photographs and interactions with them.
- A 15 minute break
- A 30-45 minute time to view and share stories from the tablet and an interview comparing the experiences. Audio will be recorded.
- A 15 minute debrief to answer any questions you might have about the study.

I am aware of the following:

- I am participating in this on my own free will – nobody, including the researcher, has pressured me into participating.
- I am free to skip any activities that I am not comfortable with, and I do not have to provide an explanation for this.
- This study is designed and intended to only research stories that bring up pleasant memories, and I will not be asked to share any unpleasant or uncomfortable memories. If I feel uncomfortable or in distress, I can tell the researcher immediately so that I may stop the activity. The researcher may also pause the interview if I appear distressed in order to ensure my well-being.

- I am free to stop the study at any time without any negative consequence should I feel uncomfortable answering any question or completing any task. In this case, or if the researcher pauses the interview, I have the options to continue, to resume at a later time or date, or to withdraw. If I choose to withdraw or to resume at a later time or date, I will receive the full compensation at the moment of interruption.
- I (and my photographs and photo storage) will be audio and video recorded as indicated above, but the recording may be paused if at any time I am uncomfortable or want a short break from being recorded. For example, to avoid recording any specific photo or photos.
- All data collected about me (including audio and video recordings) will be kept secure and completely anonymous by replacing my name with a random identifier (e.g. Participant 1) and through video editing to remove any identifying features. Only the researcher involved in this study will have access to the information I provide, and all data collected will be destroyed 5 years after completion of the study.
- Because the data will be completely anonymized, I will not be able to withdraw once I leave the study as my data will not be tied to me in any way.
- Data collected may be used in research journals, conferences, or other scholarly activities, and in these cases my identity will be kept completely anonymous.
- The research study I am participating in may be reviewed for quality assurance to make sure that the required laws and guidelines are followed. If chosen, (a) representative(s) of the Human Research Ethics Program (HREP) may access study-related data and/or consent materials as part of the review. All information accessed by the HREP will be upheld to the same level of confidentiality that has been stated by the research team.
- I am at least 60 years of age.
- I am free to ask questions about the process and study at any time. I can ask questions in person, by contacting Benett Axtell directly by email (benett@taglab.ca) or phone (647-225-4776), or by contacting TAGlab by email (inquiries@taglab.ca) or phone (416-946-8763).
- If I have questions about my right as a research participant, I can contact the University of Toronto Ethics Review Office at 416-946-3272 or ethics.review@utoronto.ca.
- I will receive a copy of this form for my records.

The points above have been clearly explained to me and I wish to proceed with participating in the study  Yes  No

Participant's Printed Name \_\_\_\_\_

Participant's Signature \_\_\_\_\_