A Saunter Down Memory Lane: Digital Reflection on Personal Mementos

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Abstract

We all collect personal mementos, treasured objects that remind us about our past. We also remember significant people and places from our past. A key way that we reflect on our identity is through collecting, organizing and talking to others about such personal mementos, places and people. However most work on mementos has focused on *physical* objects rather than their *digital* representations. And when digital archives have been examined these have been found to be underexploited. We therefore implemented and evaluated a new class of digital memory application, MemoryLane, that is designed on the basis of prior research into memory and reminiscence. MemoryLane allows people to capture, actively organize and reflect on digital representations of mementos relating to *people, places* and *objects.* Users can also annotate captured mementos with spoken or textual narratives. User feedback provides new information about the nature of digital reminiscing and reflection. Our 31 person evaluation showed that people were active in organizing and reflecting on these personal digital collections. As we expected, most mementos centred around familiar home objects, although mementos relating to people tended to be regarded as most important and to evoke stronger emotions. Participants also recorded many spoken narratives about mementos, but these spoken reflections were unpopular on playback. We discuss the theoretical and design implications of our work.

Keywords: Reflective technology, personal digital mementos, everyday memory, reflection emotional awareness, psychology of memory, sociology.

1. Introduction

Mementos are objects that are deliberately kept to remind us about our past. They can take a physical or a digital form, serving to preserve memories about significant people, places or events in our past (Petrelli, Whittaker, and Brockmeier 2008). Mementos are among the most valued physical objects in the home (Csikszentmihalyi, and Rochberg-Halton 1981). Such physical mementos often have strong associations with past events, people or habits, and they help people reflect through vivid re-experience of their past (Csikszentmihalyi, and Rochberg-Halton 1981; Petrelli, van den Hoven and Whittaker 2009; Petrelli, Whittaker, and Brockmeier 2008; Petrelli and Whittaker, in press, Turkle 2007). However the majority of prior studies of mementos focus on *physical* artifacts, and with a few exceptions (Fivush and Nelson 2004; Stevens, Abowd, Truong, et al 2003), previous work has not examined *digital* tools to support personal reflection.

New technologies (such as digital cameras, laptops and video recorders accompanied by increased storage) have meant that personal digital archives are growing at a huge rate (Beagrie 2005; Marshall 2008a; Marshall, Bly and Brun-Cottan 2006). New tools such as

the Living Memory Box (Stevens, Abowd, Truong, et al 2003), the MemoryBox (Frohlich and Murphy 2000) and FMRadio (Petrelli, Villar, Kalnikaite, et al 2010) have integrated both the physical and digital to support remembering as an immersive, tangible experience. In the same way, (van den Hoven and Eggen, 2008) have augmented mementos with digital information. But in general, studies of purely digital archives show that people's attempts to collect *meaningful* digital memorabilia are often unsuccessful: people tend to produce large, unplanned, and poorly organized accumulations of digital objects that are seldom re-accessed and gradually become forgotten. For example, people are often unable to find older digital photos (Whittaker, Bergman and Clough 2009) and when asked to choose mementos from their homes they focus exclusively on physical rather than digital objects (Petrelli, Whittaker and Brockmeier 2008). Overall, these digital memento collections tend to be viewed as invisible, inaccessible and less expressive than their physical counterparts. (Kirk, Sellen, Izadi, et al 2009; Harman, 2001; Marshall 2007; 2008a; 2008b; Petrelli, Whittaker and Brockmeier 2008; Whittaker, Bergman and Clough 2009).

We address these problems with digital technologies by designing and evaluating a novel digital prototype that supports capture and reflection about digital representations of significant people, places and objects. One aim is to make it straightforward for people to capture, organize and annotate digital representations of important physical mementos. The design embodies critical aspects of physical mementos in digital form. Prior work on physical mementos (Petrelli, Whittaker and Brockmeier 2008, van den Hoven and Eggen, 2008) shows the importance of *everyday objects*, which express symbolic relations to significant persons and events. Other work has shown the benefits of *active organization*. People like to physically organize mementos by arranging them in physical space, e.g. by placing children's artwork in a family room (González, 1995; King 1986) or photos in a physical album (Frohlich, Kuchinsky, Pering, et al 2002). This active organization is a key design feature that we wanted to support for aiding reflection.

Any new digital remembering tool also needs to provide support for *narrative*. Narration supports reflection; stories about our past serve to cement social bonds, define identity and engender emotions (Crabtree, Rodden and Mariani 2004; Frohlich, Kuchinsky, Pering, et al 2002). Narrative can also engender immersive remembering by directly

evoking past events, places and people (Dib, Petrelli and Whittaker 2010; Fivush and Nelson 2004; Frohlich, Kuchinsky, Pering, et al 2002; Glos and Cassell, 1997; Oleksik, Frohlich, Brown, et al 2008; Petrelli, Whittaker and Brockmeier 2008; Petrelli, Villar, Kalnikaite, et al 2010). Other work shows the role of narrative about the past in improving well-being (Bryant, Smart and King 2005) and supporting reflection (Bluck and Levine 1998). However various attempts to support narrative in digital applications have been unsuccessful (Frohlich, Kuchinsky, Pering, et al 2002; Rodden and Wood, 2003; Stevens, Abowd, Truong, et al 2003). A key aim of our study was therefore to explore the role of narrative in augmenting digital memorabilia to support reflection. Our application supports both textual and spoken annotation and we examine potential reasons for the failure of previous narrative tools.

We also wanted to build upon theories of everyday remembering. Various studies have shown the *reconstructive* nature of memory, and the importance of specific *cues* in triggering everyday reflection, where reflective reconstructions are triggered by social, locational and physical information (Cohen 1996; van den Hoven and Eggen, 2008, 2009; Knez 2006; Linton 1982; Wagenaar 1994). Our system therefore allowed people to contextualize mementos in terms of associated people, places and objects, and to manipulate and organize mementos in terms of these important mnemonic cues.

Overall we set out to design a digital system that mimics those aspects of the physical world that have been shown to be important for memory and for reflection on personal experiences. We aimed to support reflective capture, by allowing participants to contextualize, organize and talk about digital representations of significant objects, places and people. To allow participants to organize situated digital representations of important everyday physical objects (Csikszentmihalyi, and Rochberg-Halton 1981; Petrelli et al. 2009; Petrelli et al., 2008), a central aspect of the system was a representation of a *home* (see Fig 1), where users could place digital representations of those objects. In addition, we build upon studies of everyday memory (Linton 1982; Wagenaar 1994) showing the importance of *people* (see Fig 2) and *places* (see Fig 3) as key triggers for re-experiencing our pasts. Therefore home, people and places were the three contexts that we used to organize our system. We also provided support for narrative (Dib, Petrelli and Whittaker 2010; Fivush and Nelson 2004; Frohlich, Kuchinsky, Pering, et al 2002;

Oleksik, Frohlich, Brown, et al 2008; Petrelli, Whittaker and Brockmeier 2008; Petrelli, Villar, Kalnikaite, et al 2010). By allowing participants to actively organize and annotate materials in these three contexts we hoped to overcome the limitations of current digital systems that merely allow users to accumulate passive archives. The work differs from previous studies of narratives surrounding digital photos (Frohlich et al., 2002), where the focus tends to be on the narratives themselves. Instead, our main focus is on how people use our system to select and organize digital representations of significant people, places and things.

We addressed various questions about how people might use such a system to collect and organize digital representations of significant people, places and things, as well as how they use the system to reflect on their past experiences:

- How do people decide on digital mementos? What *types* of reflective objects do they choose to upload and *why*?
- How are digital mementos organized? Do people organize critical *people* in their lives differently from *places* or personally valued *objects*? How are mementos organized to help reminisce about people or places?
- What types of *affect* do digital mementos engender during reflection?
- How do people *describe* and *reflect on* their digital mementos? What are the benefits of narrative for reflection? Do people prefer to tell stories aloud or write textual narrative?

We explored participants' reactions to our system in a short term study, having people collect digital representations of significant people, places and things over 3 days. We then uploaded these representations into our system and had people organize them and reflect on their choices.

2. The MemoryLane Interface

We designed and built a software tool called MemoryLane to support reflection around digital mementos. This tool runs on a tablet or a desktop PC and supports interaction with contextually bound rich multimedia, allowing users to organize and annotate digital mementos. Users capture digital mementos using devices such as digital cameras or sound recorders and then organize these in MemoryLane. We deliberately opted for a simple PC based digital design rather than more complex augmented reality solutions,

because we wanted participants to be able to create materials that they could explore flexibly in their own environment. Many augmented solutions are only practical in restricted settings (van den Hoven and Eggen, 2008). MemoryLane is also different from many commercially available systems for organizing photos (e.g. IPhoto or Picasa) which support time based views. While such photo software systems promise to provide face recognition to allow people based sorting, such technology will currently only identify small numbers of frequently encountered people. In contrast MemoryLane offers participants pre-existing contexts in which to organize their digital mementos.

There are *three* contextual views in MemoryLane. Each can be populated with digital representations of personal mementos: a) *home* (Fig 1) – where artifacts can be arranged around a representation of the home area and garden; b) *places* (Fig 2) - a hierarchical map that allowed people to choose locations; and c) *people* (Fig 3) – a photo frame that can include images of significant people. Although the home is technically also a place, we deliberately created a privileged home view, because prior work has shown the centrality of the home for memento collection (Csikszentmihalyi, and Rochberg-Halton 1981; Petrelli, van den Hoven and Whittaker 2009; Petrelli, Whittaker, and Brockmeier 2008). All mementos were represented as pictures with optional additional multimedia metadata, including audio, and text, allowing people to add narratives or other information. MemoryLane also supported user ratings for the emotion and importance of every memento.

Each contextual view in the interface supported physical manipulation and organization. Mementos are represented as thumbnails that can be dragged and dropped around the interface as the user chooses. For example, in Fig 1 the image of the old heat engine is in the living room, but the user could have put it anywhere in the house (or even outside). Next we describe each view in detail.

2.2 The Home View

Given previous demonstrations of the importance of organizing physical mementos around the home, a key view in MemoryLane is a conceptualized representation of a home. Figure 1 illustrates the *home* view populated with mementos in different rooms. Thumbnails of mementos are placed on a conceptual sketch of a house to indicate

whereabouts in the house each memento resides. When a memento thumbnail is selected, this opens a separate pane on the left showing metadata information (see Fig1): a) an enlarged picture of the memento; b) recorded speech narrative with rewind, pause and play buttons placed over the picture (if the user has provided this narrative); c) importance ratings in the form of yellow stars (5 stars indicating high importance); d) emotion rating in the emoticons and associated textual descriptor; and e) textual narrative. We describe below how this metadata can be added.

Figure 1: MemoryLane Interface showing the Home View.

2.2 Locational View

Research also suggests locations are well remembered. They are also evocative cues for reflection (Wagenaar, 1994). To explore this, we built a zoomable map into MemoryLane and allowed people to upload images of their favorite outdoor locations. Figure 2 illustrates the *locations* view. It depicts geographic places that are significant to participants. The map provides zoom in and out functions, and locations are hierarchically organized, so that images can be viewed locally or in a national/global context. The outside locations view has the same functionality as the *home* view. Objects can be organized within it, and various metadata can be added and viewed when the object is selected.

Figure 2: MemoryLane Interface showing the Locational View.

2.3 People View

We are much better at remembering people than other things (Cohen 1996). To remind ourselves about others, we often keep their pictures in frames around our homes. Consistent with this, we designed the *people* view around a photo frame (Fig 3). Other software functionality was the same as the *home* and *locations* views; thumbnails of people could be actively organized, and metadata added or viewed about each person. As

we shall see, this area was used creatively to show different types of social relations, social clashes and other relationship dynamics.

Figure 3: MemoryLane Interface showing People View.

3. Methodology

Our study contained *two* phases: a) *capture* – taking pictures and recording audio narratives using a digital camera with an embedded Dictaphone or participants' own mobile phones*;* and b) *reflection and reconstruction* – augmenting, annotating, organize and otherwise interacting with mementos using our software tool MemoryLane, running to a tablet or a desktop machine**.** We now describe each phase in more detail.

3.1 Capture

During the *capture* phase, we recruited 31 participants through e-mail distribution lists and by acquaintance (16 female and 15 male, aged 25-55). Participants were volunteers consisting of university researchers, administrative and management staff, charity workers, sales people, civil servants, business people and an accountant. They were all familiar with computers and with digital photography, either owning a digital camera or using their phone for this purpose. They had no prior knowledge of the project, or our study, or prior experience of using MemoryLane. At the end of the study, participants were given a copy of their MemoryLanes that included both the basic software as well as the digital mementos they had captured and organized. This was distributed on self contained memory sticks so that participants could keep and continue using it on their home machines.

Participants were first invited for a 15 min. briefing where we gave them a Sony visual IC recorder/camera to support multimedia capture. This is a device that takes photos and records audio at the same time (Fig 4). Participants were given a short hands-on tutorial on how to use this device. Once they felt confident about using the device they were invited to participate in the *capture* stage that lasted for 3 consecutive days. Here we asked them to take pictures and record audio narrative about significant people, places

and objects in their lives. Participants were requested to capture at least 15 digital representations: 5 objects in their home, 5 of places and 5 of people.

At the end of the 3 day capture period, we interviewed each participant and transferred the data they had collected over these 3 days onto their own version of MemoryLane. Interviews lasted 1–1.5 hours. Our interview questions were aimed at understanding capture practices and experiences, for example: "How easy did you find capturing mementos in the context of home, places and people?" and "Do you have any preference as to what type of mementos you would most like to capture?" We also asked participants for their general reactions to the capture process. After this we asked participants to reflect on experiences relating to their mementos in MemoryLane by organizing them and augmenting them with further information.

Figure 4: Sony visual IC recorder for capturing and combining images with audio.

3.2 Reflection and Reconstruction

All 31 participants *reconstructed* their mementos in their personal MemoryLane. This involved participants reviewing their mementos, reflecting on related experiences, organizing them and augmenting them with additional information. It is important to note that although mementos were digitized in the previous 3 days, they might have owned the relevant physical object for many years, or had a relationship with the person or place for a very long time. For each memento, we asked participants to add: a) how important that memento was to them; b) how they felt about that memento; and c) narrative about the memories evoked by the memento. Each *reflection* session lasted 1.5 – 2.5 hours and we recorded what participants said and automatically logged all their interactions with MemoryLane. During *reflection* we also recorded which mementos were augmented with judgments of importance, emotion and what narratives were added.

3.2.1 Importance

Importance was rated using 5-point scales. We used a conventional star rating, similar to that of online video ratings, with 1 star being "not important" and 5 being "extremely important". All stars had textual descriptors for clarity.

3.2.2 Emotions

Emotions are hard to capture, represent and interpret (Boehner, DePaula, Dourish, et al 2007; Ståhl, Sundström and Höök 2005). In our system, we employed conventional representations: emoticons - that are widely used in popular IM tools such as Skype or Google chat. There is no agreed set of basic emotions, so we started with Ekman's *six* basic facial expressions (Ekman 1999): *anger*, *disgust*, *fear*, *happiness*, *sadness* and *surprise*. But initial pilots suggested a more diverse set of emotional states was needed, so after more piloting we added affect types and reactions suggested by participants: *shame*, *confusion*, *depression*, *love*, *relaxation*, and *sarcasm*. However, since participants only used a subset of these categories, for analysis we grouped these into *positive* and *negative* affect as described in our findings below.

3.2.3 Narrative

We also supported two types of narratives in MemoryLane: *audio* and *text*. Participants were able to record and upload audio about their mementos and add textual descriptions to enrich their memories. When recording narratives, participants were told to provide information relevant to their future selves revisiting MemoryLane at a later time.

3.3 Measures

We transcribed all participants' reflections and systematically analysed the usage logs. Our focus was in classifying what people collected, e.g. *types* of mementos in the context of objects, places and people. We also examined interaction patterns, judged importance, emotional reactions, narration and overall benefits. Our final and distilled set of measures was:

- Types of mementos and where they were uploaded, i.e. whether the memento was added to the home, places or people view;
- How mementos were organized and how important they were;
- What emotions mementos engendered;

- What type of narrative people added to their mementos, as well as how people evaluated those narratives.

4. Findings

4.1 Overall characteristics and interaction with mementos

The study generated great interest from the start. It was easy to recruit volunteers and people seemed to enjoy both capture and reflection. People were very interested in the process of constructing their personal MemoryLane. Overall they collected 356 mementos and after the study they were positive when they found they could keep and continue using their MemoryLanes.

Participants enjoyed using MemoryLane and they said that they could envisage using it for preserving and reflecting on their mementos long-term: "*I would definitely like to use [MemoryLane] for a longer period of time. If we ever sell our house and move, it would be great to add mementos of our life in the current house (well, the good times anyway!). It would be nice to look back on these in time, after we'd moved house."*

People collected a large set of mementos. In total, of the 356 mementos collected, 163 of these were home objects, 112 were of places, and 81 were of people. Mementos were very diverse across participants, but nevertheless, patterns emerged. For some results, coding of observations is automatically derived from logs of participants' use of the system, e.g. how they distributed objects in different rooms of MemoryLane, and whether they were more likely to distribute into public or private areas of the home. To obtain a more fine grained view of participants' reflections, we analyzed the capture and reflection interviews using grounded theory (Strauss, 1987). Key themes were identified from the entire set of transcripts by one researcher. A second researcher analyzed a subset of the transcripts, disagreements were resolved and where relevant the original analyses modified.

Some people's home mementos focused on the habitual and current, while others delved more deeply into their longer-term pasts and captured more symbolic objects that represented older memories. Mementos of locations were divided into places people frequently visited and other, seldom-visited, but special places. Finally, mementos of

people were chosen based on various relationships: nuclear family, friends, pets, celebrities and other. Next we describe in more detail what people captured in each of these areas.

4.2 What did people upload into MemoryLane and how did they organize it?

Home: People often took pictures of significant objects in their *physical* homes to add to MemoryLane. Content analysis of the interviews revealed two types of home mementos. The first were *symbolic mementos* – representing more mature memories of long past events – where the meaning was private to the individual. For example a photo of a Carrom board placed in the living room of MemoryLane evoked good times in the Maldives. It also reminded the owner of his wife who was visiting her parents in the Maldives at the time of the study, (see Fig 5 (a)). Contrasting with these *symbols* were mementos of *rituals*, where meanings tended to be more obvious, and about the everyday or habitual. Sometimes these were quite mundane e.g. a baking tin indicating a favorite hobby of cooking, Fig 5 (b).

Figure 5:(a) A Carrom board as a s*ymbolic* memento; (b) Baking tin as a *ritual* memento.

We were also interested in how these mementos were organized in the home view of MemoryLane. Did they place different types of objects in public and private places? Consistent with previous research on physical mementos (Petrelli, Whittaker and Brockmeier 2008), we found that people tended to distribute more mementos in the public display spaces of their MemoryLane home view. In particular, their MemoryLane living room accounted for 32% of all home mementos (see Table 1).

However, in contrast to prior work (Petrelli et al., 2008, Petrelli and Whittaker, in press), we were surprised to find that there were also a lot of mementos placed in private spaces e.g. bedrooms (29%) in MemoryLane. When we probed more deeply, it seemed that most mementos in the private space were highly personal objects that reminded people about critical events and significant people, e.g. a small unopened bottle of perfume received as a present from parents on graduation day or a valentines' day card from a significant other.

Prior work looking at families also shows the prevalence of physical mementos in communal areas associated with eating (Petrelli et al., 2008), so we were surprised to find only 14% of mementos in MemoryLane were in the kitchen area. This could be because our participants were mainly couples or single with no families, so they had less reason to construct 'family areas' in their homes. They may also have spent less time in the kitchen than a family would do. As anticipated, gardens (12%), attics (5%), halls (4%) and bathrooms (4%) were less popular locations for mementos in MemoryLane. The MemoryLane attic was generally where things were placed to be forgotten. It tended to contain more distant memories rarely accessed or reminisced about. Here we saw examples of an old childhood rocking horse, or a box of letters received from friends and family while living abroad. Halls and bathrooms in MemoryLane had a few mementos, but this is to be expected, as these are transitional places where people do not spend a lot of time.

Table 1: Locations of home mementos uploaded into MemoryLane.

We also observed that older mementos e.g. old family photographs, unlike other mementos were seldom rearranged in MemoryLane.

Places: Again there seemed to be two different types of significant places based on our analyses of participants' comments during capture and reflection. The first was *special places* – seldom visited and often holding sentimental or nostalgic value, e.g. the stadium of a favourite football team (Fig 6 (a)). The second type was *routine places* – mundane everyday places, visited habitually, e.g. one participant had a routine of going to Kebab shop every Thursday after work, (Fig 6 (b)).

Only 23% of place-related mementos were of *routine* locations people visit often, such as the park or work. The remaining 77% were of *special* places people visited either once or very seldom, e.g. memorable holiday destinations.

Most (67%) *special* places were from the residing country, with 53% of these mementos being from outside the residing town. The remainder of special places were abroad (33%). People seemed to be fond of capturing places just outside their town for

reminiscence. One person chose a favourite pub visited for occasional Sunday lunches with someone special; another chose a nostalgic panoramic spot in the hills – a favourite place visited with their late best friend.

Places from abroad were mainly reminders of holidays and long trips e.g. a trip to Machu Picchu as part of traveling across South America or teaching for a year in Tanzania. These are significant life events associated with locations that people wanted to preserve and narrate for future remembering.

Figure 6: (a) Football stadium symbolizing a *special* place; (b) A favourite restaurant indicating a *routine* place.

People: This area of MemoryLane was the most diverse. It also held the strongest emotional associations. Furthermore, intricacies in relationships were sometimes hard for our users to capture and show. Participants tended to have complicated relationships with others and they showed this in MemoryLane by clustering people into groups based on the dynamics of these relationships.

From participant reflections, we identified 4 types of social relations: (i) significant other; (ii) immediate family and pets; (iii) friends; and (iv) celebrities. Figure 7 shows examples of 2 types of people mementos: (a) family & pets – cats were most featured pets being often acquired as a present from other family members; and (b) celebrities – well-recognized characters from popular soaps or sports.

In this context, somewhat surprisingly, only 10% of uploads were of significant others, the most common people category being friends (50%). Next were immediate family and pets, parents and siblings (30%) and 10% were celebrities. This is consistent with (Petrelli, et al., 2009) who also found that people tend to choose physical mementos of friends more than family. One reason for this might be that participants are strategic about whom they include - adding images of those important people they do not have a daily reminder of.

To add to the complexity of the *people* area, we observed that participants clustered their mementos into different spatial locations according to their relationship. Friends were put in a different place from family, partners, and celebrities. There was a tendency to group

friends in one corner and family in the other (see Fig 3). This is similar to observations of social networking tools showing the exploitation of physical arrangements to indicate social relations (Whittaker, Jones, Nardi, et al 2004).

There were also other fascinating social dynamics, such as changes in social representation following disagreements. In those situations participants might move currently unpopular people outside the 'friends' location to indicate a different, distanced relationship with that person (see Fig 3).

We observed very interesting interactions and connections between *people* and the other two contexts. People inevitably were important in reflective memory associations and participants' explanations indicated significant personal relationships were often the main reason why some *home* or *location* mementos were selected for capture. For instance, one participant captured an image of her old piano that was originally purchased by her grandfather and passed on in the family. She expressed pride in her inheritance because it was the only remaining physical link to that aspect of her past, and the piano image in MemoryLane served to directly remind her of him.

Another participant originally placed the only picture she had of her extended family together in the *people* view of MemoryLane, but later decided to move it to the *home* view because that was the place where the framed picture was located in her real house. Again this indicates the complex interrelations between objects, locations and people.

Figure 7: (a) Pets; (b) Celebrities e.g. memorable celebrities reminding about family members.

4.3 What influenced memento choice and quantity?

People accumulate mementos of value to them, whether these represent important events in their life, significant persons or special places. As expected, most uploaded mementos were judged to be important. 76% of all mementos uploaded into MemoryLane were rated important, very important or extremely important. However there were differences in importance between types of memento. Figure 8 suggests that mementos in the *people* area are considered as more important than other classes.

To investigate this, we conducted three paired t-tests between the importance ratings (1-5) for all context areas: home, place and people. *People* (M=4.1, SD=0.8) were judged more important than *places* (M=3.4, SD=0.9), $t(30) = 3.3$, $p<0.003$ and than *home* (M=3.2, SD=0.7), $t(30)=5.2$, $p<0.0001$. However, there were no differences in importance ratings between *places* and *home,* $t(30)=1.1$, $p>0.05$.

Participant comments elaborated these points. For many, importance seemed the dominant factor for choosing mementos: *"I chose my mementos based on their importance to me and what memory they bring to me when seeing them."* For others, although importance was a factor, they were also influenced by convenience of capture. Here someone describes choosing their home related mementos: *"They were things that were fairly easily accessible (so I did not have to hunt around to dig things out)…They were also things that had some meaning to me, not just random items with no attachment".* This convenience may explain the prevalence of home-based mementos in our study, as these were easily accessible. Other people chose mementos to capture important *changes* in their life at the time of the study: *"I chose a few pictures that capture the essence of a new experience moving to a new place."*

Figure 8: Memento importance in different contexts.

We then looked at *how many* mementos were uploaded into the different context areas of MemoryLane. Figure 9 shows the quantity of mementos in the different views. It indicates that most mementos were in *home* (46%), with fewer mementos of *places* (31%) and *people* (23%). However, care should be taken in interpreting these locations too literally: as shown in other studies (Csikszentmihalyi and Rochberg-Halton 1981; Harper, Randall, Smyth, et al 2008) the meaning of the memento is often indirect. Participants revealed that a significant number (34%) of home mementos were for the purpose of reminding about *people,* with 9% expressing memories of *places*. The remaining 57% of home mementos were of significant events and items representing everyday routines. The context of the memento in MemoryLane does not therefore totally determine what it actually evokes.

Figure 9: Memento distribution across different contexts.

In the context of the home, we also noticed that more *ritual* (59%) objects were captured than *symbolic* ones (41%). This is consistent with (Petrelli, van den Hoven and Whittaker 2009; Petrelli, Whittaker and Brockmeier 2008). Symbolic mementos seem to express identity *"this is who I am"* e.g. new baby cot while expecting a new baby, or *"this is who I want to be"* e.g. books on a shelf that haven't been read yet, whereas rituals evoke mundane everyday routines constituting *"mementos in the making."* e.g. half finished art work.

4.4 How did people feel about their mementos?

Not all affective categories were used by participants. As a result we analyze them by polarity, comparing positive affect, *love*, *happy* and *relaxed* and with negative affect: *anger, disgust, fear, sadness, shame, confused, depression, sarcasm*. *Surprised* was never used.

Following previous research (Chalfen 1987; King 1986), we expected that people would upload mementos that had positive rather than negative affect. This was largely what we found. Table 2 shows that positive mementos dominated in all areas, although there was a suggestion that negative affect was slightly more common for places.

Participants found it interesting to think about the affect evoked by their mementos, but as expected, most people chose happy mementos: *"I decided on which mementos to upload based on events that I wanted to remember in the future. These were all positive, happy events, which it would be nice to look back on in the future, especially the narrative that was added to the memento, which described the event and feelings/emotions attached to it. An example was my birthday, when we went to a medieval banquet in a castle and went in fancy dress - this is something we are unlikely to do again, therefore it's good to be able to reflect on the memory by looking at the photos and reading the narrative."*

In addition to these feelings of happiness, in some cases there were stronger feelings, e.g. was a feeling of *love* strongly associated with the *people* area. However, to our surprise we found some negative feelings in the *places* areas. These were associated with discontinued habits or deaths, e.g. last places visited with one's deceased father.

Table 2: Feelings associated with mementos in MemoryLane.

4.5 What Reflective Narratives were associated with Mementos?

Figure 10 shows the narration patterns for all 356 mementos in MemoryLane across the different contexts. Speech was the most popular way of providing narratives for mementos (62%), followed by the combination of speech and text (27%). However 8% of mementos had no narrative at all and only 3% had text-only narrative.

Prior research suggests that people might like to augment their mementos with spoken stories (Frohlich, Kuchinsky, Pering, et al 2002). We found that people did indeed narrate using speech, and some were initially positive about its potential evocativeness for longer term memories: *"It would also be good to add speech to mementos to capture my thoughts, feelings and emotions attached to them. I think this would be useful when looking back at a memento that maybe happened some time ago and had been forgotten. Speech would bring back the memory straight away."*

Figure 10: Narrative distribution across contexts in MemoryLane.

Although participants were asked to narrate for 'future self', these initial observations were somewhat changed when people reflected upon and replayed their speech narrations. Here reactions were surprising: embarrassment and discomfort in hearing their own voice. Other negative reactions centred around novelty; the story behind a significant memento is often so familiar it feels odd to hear it repeated. The main perceived benefit of narrative was for social reasons: to tell the story to others, not ourselves: *"No speech – I don't like listening to my voice. Typed explanations – yes, but mostly done for the benefit of explaining the pictures to other people who might view my MemoryLane."*

Generally textual narrative was brief. Speech narratives in contrast were richer and longer, often including ambient sounds and capturing the speaker's enthusiasm about the story (Dib, Petrelli and Whittaker 2010). An example of speech narration is illustrated in Figure 11 where nostalgia and happiness are directly conveyed: *"OK…ah…this is a T-*

shirt that I got when I was in Moscow…and it is part of my collection of T-shirts in random languages…I am recording this, because I am not sure how long this lovely T-shirt is going to last…it's getting a bit shrunken and faded…so will probably have to donate it pretty soon…it's just a nice memory of the trip that I went on with my mother last year".

Figure 11: Memento augmented with *speech* narrative.

The narrations in *text* (see Fig 12) in contrast lacked the expressiveness conveyed by *speech*: *"This is a chocolate man in a chocolate shop in Devon. I took this picture on holiday...but I went at the end of the holiday so didn't have enough money to get the chocolate man."*

It also seems that people found it harder to explain their mementos in text, and this could be a reason why it was a less frequent form of narration. Another reason could be that instead of using traditional keyboard, people were using a stylus to handwrite their text on a tablet PC. This could have prevented them entering more text, although we expected this to make text entry faster and more informal.

Figure 12: Memento augmented with *text* narrative.

Overall, participants interpreted speech as a more permanent and final type of record than text. *Speech* seemed to be more complete, and was perceived as being harder to erase or change compared with text. People were also strategic in the ways they captured narrative for MemoryLane: they focused on both mementos and narrated details about those mementos they thought they might forget: "*I tried to record things which I wouldn't necessarily remember without MemoryLane in the long term – so generally people who I see every day I didn't add, but little objects which I might not have in the future I did. I also added things which have a bit of a story attached to them and detailed that with them (e.g. the Festival of Britain coin), so if my own memory fails me I will always have the MemoryLane and stories to remind me.*

5. Discussion and Design Implications

Prior research looking at pre-existing digital archives (Petrelli, Whittaker and Brockmeier 2008, Petrelli and Whittaker, in press), documents that digital archives tend to invisible and hard to access. Although our study was short-term, our participants actively wanted to capture, organize, augment and reflect on mementos from their lives in the home, people and places contexts we had designed.

Consistent with our original design goals, most captured mementos featured home objects. This replicates other studies of the physical world showing the importance of the home and its objects as mnemonic triggers (Csikszentmihalyi and Rochberg-Halton 1981; Harper, Randall, Smyth, et al 2008; Petrelli, Whittaker and Brockmeier 2008). In part, however, this finding could be because home objects are to hand and consequently easier to capture. This said, the most important and evocative reflections are of people. Consistent with other work, reflections about objects or locations revealed these were often intended to trigger people. Finally and consistent with prior work (Chalfen 1987; King 1986), people tended to want to capture mementos that engendered positive affect, although we did find negative affect surfaced with locations associated with deceased relatives.

Our findings about narrative were mixed. Augmenting mementos with narrative proved very popular, with speech being the preferred method of annotating mementos. However, when we played these spoken narratives back, people expressed embarrassment and discomfort at hearing their own voices. In addition, people felt that their spoken stories were redundant because they were telling familiar stories about these objects. These findings may explain the lack of success of other digital technologies that add spoken narrative to other devices (Frohlich, Kuchinsky, Pering, et al 2002; Rodden and Wood 2003). More recent work suggests that audio mementos can be made more compelling if they capture ambient sounds or conversations rather than simple narrated monologues (Oleksik et al., 2008; Petrelli et al., 2010).

One limitation of our work is that we elicited memento capture and collected short term reflections. Although future work needs to systematically investigate whether participants would persist with MemoryLane over the long term, there is reason to believe that the system has value. We are currently in the process of analyzing data from a longer term

study of MemoryLane after people have been using it for 3 month. This shows that participants persisted with the system, although memento capture drops off over time. As one participant pointed out, there are a limited number of significant things in her life and it may be that many of these were captured in the initial session. One significant difference between initial and long term usage was the increased prevalence of people as opposed to places and things. People were also subjected to greater re-organization than other categories suggesting their role may be more dynamic. Furthermore, the utility of the system is supported by the fact that one of our participants introduced and used the system within her work organization to allow employees to collect and share information over the longer term.

6. Future Work

There are various future technical directions that our findings suggest. We saw that the meaning and location of mementos was often complex, with objects being used to denote people or social relations, or places associated with those people. We might therefore redesign our system to allow more subtle linking between different types of mementos – for example, allowing people mementos to be explicitly linked to home objects or to locations.

We also need devices that make it easier to capture mementos. Our participants had to walk around with an augmented digital camera in order to capture mementos. In future, however, they might use passive capture technologies such as SenseCam (Hodges, Williams, Berry, et al 2006; Kalnikaite, Sellen, Whittaker, et al 2010) to capture images (and possibly even speech and locations) about their activities. With suitable integration tools, these recordings could then be sifted through and added to their MemoryLane. Of course this approach only captures the current and habitual, but for older mementos MemoryLane might be better integrated with long term digital photo collections. Thus it might be possible to import digital records of friends, family and important events directly into MemoryLane.

Given the importance of people and relationships, another way that MemoryLane might be enhanced would be to provide integration with communication or social networking applications. For example an IM or Skype buddy list might be imported into MemoryLane, and possibly even organized according to participants' previous interaction

history with those people e.g. more frequent contacts might migrate to the centre of the frame. Or social networking tools might be applied to organize the contents of the people frame, with Facebook friends and status feeds being imported into MemoryLane, and again organized based around interactions.

Another major extension for MemoryLane would be sharing and reflecting with others. People working away from home, or families separated by large distances might like to see and share in their relatives' or friends' world. Again integration with social networking sites might allow certain aspects of MemoryLane to be uploaded to one's social network profile. One might imagine that MemoryLane could be used to give relatives a 'guided tour' of the living space, social and locational environment of a distant country. One could also imagine new types of distributed communication applications where friends or relatives might 'visit' one's MemoryLane, like 'dropping by' to one's house for a coffee and a chat. Remote people might also manipulate their own image to signal a desire to interact. Images from the picture frame might move into the living space, sitting on a couch to encourage casual chat or moving into the background if they wanted to 'be around' but not interact. Remote friends might also deliberately manipulate mementos if they wanted to reminisce about them.

Another technical direction might be to explore how similar design principles might be applied to tools for organizing existing digital collections. It is well documented that digital collections tend to be overlooked and infrequently accessed (Petrelli and Whittaker, in press). However providing people with ways to organize and manipulate digital collections in terms of home, places and people, might allow people to engage more deeply with their collections and make them more accessible. It should also soon be possible to incorporate place information more easily, e.g. by automatic locational tagging of photos. Such organization would go beyond traditional photo software (e.g. iPhoto or Picasa) which currently provides for predominantly temporal organization.

Our study also suggested reasons why narrative has often failed in other applications such as recording narratives with photos (Frohlich, Kuchinsky, Pering, et al 2002; Stevens, Abowd, Truong, et al 2003). One reason was that participants were too familiar with these objects rendering their stories boring. However imposing a timelock could prevent

stories from becoming immediately available, or shifting the focus of the application to sharing with others would reduce embarrassment at hearing one's own voice.

While our focus here has been on tools supporting autobiographical memory, the same techniques could be extended to explore *self reflection* more directly. It is well known that personality disorders relate to an inability to engage in self-reflection. For example, DiMaggio et al (2008) describe how poor self-monitoring and an inability to understand the perspectives of others is a feature of those with personality disorders. Self-reflection relates to one's view of the past, as well as the important people, places and things in that past, which we attempt to capture in MemoryLane. Our tool might therefore be used with populations with various forms of personality disorder – allowing them to new ways to construct representations of their personal and social lives. We might then evaluate the effects of these new representations on their social functioning. Our tools could also be used to determine whether there are differences in the self-representations constructed by such populations and those of normally functioning adults. Future work could also explore relations between traditional methods of assessing autobiographical memory, such as AMI (Kopelman, Wilson, & Baddeley, 1990), and use of MemoryLane, evaluating whether ability to recall one's past influences how the tool is used, as well as whether using our tool affects measurable AMI performance.

In conclusion, our study has demonstrated the viability of a new class of digital application that allows people to construct a virtual world of everyday past life experiences and reflect upon them in a recognizable and structured environment. Our users were interested in using the application, and the work both informs other studies in the emerging area of digital memories, as well as suggesting many new interesting technical directions that future work might take.

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