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Family Memories in the Home: Contrasting Physical and Digital Mementos

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Abstract

We carried out fieldwork to characterise and compare physical and digital mementos in the home. Physical mementos are highly valued, heterogeneous and support different types of recollection. Contrary to expectations, we found physical mementos are not purely representational, and can involve appropriating common objects and more idiosyncratic forms. In contrast, digital mementos were initially perceived as less valuable, although participants later reconsidered this. Digital mementos were somewhat limited in function and expression – largely involving representational photos and videos, and infrequently accessed. We explain these digital limitations and conclude with design guidelines for digital mementos, including better techniques for accessing and integrating these into everyday life – allowing them to acquire the symbolic associations and lasting value that characterise their physical counterparts.

Keywords: autobiographical memory, home technology, mementos, field study.

1. Introduction

In their study of family homes, Csikszentmihalyi and Rochberg-Halton criticise home technology, arguing *"meaning, not possessions, is the ultimate goal of [people's] lives, and the fruits of technology [...] cannot alone provide this. People still need to know [...] that they are remembered and loved, and that their individual self is part of some greater design beyond the fleeting span of mortal years."* (Csikszentmihalyi & Rochberg-Halton, 1981, pg.145). Despite this observation, this perspective has not been evident in early attempts to prototype smart homes. Evaluations show we need to better understand the environment where people live, and the meaning they attach to it, rather than simply realising new technological possibilities (Taylor et al. 2007).

Consistent with this values-oriented perspective, we investigate the family home as a *place of memories*, with the goal of designing new technology for supporting and preserving those memories. While homes are primarily a space for practical and social activities, they are also where individual and collective memories accumulate. Indeed, as we shall see, homes are *designed* by their inhabitants to express and reinforce those memories. And although there are different ways to analyse the home and its contents (e.g. Belk et al., 1989), many of the most highly valued home objects relate to memories (Csikszentmihalyi & Rochberg-Halton, 1981), making memories crucial to understanding home and family technology.

We use the term memory broadly here, not referring to the recall of purely factual information (e.g. remembering to attend a parent-teacher evening). Instead we focus on affective tokens, or *mementos*: objects given or deliberately kept as reminders of a person, place or event. Our research goals are to understand the nature of household mementos and the potential impact of new technologies on selecting and invoking these. In particular we want to understand the relations between physical and

digital worlds. We address how *physical* mementos are selected, displayed and shared, and examine how these practices differ for *digital* mementos.

More specifically we examine:

What *types* of objects are mementos? Are mementos predominantly photos and artwork, or do other types of object serve this function?

How and *why* do certain objects serve as mementos? Do they represent key events in the owner's life? Do they signal social relationships, or are there other different motivations?

Where are mementos kept, and does location relate to their type? For example, are personal mementos kept in private spaces and social mementos in public locations?

Invocation: How do people interact with mementos? Are they used as talking points with others, or placed in personal spaces to facilitate more private reflection?

Preservation and management: How are mementos organized and managed over long periods? How do people decide what to preserve or discard?

Physical versus Digital: How different are physical and digital mementos? How are mnemonic practices influenced by their being physical or digital?

To answer these questions we conducted a field study to investigate the home as a family memory landscape, contrasting physical and digital mementos. An overview of related research follows in section 2. The study and data analysis are discussed in sections 3 and 4 respectively. Results are reported in section 5. We then use these observations to explore implications for the design of new technology for family memories.

2. Related Work

This is a multidisciplinary area. Our research intersects autobiographical memories, home studies, material culture, family and technology. Prior research has often focused on each of the above separately and from a specific point of view. We provide an overview that attempts to unify those different perspectives.

2.1. Autobiographical Memory

Much psychology research has investigated cognitive aspects of memory. Early work examined memory through the lifespan, to determine which periods of our lives gave rise to the strongest memories, finding that early adulthood gives rise to the richest recollection of events (Conway, 1990). Images also seem to be central to autobiographical memory (Brewer, 1986, 1992). Furthermore, the nature of these images changes with the age of the memory; older events tend to be viewed from an observer rather than a participant perspective (Brewer, 1986, 1992).

Other work has focused on the *processes* by which autobiographical memories are retrieved, looking at how different types of cue serve to trigger memory. People best remember specific aspects of autobiographical events, including *who* was involved and *what* happened, whereas *when* or *where* events occurred is less well recalled (Linton, 1986, Wagenaar, 1986). Underlying conceptions of autobiographical memory have also shifted from traditional views of a knowledge base (Conway and Pleydell-Pearce, 2000), to instead proposing core roles for reconstruction and social dynamics (Crabtree et al., 2004 Fivush and Nelson, 2004, Leichtman, and Wang, 2005, van den Hoven, 2004). For example, Cohen (1989) describes how sharing autobiographical memories serves as a mechanism for self-disclosure, developing or deepening social bonds. And Tversky (2004) documents how people's narratives of their lives often contain distortions that are made to support the goals of telling the story. Tversky also shows how memories are changed by retellings of experiences: so that deliberate omissions or elaborations of the original event become confused with the original memory after repeated retellings.

2.2. The Home and the Self

As the space where people cultivate identity and mutual affection, the family home is a rich, varied composition of personal and family objects. Csikszentmihalyi & Rochberg-Halton (1981) examined the home and found generational differences, with younger groups favouring active, self-defining objects whereas older people singled out contemplative, past-related objects. Mementos are often on display in family (e.g. kitchen) and social spaces (e.g. the sitting room). Often their 'true' (private to the family) meaning is not disclosed to visitors, who may be unaware they are sitting on furniture that has been in the family for generations, or looking at a sculpture made by a family member. Individuals exhibit strong connections with personal mementos: they express feelings of loss if these suddenly disappear and have a strong desire to pass them on to succeeding generations.

Our homes express various aspects of our pasts. The home is also where people keep a spatial and physical representation of their individual story, an *autotopography* (Gonzalez 1995): *"just as a written autobiography is a series of narrated events, fantasies, and identification, so too an autotopography forms a spatial representation of important relations, emotional ties, and past events"* (Gonzalez 1995). This organisation can exist in many forms: *"a careful, visual arrangement of mementos and heirlooms, on the one hand, and a jumbled, hidden assembly of dusty and unkempt objects, on the other, can both constitute a material memory landscape"* (Gonzalez 1995). Recollecting our lives makes use of both physical and narrative aspects: mementos mark events, while the narrative plot organises these scattered points.

2.3. Personal Collections

Personal collections have been extensively studied, but mainly from the perspective of work-related files and tasks. In work settings, people still accumulate huge collections of *paper* documents for both functional and emotional reasons (Whittaker and Hirschberg, 2001). They also archive large numbers of emails (Whittaker and Sidner, 1996, Whittaker, 2005), and other information such as webpages relevant to their work, and sometimes social life (Abrams et al., 1998, Jones et al., 2003). One common observation from this research is that people are generally dissatisfied with the organisation of their collections, feeling their personal information is disorganised and hard to access. They also tend to be very conservative in their habits, building up large collections of materials 'just in case', they find it hard to delete materials and defer decisions about keeping information until they see how and when that information will be used (Whittaker and Hirschberg, 2001, Whittaker and Sidner, 1996).

More recent work has looked at more personal information, such as the value and organisation of digital and analogue photo collections, documenting the importance of social sharing. With analogue collections, lightweight strategies are used to organise and share photos. Older valued analogue pictures might be gathered in an album or even a shoebox - to be accessed and shared occasionally. Once developed, newer rolls of pictures are discussed and shared in social settings before being added to the long term collection (Frohlich et al., 2002). Recent work on digital photography has shown that despite the greater ease of taking and storing pictures, these older practices persist. Users capture pictures, sharing and discussing them soon after they are taken, using very lightweight strategies for their organisation (Kirk et al., 2006, Rodden and Wood, 2003). These lightweight organisational strategies may not be effective in supporting long term retrieval however. Whittaker et al (2009) found that people were unable to retrieve around 40% of personal photos that were more than a year old.

The number of digital and analogue belongings in our lives is rapidly increasing (Marshall et al. 2006, Beagrie 2005). As well as older analogue artifacts, family archives may now include digital recordings (images or videos), digital communications (emails, SMS, voice messages), and self-created digital artifacts (school assignments, blogs and Websites). Preserving these new belongings requires the owner to become a digital curator. Archivists acknowledge a need to personally preserve today's electronic culture (Beagrie 2005), but this seems highly unrealistic. Particularly in the digital domain, most consumers lack the expertise and time to manage complex personal repositories and one consequence may be the loss of highly valued artefacts (Marshall et al. 2006).

2.3. Technology for the Family

Only a few studies have looked at homes as *inhabited information spaces*. Petersen and Grønbæk's (2004) ethnographic study revealed that *physical* information is often distributed, being accessible to everyone and positioned in places where it is most relevant (letters to post in the entrance hall). This

contrasts with *digital* information – which seems to be locked in the computer and generally available on an individual basis only.

Taylor et al (2007) studied the house as a place for activities and exchange, identifying key points (e.g. the fridge) that are public, privileged, frequently visited surfaces that might be used as information displays. However their design approach was not simply to add a screen to the fridge, instead to augment existing practices using technology.

Roles are also important for mementos. The relations between parents and children, although sharing aspects with strong-tie relations (e.g. partners in life), are *asymmetric* with parents taking responsibility, providing security and care (Dalsgaard et al. 2006). A similar dynamic is true of memories, with children focused on the self, and parents feeling a duty to preserve mementos from their children's everyday lives (Stevens et al. 2003). The variety of objects kept is huge: artefacts and artworks, clothes, photographs, videos. The intention is to pass on these collections, especially when adult children have children themselves (Whittaker et al., 2009).

2.5. Technology for Personal Recollection

HCI research has addressed helping people remember factual information (e.g. Kawamura et al. 2007, Kern et al. 2007), with rather fewer studies of the role of memories in people's emotional life. The Memory Box (Frohlich and Murphy, 2000) used a jewellery box metaphor to associate a recorded narrative with a souvenir. The Living Memory Box (Stevens et al. 2003) supported the collection, archiving and annotation of family memories. An ethnographic study investigated the "who, what, where, when and why of [parents] saving memories of their child's life". The resulting system allowed users to place a physical object in the Living Memory Box, record its appearance, recording an audio narrative and metadata to support later retrieval. Parents collected some mementos for children, but never recorded stories related to those objects.

Souvenirs and recollection were also investigated by van den Hoven (2004). Analysis of focus group discussions suggested that souvenirs are esoteric: carrying meaning for owners that is obscure to others. Furthermore, the telling of the story behind the object changed depending on the relation between owner and audience. Souvenirs relate to memories of a personal experience (holiday, honeymoon) or a specific person (heirloom, gift), and are "used" (watched, talked about). A resulting system used RFID-tagged physical objects to retrieve images previously associated with the object, which could be managed or emailed using a tablet PC or TV.

3. The Study

We focussed our research on families with young children - as they are active collectors of mementos (Petrelli et al., 2008, Whittaker et al., 2009). Furthermore, such families may have multiple different types of memory; parents have memories of their own lives before meeting their partner; shared memories as a couple; and then as active curators of their children's 'future' memories. Csikszentmihalyi and Rochberg-Halton (1981) found that the middle classes are oriented to memories and relationships. In contrast other social groups focus more on possessions. Therefore we focused on a specific group of middle class families with children, chosen because of their strong motivations to collect mementos of different types. Participants were recruited by acquaintance, covering a range of professions (doctor, museum conservationist, high-level managers, architect, training consultant, publisher, housewife and a few academics). All had at least one child aged 7-15, and used computers regularly for their work. Although we recognise that different social groups may have different foci, we expect other groups to behave in similar ways, but the degree of generalisability of our results needs to be explored in future fieldwork.

The study followed the methods of ethnography and took place in participants' homes. There were 3 parts to the study: a tour of various rooms explaining the value, role and function of mementos; an interview about digital mementos; and a drawing/sketching exercise for participants to map their lives visually. The overall tone was informal and friendly, and a small gift was given for participation. We limit our discussion to the memory tour and the interview - as here we are interested in comparing how the physical and digital support and express memories.

3.1. The Home Memory Tour

In contrast to much previous research that used interviews or focus groups, our participants had a highly active role. We gave them this orienting information: '*We would like you to take us on a tour of your house. We want to see rooms that you consider public, family rooms, and your own. In each room we would like you to pick 3 objects related to your life and tell us why each object is special, when and how you got it, why it is in this room and if you ever reflect on it or talk about it.*'

For each participant, we collected at least 9 objects and their associated explanations and stories. By contrasting three different room types, we could explore the relations between the public/private nature of the space and the type and intimacy of the mementos it contained, e.g. a public room used for entertaining might display artwork received as a gift, while a study might hold personally significant pieces, e.g. holiday photographs.

This "memory tour" allowed us to collect autobiographical narratives, observations about object location and other accompanying emotions displayed by informants, e.g. how an object was caressed or held. While there were specific topics we intended participants to discuss, e.g. what memory the object evoked and why it was important, we let participants talk freely, prompting only those topics not spontaneously mentioned. We concluded with questions about the participant's attitude towards keeping objects.

3.2. Discussing Digital Mementos

The second part of the study was an interview about *digital* mementos. As only one digital object was spontaneously mentioned in the memory tour; to support the comparison between material and digital, we conducted a semi-structured interview (outlined in the appendix). We started by questioning participants about their digital mementos (if they had any) and where these were located. We used the recently completed memory tour as prompt: "*You have shown us several mementos: do you have any 'special things' that are in electronic form?*" We were interested in exploring the whole landscape of digital memories, so we asked about emails and music as well as more traditional memory objects like photos and videos. We asked *where* digital mementos were kept (PC, laptop, external hard drive, CDs, mobile phone, etc.), *how* and *when* they were accessed and used. We also asked about plans for preserving digital mementos and how respondents felt about displaying them. This final question gave us the chance to probe participants' attitudes to future technological solutions.

4. Data collection and analysis

Seventeen people (from 13 families) participated, 6 men and 11 women; 5 were living in a country different from where they were born. When both adult family members participated, the tour was done individually, while the interview was joint, to engender a richer discussion. Each session lasted 90-120 mins. and was recorded. Pictures captured each memento and its context. In total, we collected 169 objects and related stories.

In the memory tour, we were concerned that the affordances of the rooms and the request to select 3 objects might bias interviewees. However, participants often discussed more than the nine stipulated objects if more important ones later came to mind. Moreover some participants in the first room of the tour foreshadowed important mementos they would discuss in later rooms, revealing a clear idea of which memories and mementos are important. Follow-up questions and comments also supported the view that we had collected stories about people's critical autobiographical memories.

Some participants claimed not to distinguish public and family rooms, while others clearly did. By observing the properties of rooms most participants classified as public, family and personal, we applied the following classification to all participants: *public*, formal rooms (sitting room, lounge) where acquaintances and strangers were entertained; *family*, informal places (family room, kitchen, dining-room) reserved for family, relatives and friends; and *personal*, bedrooms or studies, accessed by all family members, but of particular significance to the interviewees.

Comments made during the tour and the interview were transcribed and systematically classified. Our initial topics of interest were used to start a broad classification, e.g. type of object, location, value, while other dimensions and refinements emerged from analysis of the narratives, e.g. management and preservation.

5. Results

We now compare what was found in the memory tour with the interview on digital mementos. As our focus is on the comparison, only part of the results of the memory tour is reported. Interested readers can find the complete analysis of physical mementos in Petrelli et al. (2008).

5.1. Types of physical and digital mementos

5.1.1. Physical
Photographs are generally considered *the* prototypical memento for personal reflection and sharing (Crabtree et al. 2004, Frohlich et al. 2002). Therefore it was quite surprising to discover that six people selected *no* photos during the memory tour, despite having many on display in their house. When photos were selected, however, they had specific characteristics, being unique or irreplaceable: "*this is my father, who died quite young, it's one of the few photographs I've got of him*". Sometimes they symbolise a special event: "*a fantastic family holiday that we had a couple of years ago when we went to Canada*". The photos selected by our participants in the memory tour were highly emotionally significant. Their meaning was directly related to personal memories and identity, as opposed to a simple representation of people or events.

Only 16% of objects selected in the tour were photos. Artwork was a much more frequent choice, accounting for 28% of mementos discussed (Fig. 1). These could be *professional* paintings or photographs, prints or drawings (17%), or *amateur* efforts produced by family or friends (11%) in particular young children's art and craftwork (9%).

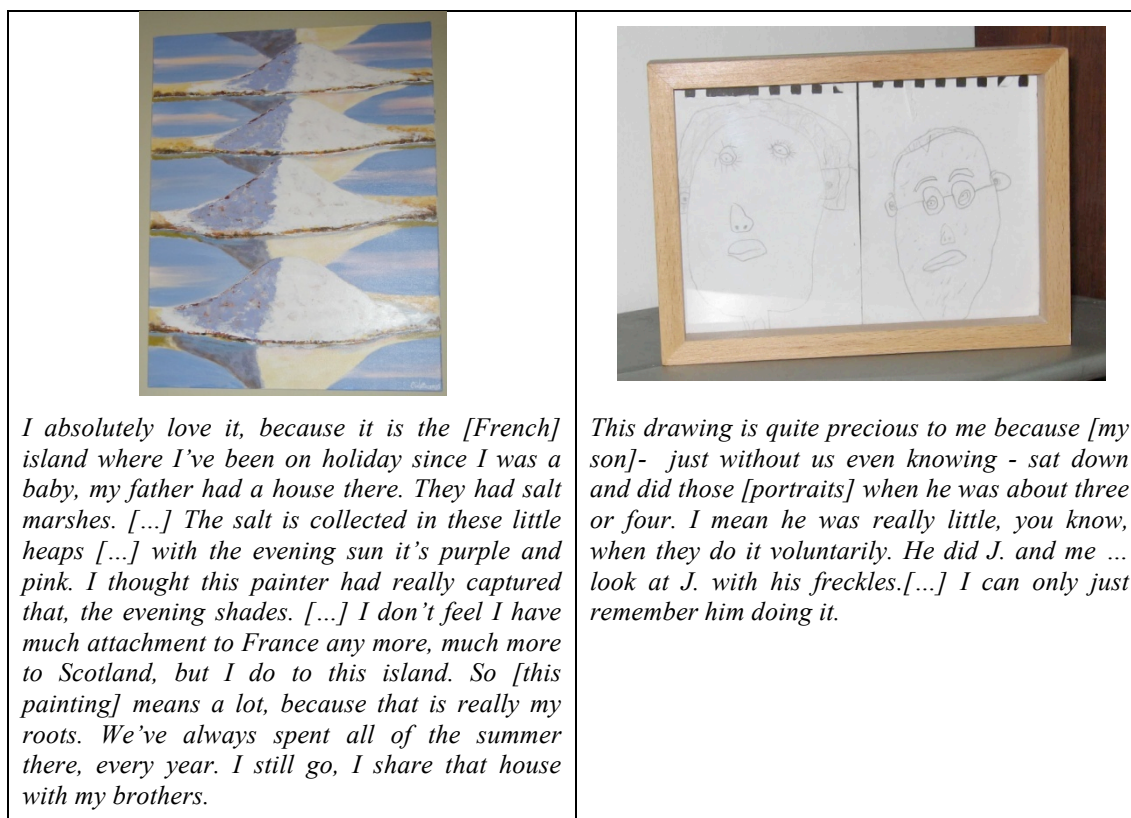|	
I absolutely love it, because it is the [French] island where I've been on holiday since I was a baby, my father had a house there. They had salt marshes. [...] The salt is collected in these little heaps [...] with the evening sun it's purple and pink. I thought this painter had really captured that, the evening shades. [...] I don't feel I have much attachment to France any more, much more to Scotland, but I do to this island. So [this painting] means a lot, because that is really my roots. We've always spent all of the summer there, every year. I still go, I share that house with my brothers.	*This drawing is quite precious to me because [my son]- just without us even knowing - sat down and did those [portraits] when he was about three or four. I mean he was really little, you know, when they do it voluntarily. He did J. and me ... look at J. with his freckles.[...] I can only just remember him doing it.*

Figure 1. Two artworks and their associated stories, professional (left) and amateur (right).

Just as the value of photos was not purely representational, in a similar way, the value of artworks is not purely aesthetic. The above examples show artworks being symbolic of special relationships (personal identity, left, or parent-son, right), emphasising both origins and intimacy.

Somewhat to our surprise, mass-produced objects often served as important mementos, accounting for 28% overall. Mundane *everyday objects* such as a cup, clock, coffee machine, golf tee, cookery book, teapot, children's toys, ladder, calendar, bed, stove, and candle holders were chosen. What makes these special is the time and energy invested in using them, or because they belonged to someone special.

Everyday objects are thus substantially different from iconic and representational ones like photos and artworks. Everyday objects become mementos by virtue of what owners have invested in them, be it time or emotion (Fig. 2).

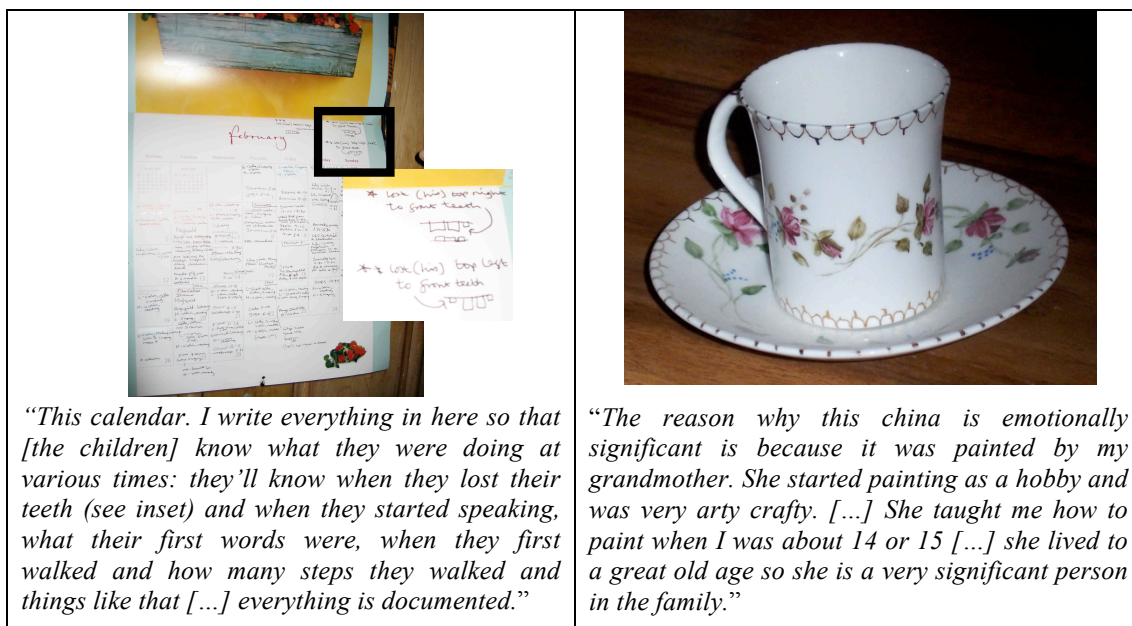|	
"This calendar. I write everything in here so that [the children] know what they were doing at various times: they'll know when they lost their teeth (see inset) and when they started speaking, what their first words were, when they first walked and how many steps they walked and things like that [...] everything is documented."	*"The reason why this china is emotionally significant is because it was painted by my grandmother. She started painting as a hobby and was very arty crafty. [...] She taught me how to paint when I was about 14 or 15 [...] she lived to a great old age so she is a very significant person in the family."*

Figure 2. Everyday objects selected as mementos.

Other mundane objects had specific functions, but unlike everyday objects were not habitually used. These were classified as *memorabilia,* accounting for 20% of mementos, including a stereoscope, a rocking horse, measuring glasses, and a set of illustrated cards.

A final class of mementos, accounting for 8% of objects, was highly *idiosyncratic*, falling outside any of the above categories. They are important for deeply personal reasons, often unintelligible to anybody but the owner. They included a shell collection; a pregnancy cast; a jar containing a father's ashes; a child's first nose bogey; a handmade bullet; a framed 1997 coffee shop receipt; 30 years of diaries; "objets trouvés" (e.g. "*a dog collar tag without a dog: maybe one day I'll phone this number, and find out a bit more about Barney the dog*").

5.1.2. Digital
To our surprise, during the memory tour, only one participant chose a *digital* memento: "*maps. I make my own maps because I do a lot of cycling and journeys. These maps then become the memory of the occasion and it's quite vivid for me*". As we will see, this was not because the other 16 people did not have any digital mementos. In what follows we discuss reasons for their failure to choose the digital.

When explicitly questioned if they had digital as well as physical mementos, there was generally an initial denial. The exception was digital *photos* which were mentioned by everyone. However, as the follow-up interview progressed, an interesting variety of digital mementos emerged. *Videos*, stored on tapes or DVD, were the most mentioned after photographs, by 8 participants (47%) while 7 (41%) explicitly regretted not having a camcorder to capture special events. Those with a camcorder reported having hours of videos, mainly of children and family events. Those without camcorders all had short camera or camera-phone videoclips.

While no one had any digital artwork, consistent with the tour, digital *artifacts* were popular. Often they were created by children: stories, poems, drawings, PowerPoint presentations, animations and photomontages. Some were done for fun, others for school projects or for special occasions (mother's day, grandparents' wedding anniversary).

Again consistent with the tour, participants mentioned a few *idiosyncratic* digital objects: a recording of a person's participation in a TV programme; playful video clips on the mobile phone recorded by the children; answering machine messages; phone texts exchanged with a partner. We classified these objects as idiosyncratic because they are individual, although still being representational and

understandable: *"the messages we got on the answerphone [...] on my birthday. I was not there, and I got most of my family singing 'Happy Birthday', and I loved it, and I kept it. I've got [...] six messages on this machine here, which I can't delete [...] one it's just me and the children phoning from France to J., telling their stories because he was not there, talking to their father."*

One category of digital mementos without immediate parallels in the physical world was *stored communications*. Only one person in the tour selected physical letters, and two others said they kept correspondence with important people. In contrast, most participants deliberately preserved emails. All participants used email for work, but six (35%) said some email messages were important on a personal basis; and five kept and filed correspondence with friends. While three felt they would never revisit these, another said: *"it is a record of what we and the kids were doing and [my friends] were doing – it is a sort of history and it is nice to read it from time to time [...] It is a bit like keeping a diary"*.

Another major difference in the digital domain was that there were not many instances of *everyday digital objects* that paralleled how people incorporated physical objects of mnemonic significance into their life. The only exception was the background image on the PC mentioned by several as having this daily recollection function.

5.1.3. Summary

We were surprised in various ways by the physical mementos chosen. There were fewer photos than expected, and those chosen had strong symbolic meaning that prevailed over immediate representational meaning. We did not anticipate the observed widespread use of everyday objects or memorabilia. Both results seem to support Csikszentmihalyi and Rochberg-Halton's (1981) finding of 'an enormous flexibility with which people can attach meanings to objects… Almost anything can be made to represent a set of meanings' [p87].

One potential reason for the small numbers of photos chosen is that our instructions focused people in selecting physically interesting objects. However this seems unlikely to be the case. Almost all mementos were chosen because of their emotional expressiveness and the reason for overlooking many pictures was that they did not seem to be emotionally significant.

One essential similarity between digital and physical mementos was their variety: in both the digital and physical worlds participants collected many different types of mementos. While there was some overlap in the types across the two worlds, there were strong differences too. Pictures and artifacts were common to both physical and digital. However there were not many instances of digital mementos being directly incorporated into people's everyday lives, nor did we see instances of digital memorabilia. In contrast, a common form of digital memento was *saved communications* which seemed less prevalent in the physical world.

5.2. Function and Value of mementos

We identified each memento's function and value from the interview: the motivations for the object to be considered a memento were used to identify its function; the reasons for selecting one particular object instead of another were used to determine its value.

5.2.1. Physical
There were multiple reasons for a physical memento to be regarded as important (Table. 1). Some mementos were reminders of an *important event* (wedding or birth), or a significant period in a person's life (attending university). Others signified a *relationship*: photos were direct depictions of others, but gifts also fall into this category, where the gift expresses a relation to the giver. However relationships often went beyond these simple links; mementos might represent joint *activities*, e.g. sculptures done in an art class taken by both partners, or the French cookery book used by a mother and her daughters when cooking together. The third category is *personal reminiscence* – where a person privately interacts with the memento to relive previous life experiences. This concept is broad: it can refer to *identity*, memories that contribute to the person being who they are, e.g. photos of ancestors, or childhood memorabilia; it could also relate to the self in more complicated ways, such as objects that reflect interests, e.g. tools used for a favourite hobby; or *personal achievements*, such as awards, authored books, or a medal for completing the London marathon.

	Events	Relationship	Reminiscing
Total	13%	59%	28%
Public	4%	16%	2%
Family	2%	20%	7%
Personal	7%	23%	19%

Table 1. Motivations for mementos with respect to places.

In contrast to previous research, in 30% of cases we discovered *multiple motivations* for choosing an object. For example, personal, social and life events are all mentioned in the following excerpt where L. reveals how a shell collection (Fig. 3) relates to family holidays (events), her childhood (reminiscence), and her children's education (relationships):

 "*the shells are quite important because they are memories of our holidays, and each year we build up our collection. I had a collection of shells when I was a child - displayed in boxes labelled with their names. … This is the past six years and each time we add more. [Collecting shells] helps to entertain the kids for a long time on the beach, and [gives us a purpose]. I find that if you do an activity and then you don't do anything to it, it's a bit negative, it's like you're wasting your time.*"

Figure 3. An example of multiple functions of a memento.

The reasons mentioned by participants about *why* an object was valued include *family bonds* (44%), *nostalgia* (20%), *aesthetic* (16%), and *moral values* (15%). The importance of mementos as conveyers of moral values was unexpected but evident, sometimes made explicit as in the excerpt above, but other times more implicit: "*my grandmother was sort of very liberal - quite a modern sort of person. She was very accepting and welcoming*" (when discussing her grandmother's china, Fig. 2). Moral-related comments were generally associated with relationships to parents and grandparents or aims for their children, showing the evolution of bonds in a family.

5.2.2. Digital
As they began to discuss values and functions in relation to their digital collections, participants went from being initially dismissive of their digital collections to gradually discover they actually had digital mementos and how important those mementos were: "*I've changed my mind, I think I do, yeah, I think I can have a sentimental attachment to stuff in [the computer], yeah*", "*They are special but I don't think about them, I'd completely forgotten we'd had them*".

Sometimes people went to great lengths to produce or capture digital memories (Figure 4).

Creating digital memories	Capturing digital memories
"*[our son] made a Powerpoint for mother's day. It was a quite creative piece and he spent ages doing it – he worked hours and hours on the animations – and the result was hilarious. He showed it after lunch at my mum's, it was like a show, very funny.*"	"*There was a children's radio program [...] and they have phone-in, you know, quizzes and competitions and [our daughter] would sometimes get on and speak to the nation. And whenever she was on, I recorded it and it's all on the computer. So we did go to a lot of effort in fact.*"

Figure 4. Two examples of effort expended on digital mementos.

Despite these efforts and the strength of the underlying memory, these digital objects did not immediately spring to mind as valuable mementos when we first talked to participants. Only later did participants begin to see them this way. When they finally acknowledged their significance, respondents showed strong attachments to their digital belongings: "*[video] is a wonderful way of seeing someone alive, and when you're far away I think it has even more significance*", "*lots of emails, the history of what we were doing [...] feels like a record I would like to keep*".

One reason for this generally low perceived importance may be because digital objects are stored away and people aren't reminded about them on a daily basis. Unlike everyday physical objects, photos or artworks, digital objects are not in places where people persistently encounter them. However this cannot be a complete explanation as some highly significant physical mementos were deliberately hidden from sight at the back of wardrobes or in drawers. A second reason may be digital objects' perceived instability and transience: "*[email] is quick and spontaneous, for me that doesn't warrant preserving*", "*digital feels sort of unstable it feels like it's not always going to work, sorry*", "*it's ephemeral I do not think we will be able to keep things that are on a computer anyway*". Technology is also viewed as inexpressive, incapable of fully representing individual and personal aspects of memories: "*email is impersonal [...] handwriting is something you can't beat, I mean the someone's handwriting is so personal*", "*looking at images [on the computer] doesn't feel as intimate [as flicking through prints]*".

Even though participants began to acknowledge that their digital collections engendered memories of relationships and events, we found few instances of digital mementos that supported personal reminiscence. In the physical world these mementos tended to be specific objects (medals, books, calendars) often located in private or family spaces and there were few equivalents of these in the digital domain.

5.2.3. Summary

Although they were not recognized as such initially, on reflection people came to see their digital mementos as valuable and worth preserving. However digital belongings are perceived as problematic: being unstable and ephemeral compared with physical ones, and too impersonal to fully express the richness of memories. Their *functions* also seem different. Physical mementos are multifaceted in their value: as well as their representational values, objects often become abstract, esoteric symbols that aren't understood by others without an explanation. Digital mementos seem much simpler; essentially representations of events or simple social relations, valued as simple triggers for past events or people. One reason for the difference could be the still primitive nature of digital technology and its recent status in people's lives. None of the participants mentioned passing digital mementos across generations, while several physical objects were talked about in this way. This lack of relationship to their personal lives may be why people initially rejected the idea they had any digital mementos apart from pictures and videos.

5.3. Location and Access

5.3.1. Physical
The value of a memento and its location in the house were related: social rooms (public and family) contain more objects that symbolise relationships, while personal spaces have more objects of reminiscing (Table 1). The position *within* the room seems to depend on function too (Table 2): mementos of relationships are prominent or on display; mementos of reminiscing are prominent if they are self-referential, but concealed if they are nostalgic objects.

Mundane objects are often directly integrated into everyday activity: "*That was my father's step ladder, you see, and actually we have many objects of my father's around this house, even his car keys, the kids use his car keys as part of their games [...] I really like that because they're quite disappointed that they never knew him.*"

		Events	Relationship	Reminiscing
Prominent	45%	6%	27%	11%
Display	31%	6%	22%	3%
Concealed	24%	3%	10%	11%

Table 2. Position of mementos with respect to motivations.

Incorporating memories into everyday life was a recurring topic: three people passed teddy bears on to their children, a son inherited his father's bow, an old family stove found a new place in the lounge, and a grandmother's teapot was used every day. People derived comfort from integrating past and future, knowing that an important aspect of their past was evoked every time they made tea, or lit the stove. Embedding mementos into a familiar space changes their nature: "*these photos are in the grain of the room, they're not just there because they can be. Sticking [a photo] on [the wall] is consuming it ... I often point one out to people ... that is so and so*". From this perspective, *using* mementos is more important than *preserving* them: "*objects on display are to be used, and not to be a museum piece. From time to time something does get broken ... the other day when I was mowing the lawn I mashed up my father's car keys because the kids had left them out there [...] I'd rather mash them up, knowing that the kids enjoyed playing with them for a few years rather than just have them in a cupboard.*" However we also found evidence of the opposite behaviour, i.e. mementos that are rarely accessed and sometimes purposely concealed.

Boxes and containers of memorabilia were a popular way of organizing mementos: 13 (80%) of our participants mentioned at least one such collection. Some collections are organised by time, containing mementos of distant periods of the person's life, e.g. childhood, university life, and are created opportunistically with what has survived years of sorting and clearing (Figure 5, left). Other times they are deliberately created around a topic, e.g. a wedding memorabilia chest, or a family treasures box (Figure 5, right).

"*There's a memory drawer in here of mine. Old scrapbooks, I mean, this is really old memories which is going back an awful long time to these programmes from school plays, school things. And I don't have an awful lot of those things any longer.*"	"*This was given to me by my mother, last Christmas. She picked up all sorts of lovely little family treasures: pictures of my great grandparents, my great grandmother's sewing things, my great uncles wooden carvings and all sorts of old family things. It's like a little corner of part of my life.*"

Figure 5. Two examples of memorabilia collections: organized by time (left) or topic (right).

These boxes of memories are often not easily accessible (stored in an attic, or deep in a wardrobe) and rarely opened. However when rediscovered they act as 'time capsules', a whole past world is revealed and the owner is thrown back in time - deeply immersed in reminiscing: "*that's one of [my son's] first pairs of socks can you remember when they were this tiny look look look ... oh I haven't looked in here for years funnily enough ... little bootie ... oh I can't even remember - those were his first pair of little booties.*" Having these objects in constant view would habituate people to them, but concealing them makes more salient the contrast between past and present, triggering a world of nostalgia when they are brought to light.

However, most discussed mementos were deliberately placed where the person can easily glance at them: "*[the study] is not a place where I would put my memories because I rarely come in here and when I do it is because I need to work*". Even when the container is rarely opened, having it in sight seems to offer comfort: "*things like the bowl or the painting that you can see are sort of public, but other things like this [the family box in Fig. 5 right] are sort of private. I mean I hardly ever show these to anybody. But they sit there [on a shelf in the family room next to the bowl and painting], and the fact that it's there and you know what it is, it's just a sort of rather nice thing to have around you.*" This suggests a passive role for certain mementos as constant, but rarely conscious, reminders. They are, indeed, rarely opened or purposely looked at: "*well I don't stand and look at them, but I don't need to stand to think about them, I mean, many times I'm sure, if I look at them and notice them properly, then it invokes the memory*". Together these examples indicate two types of reminding function: an active remembering connected to narrative or explanation and a passive mode supporting awareness

and relationship building. The space is synonymous of persistence: "*there's something about the quality of having things overlaid on each other physically, you put them there, it's just there.*"

Active remembering is, most of the time, done in a social context, it is *sharing* memories. We discovered that sharing goes beyond the simple showing of photos of events or people to family and friends documented in prior work (Chalfen 1987, Crabtree et al. 2004, Frohlich 2004). Such sharing can cement parent-child relationships, as when a mother explored her childhood memory box with her daughter K. (Fig. 6):

"*this was given to me by my grandmother when I was ten, and this was given to me by my mother when I was six, and this is my Brownie Badge… I showed [the box] to K. the other day and she was absolutely over the moon, she said 'I want a locket as well, with pictures of my mum and dad in it!'* […] *You know, they've all got enormous meaning to me, but only to me now.* […] *The only people I would think about sharing with, would be the children. There is nothing inherently important. It's only important because it makes a link across the generations.*"

Figure 6. Sharing a personal collection of childhood memorabilia with a child.

5.3.2. Digital

Digital mementos are accessed in very different ways from their physical counterparts. Whereas a minority of physical objects in collections may be deliberately concealed, most physical mementos are freely accessible, being on display or integrated into everyday life. Digital objects in contrast reside on the computer or a recording device (answering machine/phone) and consequently access is a deliberate and often major effort.

Both digital photos and videos are used to talk about what happened in the family: laptop or family video watching is generally associated with relatively rare special social occasions like grandparents visiting, or the children flicking through old photos at Christmas. In consequence access tends to be rather infrequent. This engenders a sense of guilt, as if participants were not fully exploiting their digital mementos. Similar sentiments are expressed about the fact that they do not print photos any more.

More prosaic barriers to video access are that it is hard, and the results not very satisfying: "*it takes time to set up all the connections [...] you forget how it is done, I should write it down – it is all very frustrating*", "*it's a special cartridge you have to plug it into the TV, so it's not especially easy to watch.*"

Accessing digital photos is also perceived as difficult, the main issue being how they are organized (Whittaker et al., 2009), resulting from the division of labour that creates that organisation. Downloading, editing and organising photos seems to be a man's job done on their work computer, rarely on the home PC. Women complain as a result that they do not know where the files are, or they can't access them: "*I haven't got a compatible driver so I can't actually look at the disc that we've got with all the kids photos on so I have to look at them on his computer because I need to upgrade mine*"; "*I do not know how to use it so I need him or one of the children to set it up for me*".

Feeling unable to freely access digital photos is a clear source of frustration: "*I suppose that ties to me saying that I'm not being able to get at them and it's frustrating and that's why it's nice to have an album of prints.*" The barriers to access are often compared with the democracy of physical prints that can be straightforwardly picked up and flicked through: "*I can just kind of flick through and I do that in a way I wouldn't just sit and look at stuff on the computer*"

The immediacy of physical access is contrasted with the effort demanded by technology: "*There's something about the quality of having things physically, you put them there, it's just there [...] compared to the act of scanning something, where it disappears into a black hole and you've got to organise, that's part of the issue. Being able to organise is good. Having to organise is a pressure.*" And time spent organizing on the PC is considered a housekeeping duty - not creative and rewarding

("*[if I have time] I prefer to work in the allotment*[1]"). It is too much like work, and there is the persistent worry that it may be a waste of time "*I think of digital as things that will not last*".

Despite our participants having large digital archives and being digitally literate, we saw few examples of participants using plug and play devices such as phones, iPods or laptops to access or share their digital mementos. Accessing the digital seemed to be intrinsically onerous and people had to make deliberate attempts to access them. Unlike physical objects, digital ones are still not easily integrated into our everyday environment.

We already noted that a major difference between the physical and digital is that physical objects are well incorporated into people's everyday lives. We wanted to probe respondents' views concerning various new technologies (e.g. digital picture frames) that make it possible to better incorporate digital mementos into everyday life. With few exceptions, the idea of having digital photos and video on constant display was unappealing[2]. Some found the idea of changing images irritating, others felt a digital display would intrude and change the fabric of the room: "*the problem is that you end up with something like a TV that has a particular [privileged] status, whereas the objects in the room are more in the grain of the space*". As it has been designed so far, digital technology does not seem to smoothly integrate into the homes that people have built around themselves.

5.3.3. Summary
In the home, different physical mementos are located in different places, affording different types of invocation. Apart from being actively displayed and shared, memories are integrated in everyday life through mundane, but significant, objects in everyday use - signalling continuity between past and present. Of particular emotional significance are small collections of objects concealed and opened only rarely. The use of space also offers the possibility of reminding, e.g. a memento that is usually in view can be easily converted into a more active experience, i.e. talking about the object at any time and in a very natural way.

Digital mementos in the home do not have the same property of being integrated in everyday life or being encountered by accident: they require an explicit act and a lengthy process to be accessed. Although it is occasionally possible to opportunistically re-encounter digital mementos, e.g. rediscovering significant text messages or photos when killing time fiddling with one's mobile phone, nevertheless the home is still predominantly physical. Accessing the digital seems to be a deliberate, often effortful, act. There were a few examples of families setting up digital photo shows for visiting relatives and some comments were made about serendipitous re-encounters with digital mementos, e.g. looking for a specific photo but spending an enjoyable hour browsing unrelated photos. However such digital experiences are an exception and do not show any integration of physical and digital. This lack of integration may prevent owners from building a daily relationship with digital objects that seems to be a frequent component of certain types of autobiographical memories. Furthermore, participants tended to be rather negative about new display technologies to show and share their digital images/videos. Physical objects are also more democratic. They may be of particular significance to just one person, but are accessible to everyone. Files on the computer in contrast, require people to know where they are stored. Often they are on personal laptops and unavailable to everybody.

Finally, these access problems may contribute to the initial lack of perceived value of digital collections. Digital mementos are stored in the computer, out of sight and out of mind. This prevents easy contact between the owner and the object, contact that may be essential in some cases, for the building of meaning, to turn the object into a valuable memento. This may explain why the digital objects spontaneously cited or first remembered were photos and videos that tend to be sporadically accessed, as there are specific social practices associated with revisiting key events. Photos and videos record events and are revisited when people purposefully recall those events. In contrast idiosyncratic digital objects are unique and are more likely to be forgotten after the initial event is passed.

5.4 Management and long-term preservation

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[1] An allotment is arable land rented from the local council.

[2] None of the interviewees possessed a digital photo frame. The three participants who were more positive to the idea of digital memories on constant display had heard of this technology and were somewhat open to the possibility.

5.4.1. Physical

The management and preservation of physical mementos does not seem to generate major anxiety. All participants reported having boxes where they collected children's artwork and crafts, some also kept clothes or other special objects. All also mentioned periodic sorting and clearing, distilling what is still worth keeping, with minor guilt associated with such clearing out. This activity extends to personal possessions: "*that drawer is all that survived from that bit of my childhood, really. It's been weeded down year after year. And every time you go through the drawer: 'Oh God! look at all this rubbish, it's got to go.' I wouldn't want to get rid of them altogether. I very much like having them here, in my house now*" (talking about the childhood memorabilia in Fig. 5 left). Distillation is crucial: sifting through a small collection of memorabilia is emotionally evocative, but large boxes put people off: "*loads of cardboard boxes with loads of stuff, in general junk really. I should chuck all out but I feel I should go through it and decide what I want to keep and it will take ages so I never do ... so the boxes sit in there*". The content of these large boxes has little value, as it is never accessed. Thus having a *compact* collection is important in sustaining interaction throughout a lifetime: "*when moving house I looked [into my suitcase of old stuff], I opened it, ah! I go: 'look at this!' and then I close it again. I don't want to throw it away. [...] How many times have I looked in that box of mine? About once every ten years?*"

5.4.2. Digital

The persistence and the sense of security associated with physical mementos clearly contrasts with the perceived fragility of the digital. Most respondents backup their digital belongings onto CDs or DVDs. Some devise complex strategies to preserve these: "*before we go on holiday we always make sure we've copied all the photos on the computer onto an external hard drive and we hide it somewhere in the house so if someone came and nicked the computer we wouldn't lose all the photographs*"

Interviewees had clear strategies for digital preservation, but this does not prevent them from worrying about the viability of today's technology: "*I never feel confident that I've made the right choice about which kind of technology to back, so I'd prefer something which is tangible I think*", "*I think of digital [objects] as things that will not last*", "*I don't have a trust in [digital media], there is less physicality in the computer hard drive than having something on paper, which might fade, but you will still have an image*".

Three respondents, all men, mentioned scanning papers to preserve a digital copy. Of these, only one was motivated by the experience of loss: "*[my son] had fabulous drawings that he's done since he was two, and he took it into school to show the teacher, and he put it down at some point, forgot it. And so we've lost all the images he produced when he was a child. [...] so it's kind of desperate really, all wiped out, so if we had digital copies...*" There is a generic sense of physical objects as destined to last and in no real need of maintenance; the owner can forget about them for the next 30 years, to be rediscovered one day.

Section 5.3 mentioned conflicts in accessing common digital mementos stored on personal laptops. From the point of view of *managing* digital mementos the situation is even more complex. The same person may have "*an old laptop, which has got a whole load of emails on it [...] I'd like to kind of take that off because that feels like a record I would like to keep. And then obviously on my more recent computer I have my work files and all my working email and I've sort of got personal stuff as well.*" There are often work and family computers, several phones with images, clips and text, and possibly external storage media (DVDs, CDs). This makes up a multitude of devices that contain digital mementos and the owners do not have a clear map of what is located on each device (Marshall et al. 2006).

Secondly, the organization of digital mementos is done around specific media: photos on external hard drives, videos on DVDs, emails zipped away, digital artifacts in several folders. This organization contrasts with that seen with physical objects which often follows the logic of time (objects of the same era) or topic (objects about the same event or person) tend to be co-located.

Organising digital information is also onerous. For example, people now take huge numbers of digital pictures relating to events (many more than their analogue equivalents). Then there is the time-consuming activity of deleting bad or undesirable pictures, occasionally cropping or editing them and organizing them into a scheme that will make retrieval possible. This is more work, which is less

pleasurable than sorting through a small set of analogue pictures to add to an album (Whittaker et al., 2009).

Finally, digital content tends to multiply as a consequence of the owner's activity: "*I originally said 'Let's just recycle the video tapes', but I actually find it very hard to do, because erasing the images somehow just seems, not right. [...] it's almost as if the image carries a little bit of the person with it, which of course it doesn't really, on one level, but on another level it does, so I hate binning an image of my kids, even though I've got twenty copies of the same one spread through different computers.*" Keeping track of the many copies, the different resolutions and edits becomes a hard task, particularly as digital software is felt to be inadequate for organizational purposes (Whittaker et al., 2009).

5.4.3. Summary
Accessing important physical mementos, revisiting and sorting them is an enjoyable activity, reserved for smaller collections, while bigger ones tend to be ignored as the effort needed is perceived as too great. Selecting and reducing the number of kept objects is essential to a sustainable collection: but with the digital it is easy to over-generate material: disregarding the future problem of management and access.

Preservation is also substantially different in physical and digital realms. Preserving physical tokens of children's memories requires an effort in terms of selection but does not require becoming a large scale curator. In 30 years time, that physical collage might have lost a bit of colour, but its essence will be preserved. The same cannot be said of digital mementos. They demand more organisational effort, and attention has to be paid to move digital objects from old unused computers and migrate old files to new formats. Thus, while preservation from technical breakdown is anticipated, long-term preservation is viewed with trepidation.

6. Designing new technology for digital memories in the home

Our study identified many problems with digital mementos. Current digital artefacts were seen as invisible, hard to access and inexpressive compared with their analogue equivalents. Unlike their analogue counterparts, participants felt that digital artefacts were onerous to organise and maintain, as well as being more ephemeral and unstable. In order to provide digital mementos with the properties of physical mementos it is necessary to create technology that seamlessly integrates with people lives: the design has to start from human activities and should consider the whole user experience with digital mementos, from capturing, to organizing and managing, to accessing and sharing. In this section we look at how the current problems with digital could be overcome sketching out some possible design solutions.

6.1. Broadening the set of digitally captured objects
Our results indicate that, although there are many types of digital mementos, the set of captured objects could be broader and richer. One reason that our participants overlooked their digital memorabilia is that their digital collections did not encompass mundane physical objects that are critical for reminding as they are persistently reencountered. New technologies might address this in two ways. One possibility is to develop new tools that allow scanning of critical objects. For example, Kirk et al (in press) describe a tabletop application that allows people to straightforwardly scan images of significant objects and to organise them in a 3D software archive. Another (in our view more promising) approach is to explore ways to integrate the physical and the digital. Our participants were highly oriented to the tangible properties of many mementos and the fact that they could organise these spatially throughout the house. One way to retain this physicality, but to explore synergies with the digital, would be to create embodied objects where physical mementos are augmented with digital information. These types of experiments have already been carried out with some success by van den Hoven (2004) (van den Hoven and Eggen 2007) who explored augmented methods for interaction with physical souvenirs.
With this approach, critical tangible, situated properties of physical mementos could be retained, allowing their owners to better incorporate these into their everyday activities. In addition, such digitally augmented objects afford new properties, e.g. the ability to record and associate rich stories or narratives with the objects themselves (Frohlich and Fennel 2007). Moreover, by using sensors, it is also possible to capture the history of people's interactions with the object. In this way, an entire family's physical or verbal interactions with that object could be saved, stored and played back for future reminiscing.

The concept of mixed reality mementos that combine physical and digital has potential in other ways. Physical archiving practices such as making albums or scrapbooks or revisiting collections engender positive emotions; whereas digital archiving does not. One challenge for new digital archiving tools is to try and support new practices similar to making albums or scrapbooking that will lead participants to enjoy the process of sifting through their digital archives, selecting and composing. Again augmented reality might offer a way to replicate enjoyable physical practices, while simultaneously generating potentially useful digital metadata or narratives that might assist in the organisational process. An interactive table could become the working desk for cutting, pasting, decorating and composing digital mementos.

In some ways digital memorabilia are different in kind from their physical counterparts, and there may be opportunities to exploit this. We noted that participants stored more digital conversations (e.g. emails, texts and voicemail messages) than physical ones. There may be opportunities to develop this advantage for the digital by designing tools that allow people to aggregate and organise such collections of conversations. One possibility might be to exploit tools that have been developed to visualise complex email or internet based group conversations (e.g. Smith and Fiore, 2001, Donath and Boyd, 2003). Just as albums provide attractive ways to access and share physical photos, these visualisations may provide interesting ways for people to browse personal conversational histories.

Other work suggests that these new media might be treated in fundamentally different ways from their physical counterparts. In a recent study of sound memorabilia we found that recording practices were very different from more traditional types of mementos (Dib et al., in press). Participants were not content to use sound to passively record events, instead they constructed and manipulated the situation to represent key events in a special way, e.g. to record 'radio plays' or interviews about key holiday events. It may be that developing new tools for capture and playback of conversational or sound mementos will lead to very different experiences and practices than those used for more visual or object-centric memorabilia.

6.2. Reducing the burdens of management and maintenance

Our study has shown that digital mementos are seen as onerous to organise and maintain. People had little enthusiasm for organising their digital collections with obvious implications for later access and retrieval (Whittaker et al., 2009). However, new digital devices can record multiple types of metadata associated with each potential digital memento, e.g. location, time or time-stamped interaction history. This metadata might be exploited by machine learning tools to help organisation by clustering digital or augmented objects with similar profiles, e.g. those accessed at the same time or by the same people or in similar locations. However, despite very many explorations of automatic methods of analysing and clustering digital photos (Graham et al., 2002; Kang et al., 2007, Mulhem and Lim, 2003; Platt et al., 2003), none are in widespread use in commercial products. One possible explanation is that these automatic methods do not mesh well with the ways that people think about, organise and access their mementos. For example, we know that with autobiographical memories, people most frequently think about these in terms of participants, social relations and key events (Wagenaar, 1986, Linton, 1978), whereas most content analysis software for photos focuses on low-level visual features, e.g. clustering outdoor vs. indoor pictures. Despite these difficulties some innovation is beginning to emerge: the new Apple's iPhoto '09[3] provides automatic person tagging using face recognition and exploits GPS information to position photos on a map. Crucial questions arise from a user and technical standpoint: are participants willing to tag enough people to allow face recognition to succeed, and what kinds of error rates will people tolerate?

Although it is likely we will see more of these features being included in software for managing digital photos, automatic clustering is not a general solution to users' organisational needs. Digital mementos are often dispersed across different folders and accessed via distinct applications; and sometimes they are stored on different devices or different computers. Our participants did not sort their physical belongings by type, but by meaning: grouping them by life period, event, or relationship. New computer infrastructures are needed to rationalize, collect and smoothly integrate these different fragments of our digital life. Docking a mobile phone for charging could automatically download undeleted messages and photos; these could be time-aligned with other photos and videos and with emails sent by the same people appearing in the pictures and in the messages. Our lives may be quite

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[3] iPhotos already organizes pictures by time into 'events'; it also supports simple sharing on social websites like Flickr and Facebook.

predictable: the group of people that pervade our life may be small enough to attempt automatic detection, e.g. by using the names in the phone contact list it might be possible to identify emails from the same person. The same principle of displaying photos by time, place and people could then be applied across any personal digital media providing a more organic view on our digital life.

Finally our participants expressed strong concerns that digital data were ephemeral and hard to preserve. When they finally focused on their digital collections, participants saw them as artefacts they cared a great deal about and they worried they might lose. At the same time they didn't wish to be concerned with low level maintenance activities, such as migrations across file formats/applications as these change. As for the daily management discussed above, these low-level curation tasks are not things that interest or excite the average person. Companies, e.g. British Telecom, have started offering online storage or Digital Vaults. While this preserves the material from digital catastrophes, e.g. hard disk break down, a stolen PC, fire, there is no guarantee the software to read it will be still available in 20 years time. Without such a service, it is easy to imagine the dismay of a person who has received hundred of thousands of unreadable files that contain the life of a deceased beloved person. There may be no way to discriminate what is worth preserving and what is not as the content is not easily accessible. For this we have hope that manufacturers will recognize the need for backward compatibility and provide solutions to allow our grandchildren to have a glimpse at our lives.

6.3. Enhanced Access to Mementos
The central weakness of current digital mementos is that they are inaccessible and not well integrated into everyday life. As a result they are forgotten, even by people who have invested countless hours in creating, collecting and organising them. Their inaccessibility leads to unfortunate consequences. Unlike physical mementos, they cannot be distributed to different locations around the house to express and elicit different styles of remembering. Instead of being seen and discussed by guests in public spaces, reinforcing family memories in the kitchen, or supporting personal reminiscence in an office or study, they are locked in the computer. Certain other things follow from this lack of integration. Digital mementos aren't encountered on a daily basis. As a result they aren't organised or sifted according to their value. The fact that they are locked away in the computer also restricts appropriation: they can't express symbolic meanings through new uses, instead they are constrained to simple representations of events and people.
An augmented reality approach would overcome some of these current limitations. Augmented objects have many of the same affordances as physical ones, so there is no software interface needed for accessing them: users simply treat augmented objects like physical ones finessing the problems of invisibility of digital archives. Small, self-contained augmented objects could be accessed, invoked and organised in familiar physical ways and more easily integrated into everyday practices in the home.

Ubiquitous computing in the home for the purpose of digital memories implies many CPUs and many display devices, likely of different size, portable and standing, all networked and interconnected. Handling mixed reality mementos might then provide valuable data for generating new types of enhanced digital experiences that are context sensitive. Frequently accessed objects might behave in ways that are different from less frequently handled ones, or objects that are handled in predominantly social settings might again have different properties from those that are private. For example a tablet PC that looks like a book and sits on a shelf could display family photos when picked up in the lounge but could display personal communications when taken to the study for more intimate use. Emails could make use of fonts created with personal handwriting strokes depicting the email as a hand-written letter, and saved in piles linked with a ribbon. This contextualised combination of the physical and digital in a simple, dedicated information appliance (Norman 1999) could reduce the feeling of the digital being ephemeral and inaccessible. Digital conversations, e.g. emails, text messages, and voicemails, are valued but rarely extracted from the device they were received on. Here, there is room for designing new techniques for integrating these conversations with more traditional types of artefacts. Narrative is core to bring memories back to life (Nelson & Fivush, 2004), but it is rarely captured (Dib et al., in press, Petrelli et al 2009): ambient technology or augmented objects could be used for this purpose but lightweight techniques to capture and integrate digital narratives are needed (Frohlich & Murphy 2004; Frohlich & Fennell 2007).

Our analysis of physical mementos also revealed different types of access experience. Some mementos are highly visible - placed in social locations to engender conversation. Others are mundane objects incorporated into everyday activities that often have a secret story that is not available to those outside

the family. Yet others are stored in hidden places at the back of drawers or in attics where access is an immersive experience with a secret collection.

We can reflect on how we might replicate these experiences in the digital domain. For purely digital objects, the immersive experience should be the easiest to achieve, as we can capitalise on the fact that digital collections are currently seen as being hidden or invisible. One way to enhance this experience might be to embody digital collections in attractive physical forms, like the Memory boxes that people stash away in the backs of drawers or wardrobes (Frohlich and Murphy, 2003, Petrelli et al., 2008). New innovative design could take advantage of network technology to create a much more engaging memory box: when mementos (digital as well as physical) are dropped into it, additional information could be automatically collected by the box and stored locally; when, 20 years later, the owner opens the active memory box, she will find the objects she put into it, along with additional automatically collected information, such as pictures of her friends at that time, her university timetable, the map of her travels in South America, the music she was listening to, plus the news and clips of her favourite TV programs.

Other types of access such as public sharing of strategically placed mementos should also become easier as different types of screens and display devices become readily available in the home. Rather than sharing digital mementos passing a laptop between people or gathering around a PC, it will soon be possible to straightforwardly send digital mementos to a chosen convenient display device, e.g. a television (van den Hoven 2004, Greenberg and Nunes 2009). It should be easier to 'dock' different digital devices that contain mementos and to share these with others via whatever display we choose.

Another intriguing possibility is the prospect of making digital mementos more mobile, i.e. taking them outside the home. People now routinely use mp3s and iPod to carry their personal music with them wherever they are, allowing them to immerse themselves in their own sound world when they travel. The same might be possible for digital mementos. Carrying digital memorabilia on a mobile device like an iPod or phone allows, for example, personalising an anonymous hotel room when travelling by displaying personal digital mementos. They might also be using mobile devices to share mementos with others in multiple mobile situations.

A final extension might be to use interaction data as a way to recreate the concealment and rediscovery of mementos we observed in the memory tour. Active use can be a good implicit indicator of memento importance, i.e. printing, sending as email attachment, or editing a photo are all examples of associated value. By observing user's actions a few important mementos could emerge from the wider collection, while the rest disappear into the store of seldom-accessed memories. This distinction between implicit favourite and the rest of the collection could promote new and engaging ways of revisiting, for example a photo album of 'never seen before' or the random display of rarely seen photos could occur when the user logs on or off their computer.

Summary

We characterised and compared physical and digital mementos in the home. Physical mementos are highly valued, heterogeneous and support different types of recollection. Contrary to expectations, they are not purely representational, and can involve appropriating common objects and more idiosyncratic forms. In contrast digital mementos were initially perceived as less valuable, although participants later reconsidered this. Overall digital mementos were more limited in function and expression than their physical counterparts, largely involving representational photos and videos. Designing new methods for capturing organising and accessing digital memorabilia presents clear challenges, but our results suggest numerous interesting avenues for possible exploration, addressing some of the current limitations of digital mementos. We explain these digital limitations and conclude with design guidelines for digital mementos, including better techniques for accessing and integrating these into everyday life, allowing them to acquire the symbolic associations and lasting value that characterise their physical counterparts.

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Appendix – Digital memento interview schema

Do you have any "special things" that are in digital format? [if the respondent seems perplexed prompt with: email or voice messages, photo, video clips, artifacts they/they-children have made, music. Be sure all the media are covered: text, speech, image, video clips, music, artifacts]

Where is each one kept? [Interviewer – be sure to mention all: home PC, work PC, laptop, PDA, mobile phone, camera, camcorder, iPod, CDROM, cassette, disks] Do you mind showing it to me?

How often do you access it? In which context? [Interviewer – responses could be: while travelling, by chance, to show someone, … - be sure all possibilities have been considered by the respondent]

Have you shared (sent or shown) this with someone? If not, is there anyone in particular you would like to share this "digital memento" with?

What are you going to do with this "digital memento" when you change laptop/phone/PC?

How would you feel about having this digital thing displayed in a room? Which room would you put it in?

If the respondent is not interested in digital memories:
       - why is that so?
       - would a different way of interacting with personal digital memories change this attitude?