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Using physical memorabilia as opportunities to move into collocated digital photo-sharing

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Abstract

The uptake of digital photos vs. print photos has altered the practice of photo-sharing. Print photos are easy to share within the home, but much harder to share outside of it. The opposite is true of digital photos. People easily share digital photos outside the home, e.g., to family and friends by e-mail gift-giving, and to social networks and the broader public by web publishing. Yet within the home, collocated digital photo-sharing is harder, primarily because digital photos are typically stored on personal accounts in desktop computers located in home offices. This leads to several consequences. (1) The invisibility of digital photos implies few opportunities for serendipitous photo-sharing. (2) Access control and navigation issues inhibit family members from retrieving photo collections. (3) Photo viewing is compromised as digital photos are displayed on small screens in an uncomfortable viewing setting.

To mitigate some of these difficulties, we explore how physical memorabilia collected by family members can create opportunities that encourage social and collocated digital photo-sharing. First, we studied (via contextual interviews with 20 households) how families currently practice photo-sharing and how they keep memorabilia. We identified classes of memorabilia that can serve as memory triggers to family events, trips, and times when people took photos. Second, we designed Souvenirs, a photo-viewing system that exploits memorabilia as a social instrument. Using Souvenirs, a family member can meaningfully associate physical memorabilia with particular photo-sets. Later, any family member can begin their story-telling with others through the physical memento, and then enrich the story by displaying its associated photos simply by moving the memento close to the home's large-format television screen. Third, we re-examined our design premises by evoking household reactions to an early version of Souvenirs. Based on these interviews, we redesigned Souvenirs to better reflect the preferences and real practices of photo and memorabilia use in the home.

Keywords: Collocated digital photo-sharing; Physical memorabilia; Tagging

1. Introduction

Digital photography has become increasingly popular. This is for good reason. It allows numerous photos to be taken and stored, while minimizing the cost and hassle associated with film. People are free to take more photos, increasing their chance of getting a "good" photo, taking playful "candid" shots, and recording event details as memories. They can select and edit their favorites for printing. They are able to store many photos without physical space restrictions. They can easily send photos to others via e-mail or cell phones. Indeed, it is impossible to know just how many photos are taken with digital cameras per year (Norman, 2003).[1]

While digital photography has revolutionized the way we take photos, we now must consider how such technology affects how people use their photo collections, especially for photo-sharing. As Norman notes:

> The technologies of digital picture transmission, printing, file sharing, and display are sufficiently complex and

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[1]This paper expands considerably on work first reported at the ACM DIS conference by Nunes et al. (2008) and illustrated in the video by Greenberg and Nunes (2009).

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> time-consuming as to prevent many people from saving, retrieving, and sharing the pictures they cherish. (Norman, 2003)

Once taken, digital photos are tied to current computing systems that shape and potentially mar our ability to let photos "do what they do". That is, digital photos have altered – and sometimes even lost – many of the affordances that helped create and sustain the culture of how we take, use, and in particular how we share print photos (Chalfen, 1987). The challenge for systems designers is to provide digital photos with affordances enabling the best practices that give print photos their value.

Of course, digital photos have their beneficial affordances, especially for encouraging distributed photo-sharing (Miller and Edwards, 2007). Tools for sharing photos over the web, via e-mail, instant messengers, social networking and photo sharing sites, combined with the increasingly widespread availability of broadband internet in homes, has made it easier than ever to gift-give photos to distributed friends and relatives, or even various web communities.

Still, many people find that showing print photos face to face in the home is the most enjoyable way to share photos (Frohlich et al., 2002; Lindley and Monk, 2006). In spite of the wealth of photos stored digitally, households rely primarily on printed photo albums for collocated photo-sharing (Frohlich et al., 2002). Intuitively, it is easy to see why. Consider the family shown in Fig. 1a as an example. This family's print photo albums are located in their living room on a public shelf. Perhaps as part of a conversation, any family member can easily take a photo album off the shelf and onto the living room table. They can easily sit around that album, pointing to photos and discussing them, and pass the album around for a closer look. In contrast, their social use of digital photos is awkward (Fig. 1b). They now have to move to their father's home office, as the father (as the primary photo-taker) keeps the family photos in his personal account on the computer located there. This setting is not ideal for family viewing. There is only room for one person to sit in front of the computer desk; the others must stand, sometimes at an awkward angle or distance from the display. Additionally, they must wait while the computer starts, the proper user account is logged into, the desired photos found, etc. The result is that digital photo-sharing may be excessively unwieldy, or awkward and not as engaging as print photo-sharing. More usually, it just may not happen, as serendipitous opportunities may not present themselves. Our study findings, articulated later in this article, highlight that these and other issues are commonplace for many families.

To recap, the problem is that digital photos are currently difficult to share face to face in the home. As with much of the current research in ubiquitous computing – especially in domestic computing – the challenge is to design computing technologies to fit in with existing routines and practices within the home (Dourish, 2001). The specific question then becomes: how can we design systems that encourage opportunities for face to face sharing in the home that are lost with digital photos?

Fig. 1. Sharing photos in the home (a) with print albums and (b) with digital pictures.

In this paper, we consider one possible answer: that the tangibility and physical location of home physical memorabilia – souvenirs, keepsakes and mementos – can create opportunities that naturally lead to collocated digital photo-sharing. Norman (2003) hinted at this potential solution in the juxtaposition of his discussions of souvenirs and photos as memory evoking objects. Of photos he says:

> Personal photographs are mementos, reminders, and social instruments, allowing memories to be shared across time, place, and people. (Norman, 2003)

Immediately after, he discusses how souvenirs and mementos are also valued for the memories they evoke:

> [A souvenir] is important only as a symbol, as a source of memory, of associations. (Norman, 2003)

Indeed, displays containing both souvenirs and framed photos, such as in Fig. 2, are common in many homes

Fig. 2. A display of photos and physical mementos.

(again, articulated in our upcoming findings and also found by Petrelli et al., 2008; van den Hoven, 2004). This suggests that we might be able to exploit the connection between memory evoking objects by using physical souvenirs as a link to digital photos. A similar idea has been articulated for recollecting past memories (van den Hoven, 2004, van den Hoven and Eggen, 2003, 2005, 2008).

As will be discussed in this paper, we wanted to see how a system designed around such a link could situate and encourage digital photo-sharing in the home. Our aim is not necessarily to supplant printed albums; we suspect the practice of printing and organizing subsets of favorites into print albums will remain with some families. Nor is it to suggest that all families keep and use physical memorabilia in a way conducive to photo-sharing. However, given the variety of families and the wealth of digital photos being taken and stored, we hypothesize that our approach is a reasonable way to reintroduce some of the affordances of collocated photo-sharing for some homes. It is also important to realize that we are most interested in making it easy to move into collocated photo-sharing. We are less concerned with the continued act of sharing as it transpires and the memory recollection that is part of this activity. However, we do discuss ways that one could move between photo collections while sharing.

To examine this hypothesis, we conducted contextual interviews with 20 households (Section 2), where we analyze how families currently practice print and digital photo-sharing (Section 3), and how they keep physical memorabilia (Section 4). We then describe SOUVENIRS (Section 5), a photo-viewing system that exploits memorabilia as a social instrument. Using SOUVENIRS, a family member can meaningfully associate physical memorabilia with particular photo-sets. Later, any family member can begin their story-telling with others through the physical memento, and then enrich the story by immediately displaying its associated photos simply by moving the memento close to the home's large-format television screen. We re-examined our design premises by evoking household reactions to an early version of SOUVENIRS (Section 6). Based on these interviews, we discuss and critique SOUVENIRS and how it can better reflect the real practices of photo and memorabilia use in the home. Related work will be discussed within the context of these sections.

2. Contextual study

To gain a better understanding of people's existing practices around film and digital photos and to understand how people used and stored memorabilia in the home, we conducted *in situ* contextual interviews with 20 families. These examined family routines for how they stored and shared photos, and how they used memorabilia.

We state outright that our work was originally design oriented: this study came after we had developed a first version of SOUVENIRS. We were inspired by an idea, developed a design rationale, and built SOUVENIRS to help us understand the design nuances. As we will see in Section 6, we used this first version as a technology probe (Hutchinson et al., 2003) with our study participants, where we evoked their reactions to a video presentation of this system. We then redesigned parts of SOUVENIRS to reflect their reactions as well as what we learnt about household photo-sharing and memorabilia practices.

2.1. Participant households

We recruited 20 Canadian households that spanned a range of lifestyles, occupations (e.g., dentists, graduate students, professors, sales engineers, bank managers, etc.) and ages (from teenagers to adults in their 50's). The households we selected were all families vs. room-mates or individual occupants. Families were our target audience: they would be more likely to share photographs within the home, and their shared collection of photos would be relevant to all family members (i.e., "family photos"). Yet we were not strict with how we defined our families: our final sample included some families with no children, some families with up to two children, and some families with up to two live-in grandparents. Additionally, all our households had at least one family member who took and stored digital photos on a regular basis. We tried to schedule families so that all family members would be available to participate. While not possible in some cases, most of our sessions did include all family members.

2.2. Method

We used semi-structured contextual interviews (Beyer and Holtzblatt, 1998), each approximately one hour long. Children under 14 years were not interviewed due to ethics concerns. Interviews were held in participants' homes, as this would allow them to recall and describe their routines for photograph and memorabilia storage and sharing in context. It also allowed us to gain a first-hand view of how these practices fit in the domestic environment.

We first asked household members to show us how non-digital and digital photos were organized, displayed, and shared within and outside the home. In being shown the

collections we became involved as observers in a sharing event, and, while these were artificially caused, it is likely that real sharing events would involve similar actions. Next, we asked household members what types of memorabilia – souvenirs, keepsakes and mementos – they collected, what memories were associated with these, and how they displayed them in the home. To ground our interviews within actual practices, we asked participants if they would show us (and if we could photograph) the location and the types of photographs and memorabilia they kept (Fig. 2 is an example). Interview and touring sessions were semi-structured in order to be opportunistic. We often used our questions to probe participant's actual context or asked if we could be shown a particular collection or display as it came up in the interview. We also asked participants about collections or displays as we came across them in the tour. Finally, we showed families a video demonstration of SOUVENIRS. They told us what they thought of it, how they might see themselves using it, and what they disliked or might want to see changed or added to it. This aspect of the study is discussed in Section 6.

2.3. Data collection and analysis

All interviews were audio recorded and handwritten notes were taken to aid analysis. We used the well-known open coding qualitative method (Strauss and Corbin, 1998) to analyze this data, and generated a large amount of codes that reflected a variety of household routines. We then used affinity diagramming (Holtzblatt et al., 2005) to categorize these codes and pull out important themes. These themes, rather than the individual codes, form the heart of our result section. However, we do provide an overview of our codes in subsequent sections to help ground future research in this space. Our findings are presented in three parts: use of digital vs. print photography, use of memorabilia, and reaction to our system design.

3. Photo-sharing in the home

The first part of our study was aimed at gaining a better understanding of people's existing practices around film and digital photos. We briefly present the related literature surrounding photo routines and then articulate our own interview findings.

3.1. Related literature

Our research targets a specific culture around photography known as the *Kodak culture* (Chalfen, 1987). Here, photography is undertaken by ordinary people (as opposed to professional and hobbyist photographers) who use photographs to participate in *home mode* communication: "*a pattern of interpersonal and small group communication centered around the home.*" This home mode emphasizes story-telling as a dominant feature of how photos are interpreted and shared (Chalfen, 1987).

While the Kodak culture is adopting digital photos, this does not imply that the Kodak culture embraces all digital photo methods. For example, Miller and Edwards (2007) found that websites for digital photo-sharing, such as Flickr.com, are largely unadopted by the *Kodak culture*. Indeed, another culture (which they call Snaprs) uses these sites primarily for showing off photographs (rather than family snapshots) to strangers. In contrast, *Kodak culture* people often relied on printed versions for sharing, but showed a preference for using e-mail (instead of websites) when sharing digital photos. This was because they prefer private photo-sharing with family and friends, as opposed to the Snapr notion of online public photo-sharing. This suggests that Kodak culture families would highly value technologies that can improve the manner in which they are able to share digital photos in their homes with family and friends, vs. strangers.

Other researchers have examined co-present story-telling over photos to elicit requirements for *photoware*: software aimed at photo-sharing and organization. Frohlich et al. (2002) found that co-present sharing is an enjoyable activity because it allows people to relive experiences, share them with others, and jointly reminisce. While performing these acts, people also had a strong preference for sharing prints because of their manipulability. Crabtree et al. (2004) investigated co-present story-telling further and articulated the importance of being able to *gesture* at photos and create *situated arrangements* (e.g., various piles of photos that designate public or private viewing). Building on this, Lindley and Monk (2006) found that prints were preferred for facilitating these types of interactions. They also found that people like viewing photos on large, high-resolution displays in social spaces (e.g., the living room), but dislike the need for crowding around a laptop or monitor when showing to larger groups. Slide show modes for showing digital photos were also seen to inhibit conversation by restricting the flow of sharing (Lindley and Monk, 2006).

While our research looks to encourage co-present sharing in the home, archiving and organization practices are worth considering as they affect how photos are made available for sharing. Frohlich et al. (2002) found that archiving prints mainly involves the culling and placement of photos into albums. However, in actual practice, this task becomes tedious and time-consuming, and, in many cases, is left undone. For digital photos, Rodden and Wood (2003) and Kirk et al. (2006) found a reliance on simple date/event based folder schemes. This works because people typically browse recent vs. old photos, so searching for a particular photo does not involve looking through the entire collection. Folders can also be used to narrow a search to a particular time or event. In this regard, Bentley et al. (2006) noticed that users will sometimes stop photo searching when a "good enough" photo is found, rather than continuing to search for a more optimal photo. They also noticed the act of *sidetracking*: photos encountered during searching can change the

direction of the search, providing more serendipitous opportunities for photo browsing. These results suggest that query searches for specific photos may not be necessary for personal/family photo collections.

Photos displays in the home can be considered as a means for both archiving and co-present sharing. Kim and Zimmerman (2006) found that two types of displays were used in homes: *formal*, and *informal. Formal* displays refer to professional posed photos (e.g., graduation photos, family portraits, etc.) placed on display. While these offer potential to start conversation with guests, it is the personal and candid *informal* displays that provide greater opportunity for story-telling. Swan and Taylor (2008) looked at particular examples of photo displays, and how their arrangements and properties convey meaning to home inhabitants and guests. For example, the positioning of two framed photos-one prominently visible, one somewhat obscured – can relay a message of the relative importance placed on them. The message may or may not have been intentionally created, but, nevertheless, artifacts of print photo displays in the home can convey impressions of the home and affect the story-telling narratives given around the displays (Taylor et al., 2007).

3.2. . Overview of analysis codes

Our interviews about print and digital photos build on the related work by focusing on how families manage, store, and share their photo collections. In particular, we were interested in how various technologies and techniques for photo management created opportunities and influenced families' abilities to share their photos. The result of these interviews was a large body of discussions about families' practices and experiences with their print and digital photo collections.

We used open coding to analyze and pull themes from these discussions – an overview of the codes is shown in Table 1a. A full listing of the codes is available in Nunes (2008); the table is a summary that breaks the analysis into five main themes, giving subcategories for each theme along with example codes. The table highlights some of the ways we saw families describing their practices with photos, and how we were able to break these descriptions down for use in our analysis. While our results will be presented in later sections, this piece of our analysis is relevant to consider for future research into domestic photo routines (e.g., as a basis for focusing inquiry or analysis). The five main categories shown in the table are briefly described below:

- **Photo types** (Table 1a) describe the kinds of photos that comprise a particular collection. Participants tend to take particular types of photos, and the type influences what they choose to display or share with others. Participants' descriptions of types often included the occasions that prompted photo taking, the content of the photos themselves, or meta-information about photo-sharing, (e.g., giving duplicates to a person in the photo).
- **Storage locations** (Table 1b) describe the physical locations where collections are kept. Descriptions typically include high-level areas in the home

Table 1a
Sample analysis codes: photo types.

(a) Photo types	Example codes	Description
Occasions for photo-taking	[Trips]	Vacations or other events that involve going places
	[Special events]	Parties, ceremonies, performances, etc.
	[Day-to-day]	Around the home, candid, day-to-day pictures
Content of the photos	[Friends]	Photos of friends
	[Architecture]	Buildings
	[Scenery]	Photos of nature, etc.
Meta-info about particular photos being stored or shared	[Copies]	Doubles of prints
	[Relevant]	Photos relevant or interesting to the people they are being shared with (e.g., shared experience, common interest)
	[Recent photos]	Photos taken recently

Table 1b
Sample analysis codes: storage locations.

(b) Storage locations	Example codes	Description
High-level area (i.e., room)	[Office]	A home office
	[Living room]	The family living area
	[Parent house]	Items stored in a parent's house
Low-level container	[Shelf]	Placed on a shelf
	[Drawer]	Placed on a drawer
	[Fire safe]	Kept in a fire-proof safe

Table 1c
Sample analysis codes: storage types and strategies.

(c) Storage types/strategies	Example codes	Description
Physical form of storage	[Album]	Kept in albums
	[Loose]	Loose photos
	[DVD]	Stored on a writable DVD disc
Organization Schemes	[Event]	Stored by event
	[Chronological]	Stored in order by date taken
Rationales for storage choice	[Available space]	Location chosen because it provides adequate spaces to store the items
	[Near guests]	Stored in a place near where guests would be
	[Pragmatic]	Pragmatic reasons (e.g., because it's a shelf, or photos hung where there are studs in the wall)

Table 1d
Sample analysis codes: likes, dislikes and challenges.

(d) Likes/dislikes/challenges	Example codes	Description
Potential for sharing	[Send link]	Sending a link, rather than an email attachment
	[Screen viewing]	Viewing on screen presents difficulties (e.g., viewing angle, brightness, etc.)
Organization	[Avoids clutter]	Storage mechanism avoids clutter
	[Hard to caption]	Hard to write captions or labels for digital photos
Safekeeping	[Prevent damage]	Storage mechanism helps to prevent damage to the photos
	[Archival]	Will the format be archival? Will the photos still be viewable in 50 years?
Accessibility	[Easy access]	Easy to get at the photos
Technological issues (digital)	[Loading time]	Time taken to load up digital pictures
	[Slow connection]	People with slow internet connections will have a hard time sharing photos
	[Unreliable]	Loss of access due to system failure (e.g., online site is down, or system crash)
Tangible form (prints)	[Hides technology]	Technology behind photo showing is 'hidden' when sharing prints
	[Fun to search]	Searching through photos is enjoyable, get to look at the others you might not have been looking for

Table 1e
Sample analysis codes: Finding strategies.

(e) Finding strategies	Example codes	Description
Explicit markings	[Date]	Might find searching by date
	[Album label]	Might be able to find in a labeled album
Implicit markings	[Album style]	Style of the album (i.e., cover color), can remember contents from appearance
Browse	[Guess]	Would have to guess where a picture might be
	[Flip through]	Would have to flip through photos

(i.e., rooms), or lower level information about particular containers in which photos are kept (e.g., shelf, drawer).

- **Storage types and strategies** (Table 1c) describe how photo collections have been organized and managed. This typically includes information about the physical form of storage, organization schemes, and rationales for the photo storage routine.
- **Likes/dislikes/challenges** (Table 1d) refer to descriptions of participants' experiences in managing and sharing their photo collections. This includes issues that affect the potential for sharing photo collections, issues relating to how easily photo collections can be organized, kept safe, and easily accessed. This also includes issues in dealing with digital technology needed for managing digital photos, and experiences with the tangible form of prints.
- **Finding strategies** (Table 1e) refer to participants' descriptions of how they would go about finding particular photos as a precursor to sharing. This typically includes using explicit markings (such as when an album has been labeled), implicit markings (such as knowing that a photo-set is in a particular style of album), or having to browse photos in order to find a desired set.

3.3. Organization and location

We now describe the practices we saw surrounding these coding categories. For our purposes, we distinguish photographs in terms of how they are stored vs. how they are taken. During our interviews, we found that people discussed photos based on how they are stored and used,

rather than on what camera (digital or film) they used to take the photograph. In particular, families who maintained print photo albums after switching to a digital camera treated them as print photos, and often had only a fuzzy idea of which prints were originally film or digital. Similarly, those who scanned in old prints as digital copies treated them as digital photos. To understand the differences in use between these two types of media, our results focus on comparing the routines surrounding print photos with digital ones.

Much of what we found replicates and confirms previous findings. For brevity, we restrict our presentation to those aspects that go beyond what was previously shown, or that emphasize prior findings related to issues in photo-sharing.

Like existing research, we found that **print photo collections** were typically stored in photo albums, photo envelopes, and photo boxes (also found by Frohlich et al., 2002). Photos were also placed on display throughout the home in both formal and informal locations (also found by Kim and Zimmerman, 2006). In terms of collocated sharing, what we found to be most important, with respect to this, was the public nature of these locations. That is, these locations served the purpose of providing serendipitous opportunities for photo-sharing as photos placed on display in a common area of the home could easily be noticed by guests. Participants described this type of serendipitous sharing and we observed it first hand as we toured participants' homes.

Digital photo collections, on the other hand, were typically found in much less public locations. That is, they were mainly kept in folders on the computer or on CDs/DVDs (also found by Frohlich et al., 2002). Some participants also kept copies of photos on an online site as it allowed for easier sharing with remote family/friends, however, this did not typically make digital photos more publicly available *within* the home. As participants showed us these locations, it became clear that their digital photos were not easily accessible for sharing because they were strongly tied to the computer they were kept on and, thus, its location. When asked to view the families' digital photos, it was typically only with considerable effort that they were able to do this, e.g., logging in to the computer, finding the photos, and displaying them for us. Participants also described situations where this happened when they had family or friends over:

> You've got to go to the computer right, you can't just go to the kitchen table with it. Which is where – we had my birthday party, remember, where'd everybody hang out? We've got all that space and all that space and everybody was just right here. Unless you have a laptop with wireless, which we don't have…" – P16, Husband

3.4. Family member roles

Next, we wanted to determine the roles of family members when storing and organizing the photos. Specifically, we wanted to see the following: if there was a primary photo organizer; if knowledge of photo collections was largely relegated to that organizer; and whether other family members shared knowledge of these collections, which in turn would allow a particular member to recall, find and show photos stored and organized by someone else.

We expected significant differences between print and digital photo collections.

In **print photo collections**, the roles varied by family type. For families with children, we found that photo organization, such as photo albums, was primarily undertaken by a single parent – usually the mother. Although others would sometimes help in the organization, this was usually in a secondary role. What was striking was that in most instances *all* household members were aware of the collections, even though the collection was maintained by a single person or family subset. This was typically because the collections were stored in common areas of the home shared by all members of the household (e.g., living room, shared home office), thereby creating and promoting shared household knowledge.

Households consisting of younger couples differed. This was generally because the couple had not been together as long, and the idea of a shared family collection had not yet evolved and solidified. These participants often had personal photo collections that had been kept and maintained separately, where the collections began prior to couplehood. Thus, the collections were largely personal and perhaps less relevant to the other person. As a result, shared knowledge of these collections varied. In instances where personal albums had been placed on shelves throughout the home, we saw that participants did share knowledge of them.

Digital photo collections containing family pictures were also maintained by a single parent in a family with children, but this time more often by the father. In sharp contrast to print photos, knowledge of collections was generally limited to the person who had organized them. While some family members may know that a photo collection was being kept, they often did not know what was there or how to access them. Because our interview protocol asked a family member to show us the digital photo collections in the presence of other family members, this lack of knowledge was often revealed as in the quote below:

> Father: [after showing the mother some folders containing photos] Did you know that? Mother: No, I don't use that, I don't know.-P1, Mother and Father

Even when participants knew a photo collection was being kept, there was reluctance expressed about accessing a collection maintained by another family member. This reluctance was because photos were managed under individual user accounts, or even computers, which were seen as private-belonging only to the owner.

> I'd use [my husbands] computer but it's his computer. I know his password but it's like his space. And my computer is my space-P4, Wife

Because access to the digital photo collections was often limited, we saw that the primary organizer usually took on the role of a librarian for the family photos. If another family member wanted access to a particular photo or set, they would resort to a social channel for access, relying on the primary organizer to retrieve the photos for them.

> I don't think they even know about the organization. Usually when they wanted some [photos]-like for her project, she'd ask 'Mom, can I have', you know, a picture of her in an occasion. And then I will find it and I will get her a copy-P8, Mom

Only one of our families maintained photos collectively, where they chose to store them in the common root folder C:/photos. Most other families used a folder held within a user account, typically My Documents/My Pictures. However, older children (e.g., teens) who took photos tended to maintain and control their own digital photo collections quite separately from the family collection.

To summarize, both print and digital photos had a primary organizer. With print photos, photo-sharing is easy as all were aware of the collection and how to access it. With digital photos, photo-sharing proved difficult, as family members often did not know about the collection or how to access it, or were reluctant to access them because they were stored in personal accounts.

3.5. Why and how people share photos

When we looked at how families chose photos to share (Chalfen, 1987), we noticed a correlation between their motivation for photo-sharing and the means they used.

1. **Displayed photos** are those placed out in the open, typically in frames hung on walls or placed on shelves. These photos are readily noticeable by any one within their general vicinity. In this way can be shared implicitly.
2. **Shown photos** are those that an owner brings out specifically to share with others, e.g., a print album of vacation pictures taken from a shelf and shown to guests, or a wedding slide show (slides or digital) shown to relatives.
3. **Gift-giving photos** are given as gifts to the recipient. Gift-giving does not necessarily involve face to face sharing; recipients are free to look at the photos at their convenience. Examples include mailing or handing off printed doubles, or e-mailing digital photos to friends.

For **displayed photos**, family members typically chose photos based on aesthetic vs. communicative reasons. That is, they chose photos that were personal favorites, where the idea that guests would also see them was not the main influencing factor.

> Everyone has their favorite ones that they want to print and display. In fact I have a bag of negatives because I think – this is just a rental property – but I think I'm gonna have a house someday, and I'm gonna want to blow this one up and frame it. – P17, Wife

For **shown photos**, we asked family members about why they showed particular photos to guests (Chalfen, 1987). Their reasoning typically included the guest being in the pictures, or the guest having shared the experience or event shown in the photos, or that it led naturally from social relevance (e.g., conversations about particular vacation destinations). Thus the particular guest and the course of conversation are the primary factors, rather than simply showing some recent liked photos.

> Just if we thought it would be interesting to someone else. Like if there are people we did sports with or hiked with-like our mountain trips. Or if we're traveling somewhere-someone that's interested in hearing about the trip, we'd show.- P5, Father

For **gift-giving**, participants often stated that photos were chosen and given as a "status update" to infrequently seen family and friends, i.e., to provide interpersonal awareness to intimates living outside the home (Neustaedter et al., 2006). Photos typically illustrated recent life events, or present new photos of children growing up.

> My parents…anytime they take pictures they make us copies ... and we get copies of our nieces and nephews or our kids that they've taken. Usually it's kid related. – P5, Mother
>
> I was living in a resort at the time, so I was sending them to my family and sharing them with them that way…I would send the scenic pictures because, of course, the mountains are so beautiful. And I would also send them, like if I had a friend I talked about a lot, I would send 'oh, this is…we work together'. – P17, Wife

Print vs. digital photo-sharing – The differences between print and digital photos affect how people share photos. A summary of our findings for the methods and motivations for sharing photos and how they are amenable to print and digital technologies is given in Table 2. At one extreme, physical prints are currently more amenable as *displayed*

Table 2
Photo sharing methods and their amenability to technology.

Photo sharing method	Most common motivation	Most amenable technology
Displayed Photos	Aesthetics/favorites	Print
Shown photos	Social relevance	Print and digital
Gift-giving	Interpersonal awareness	Digital

photos (Table 2, row 1). While digital photo-frames are readily available, they are still expensive and constrained by power, lighting conditions, and limitations on how they can be positioned in a particular space. Indeed, there is some evidence suggesting that digital photo-frames are ill-conceived as replacements for print photos (Swan and Taylor, 2008). Only one of our families owned a digital photo-frame, and they stated that this was kept off most of the time:

> Well we used it at Christmas when we first got it. And we actually think we'll take it with us the next time we travel-cause you can see the pictures a little better on that rather than on the digital camera...I think we probably would use it more if we were having a bunch of people over. But when it's just us, we don't bother plugging it in.-P9, Wife

At the other extreme, digital photos are seen as much more effective for *gift-giving* (Table 2, row 3). Compared with the cost and effort of print duplication, it is very easy to e-mail others photos and links to online albums. *Shown photos* are still amenable to both print and digital media (Table 2, row 2); while many participants liked showing slide shows on computers or laptops, those who maintained print photo albums preferred to show those.

As mentioned earlier, new cultures have emerged around sharing photos on websites such as Flickr (Miller and Edwards, 2007). In form, this kind of sharing resembles gift-giving, however it seems to be centered on sharing aesthetically-pleasing photos, although often with "strangers."

Sharing and tangibility – Notwithstanding the above, we were somewhat surprised by how many people still chose to print photos that they had taken with a digital camera. For most, the affordances of a paper print, especially for showing, was superior and still had great appeal. First, printed photos offered *easy viewing.* Participants reported that printed photos hide the technology that would otherwise be visible when viewing on a computer. This could include the physical appearance of the computer, the necessity of navigating a GUI in order to find and display photos, or the lower image quality when viewing on a computer monitor relative to a print. Efforts in finding and navigating to digital photos on the computer, invoking the correct application to view them, or selecting and placing photos on another media to be shared are avoided with printed collections. People also said they preferred not to use computer technology when showing photos to older relatives, as they may not be comfortable with that technology.

The tangible form of the photo album was also reported to have a positive effect on the *social engagement* of families and friends when sharing photos within the home. This tangible engagement is revealed in the two quotes below.

> I really like having them there to look at… just having it more like a book so you can socially sit and go through things with like my mom and friends – P5, Mother.
>
> I really like to be able to grab something and hold on to it and look at it and pass it around. Where, the digital, you stick it all on a CD and it takes less space, but you don't do anything with them. – P16, Wife

A physical photo album can be held and passed around, and this ability actively engages those who are being shown the photos. Showing the photos on the computer may resemble more of a presenter and audience relationship, as those being shown the photos have no control and are less likely to become involved. Another social benefit of prints, reported by other researchers (Crabtree et al., 2004; Lindley and Monk, 2006), is that the arrangement when showing photos on a desktop computer prevents the presenter from seeing the reactions of those being shown the photos.

3.6. Discussion

In summary we can see that digital photos have significant problems when it comes to co-located photo-sharing, all of which stem from their abstract and hidden nature and lack of true physicality. Print photos, on the other hand, fit co-located sharing well because of their physicality:

1. **Location** – Print photos are typically easy to access because they are in printed form and placed in areas that frequent sharing activities. This makes them visible and ready at hand for sharing. Digital photos on the other hand are located on computers that are hidden, hard to access, and not necessarily in locations amenable to sharing.
2. **Serendipity** – Print photos are easily placed on display in homes and this creates opportunities for serendipitous conversation and photo discovery. In contrast, digital photos are generally not readily visible in the home to spark such spontaneous sharing opportunities.
3. **Accessibility** – Both print and digital photos are typically maintained by one family member; however, the placement of print photos in a public home location means that other family members know about the photos and can access them. In the case of digital photos, knowledge of them by family members other than the primary organizer is limited and people are reluctant to search for them. Computer access restrictions further circumvent other family members from finding digital photos. One can certainly print digital pictures, yet doing so for all of one's photos is not a reasonable option for most. It is expensive, and it does not scale well to the myriads of photos that people now take.
4. **Ease of viewing** – Print photos can be quickly shown to others and people actually prefer to touch and pass

around tangible representations of their memories. This certainly contrasts with digital photos, which do not typically have any physical form factor. Of course, digital photos could be presented on a laptop or tablet PC that is passed around, but this does not get around navigation issues involving computer software. That is, to display any photo, users must first navigate through various windows, menus, or dialogs. This is somewhat akin to flipping pages in a photo album to find a desirable photo for sharing, yet the fact that one is viewing photos as they browse (found to be desirable) is much different than viewing applications and windows unrelated to the act of photo browsing.

We also saw that people share photos for different reasons and using different means. In the digital realm, *gift-giving* is already well handled by asynchronous messaging systems (e-mail, instant messengers) and by special purpose websites. *Displayed photos* are now being addressed by digital photo-frames, although its general acceptability still has a long way to go. *Shown photos* are the sweet spot for any system that links physical memorabilia with photo collections. As we will show later, this is where memorabilia could play a role in promoting easy sharing of digital photos in a socially engaging location.

4. Physical memorabilia: souvenirs, mementos and keepsakes

The next stage of the study investigated participant families' practices with physical memorabilia to better understand how souvenirs, mementos, and keepsakes may or may not work well as a means to easily move into collocated photo-sharing. Again, we first present the related literature and then articulate our own interview findings.

4.1. Related literature

Souvenirs, mementos and keepsakes are all types of *physical memorabilia*, i.e., an object deliberately kept by a person as a reminder of a person, place or event, and which are directly meaningful to their memories (Petrelli et al., 2008). We use these terms somewhat synonymously in our discussion below.

Several researchers have studied the collection, use, and importance of memorabilia. Matching the definition above, Csikszentmihalyi and Rochberg-Halton (1981) found that souvenirs, heirlooms, and mementos were amongst some of the most cherished objects in the home because of their associated memories. Yet their work did not provide a detailed discussion of these objects; instead it looked at the broader meanings and sense of self-created by objects in the home. A focus group of five participants was conducted by van den Hoven and Eggen (2005) to further define "souvenir". This work turned up a variety of potential meanings: objects symbolizing relationships between people, places, moments, etc.; objects that have emotional value; or, objects used to evoke memories. What is notable about all three of these definitions is that each involves "*physical objects to which memories are attached.*" This, of course, ties directly into our own motivations for pursuing further studies of mementoes as an affordance for entering into photo-sharing sessions. The focus group also revealed that participants' most valued souvenirs were often kept on display in a public location such as the living room. In a follow-up survey of 30 participants, 22 reported having media related to their most valued souvenirs: photos were most common, but other music and video were also reported.

The work of Petrelli et al. (2008) is highly related to our own study. Their work considers how digital technologies for evoking memories can be designed by leveraging the role that physical objects already play as mementos in the home. In this respect, they describe a study of household routines for collecting and displaying mementos. The study was conducted independently but in parallel to our own, using a very similar method, although they studied participants in the United Kingdom and ours were in Canada. Both studies were reported at conferences within a few months of each other (our initial report in Nunes et al. (2008) precedes theirs by only two months). Petrelli et al.'s study focuses on identifying categories of mementos in terms of the type of object that is being saved or collected. These included the following: digital objects, photos, artwork, everyday objects (e.g., a cup, memorabilia (e.g., a set of illustrated cards), and idiosyncratic items (e.g., a father's ashes). They also offer a detailed comparison of the locations in which people place these types of items, namely public, family, or personal spaces (with the addition of being concealed or visible). Here we can draw an additional understanding (not articulated by Petrelli et al.) that some mementos will be more accessible for linking with a photo sharing application than others given their location. Petrelli et al. also show that mementos are memory triggers for different time periods. In particular, 46% of mementos studied were related to events or people in the recent past. This shows promise for linking mementos to digital photo collections, given that digital photo collections are predominantly from the recent past (digital cameras have only become widely used in the last decade). Scanned photos could certainly be linked with mementos mentally linked with the distant past, and, in this case, Petrelli et al. found items relating to childhood, youth, and one's roots.

In contrast to Petrelli et al.'s study, our results directly present souvenirs in terms of how they may or may not be good items to link to collections of photos. We realize this is a subtle distinction, yet it is an important one for our approach allows us to directly anticipate which souvenirs and mementos can be leveraged easily within a photo sharing system like SOUVENIRS. This distinction should be expected for our work began from a design perspective where we had already created an initial version of

SOUVENIRS. Our study goal was to better understand the system's context of use. Petrelli et al. (2008) began with their study of domestic routines surrounding souvenir usage with design opportunities coming after. Neither approach is better, each offers distinct value. In subsequent sections, we compare Petrelli et al.'s additional findings to ours, where we highlight the distinctions.

4.2. Overview of analysis codes

Our own investigation of memorabilia centered on three key points:

1. **Types of memorabilia** – What items are kept and collected? What size are they? How easily can they be moved?
2. **Location** – Where were items located throughout the home? How easily could they be accessed? How noticeable are they to guests?
3. **Memory association** – What memories are associated with items? Are memories associated with both the items as well as particular photo-sets? How easily could the physical items be linked with photo collections?

We used the same coding method as we did for coding family photo routines – an overview of codes is shown in Table 3. Again, we do not list all codes (see Nunes, 2008 for that) and instead highlight several that could act as a basis for future investigations. The five most prominent themes from our data are shown in the table are briefly described below.

- **Memorabilia types** (Table 3a) refer to descriptions about what kinds of memorabilia family members collect, ranging from items deliberately intended to act as a memento, such as *collectibles*, to others not originally intended to provoke memories, such as *personal accomplishment* items or *trip output.* (e.g., maps and pamphlets).
- **Reasons for collecting/not collecting** (Table 3b) refers to descriptions of why memorabilia are collected. Example reasons include to serve as a souvenir from a trip or event, or to act as a reminder of one's heritage. If participants did not collect memorabilia, this category includes descriptions of why they were not collected, such as to avoid clutter from storing them.
- **Storage locations** (Table 3c) refer to the physical location where memorabilia are kept. Descriptions typically included high-level areas of the home (i.e., rooms), and lower level containers or places that memorabilia are stored (e.g., shelves, walls).
- **Reasons for locations** (Table 3d) refer to descriptions of participant's rationale for keeping memorabilia in a

Table 3
Sample analysis codes for souvenirs.

(a) Memorabilia types	**Example codes**	**Description**
Collectibles	[Statues]	Statues (small or large)
	[Dishes]	Ornamental dishes, e.g., plates, vases
	[Pins]	Small pins with a picture or emblem printed on them.
Wearables and	[Food]	Food items, e.g., tea, chocolate, candies.
consumables	[Clothes]	Clothing items that can be worn, e.g., hats, shirts
Personal accomplishment	[Trophies]	Trophies or medals won for personal or team accomplishment
Trip output	[Maps]	Maps of trip locations
	[Pamphlet]	Pamphlets describing a location, e.g., schedule, itinerary, handouts from tours
(b) Reasons for collecting/ not	**Example codes**	**Description**
Collecting	[Roots]	A reminder of one's heritage and cultural roots
	[Memory]	A memory of the event or location
Not Collecting	[Clutter]	Souvenirs are seen as being messy and producing clutter
(c) Storage locations	**Example codes**	**Description**
High-level	[Bedroom]	A family member's bedroom
	[Living room]	The family's living room
	[Office]	Room designated as a home office, e.g., where the computer is kept
Low-level	[Shelf]	A shelf hanging on a wall, or case of shelves
	[Wall]	Hanging on a wall directly
	[Storage]	A storage shelf or area in the home
(d) Reasons for locations	**Example codes**	**Description**
Rationale	[Display]	An area that is easily visible publicly in the home
	[Not clutter]	An area that would not make the items look like clutter
	[Space]	An area that has enough space to store items
	[Conversation]	An area that it can act as a conversation piece
(e) Associated memories	**Example codes**	**Description**
Direct experience	[Event]	Memories of the event
	[Location]	Memories of the location the item is from
Indirect experience	[Roots]	Reminder of one's heritage or roots
	[People]	The people who gave the item to a family member

particular location. This typically included reasons such as placing the item where it could be seen on display or act as a conversation piece, or placing items where there is adequate space to store them and the items do not cause a cluttered appearance.

- **Associated memories** (Table 3e) refer to participants' descriptions of the memories that each memorabilia item evoked. Descriptions typically included direct experiences where the item evoked a memory of a specific place or event, or indirect experiences, such as to serve as a reminder of one's heritage or as a reminder of the person that gave them the item (if it was a gift).

We now focus our discussion around the four types of souvenirs that we saw: *collectibles* (individual and group), *wearables and consumables*, *personal accomplishment*, and *trip output* (Table 3a). Here we interweave findings reflecting the other themes identified by our codes to illustrate the locations, memories, and reasoning associated with souvenir collection and displaying routines.

4.3. Collectibles

Collectibles are memorabilia that represent places or events. As a group, collectibles contain by far the greatest variety in types of items. Examples include things such as decorative or artistic souvenirs from a place, statues, rocks, or postcards. Thus, the Collectibles category could easily include items from most of the categories presented by Petrelli et al. (2008), e.g., artwork, everyday objects, memorabilia, and idiosyncratic. We were also able to further break down our Collectibles category into *individual* or *group* collectibles, which is an important distinction that we articulate.

Individual collectibles are typically one-off items chosen to represent a specific place or event. These items can range from knick-knacks (e.g., the birds and ship in Fig. 2) to those that are decorative or artistic. Collectibles are often kept on display. Fig. 3, for example, shows several collectibles in one family's home. From left to right, the ornamental trees on the shelf, the painting on the wall, and the statue on the stand were all collected from various locations that the family has traveled. Another participant describes several of the individual collectibles on display in her home:

Fig. 3. Example collectibles on display in the home.

> It's a bouquet of tulips. That would represent our trip to Holland because Holland is known for their tulips. And the reef shark there represents our trip to Fiji because we saw a lot of reef sharks…the didgeridoo, you look at it and you automatically know it is from Australia… at least I do. – P11, Wife

Some families profess to eschew memorabilia. Yet closer inspection reveals a different story. Consider our "Banica" family participants (mother, father, and teenage daughter). They moved to Canada from Romania 5 years ago, and their grandmother has been staying with them on an extended visit for over a year. At the beginning of our interview, the family claimed not to have very many mementos on display. As described by the mother:

> If you ask me, I don't like too many things displaying around the house. I find it tiring. I like an open space. That's why I don't like too many decorations

However, they did describe the importance of sharing photos from Romania in order to share their heritage with their new Canadian friends:

> We are Canadians now, but we came from Romania five years ago and lots of friends and Canadian people wanted to see our background. So we bring some of these from Romania – to show to the church, to the people we meet, to the friends.

As the interview progressed and we were shown around various locations in the home, we found that mother, daughter, and grandmother collected a large amount of memorabilia from Romania. These items, such as art work, ornamental and religious items, etc., were placed on display and spread throughout the home – including a guest room/office, on walls in the main living area, and even in a finished basement. Fig. 4 shows just a small sample of the collectibles found in the Banica family's home. As we came across these items, we found many of them led to story-telling, which gave a very detailed picture of their heritage.

> This is a very well known Romanian writer, so when I see this picture I remember my background – I've been a teacher in Romania – my background, the writers, all that.
>
> This I brought from Romania, we like this kind of art. When we see them we think about the places in the mountains. They have villagers…people from the village that don't have studies to do art. They do crafting…that kind of art. And I think about those places, as we used to go to the mountains. They were displaying them on the streets there.

Fig. 4. Examples of collectibles reflecting cultural heritage.

> This is very famous in Romania, it's what they call the miracle icon. The people go there…they go and prey and they get their wish there.

The family did not have many opportunities to return home so these items, which were highly representative of their heritage, were very important in allowing them to pass cultural knowledge from parents/grandparents to their child. As the mother describes, these items allowed them to remember:

> The places, the people, and feelings as they relate to our background and history and memories.

While the family may not consider these items too often in their daily life, the various items displayed in their home provide opportunities for story-telling and reflection, which was seen as an enjoyable experience.

> [The tour] made me think about when you run around too much, we don't think about the stuff that we have…it was nice because in the beginning I was thinking 'Oh, what can I show?'

As with print photos, we found that the location families chose for individual collectibles was largely motivated by pragmatic reasons, such as where there was adequate room to display them, or by aesthetics, such as where they fit in with the décor of the house. In particular, they tended to be decorative and often found on public display in various locations throughout the house, e.g., hung on walls, in bathrooms, or on shelves and mantles.

As a group, individual collectibles appear to be immediately promising for linking to photos. They are usually selected as they convey an image reminiscent of the place or event they represent. These items tend to be placed on display, often in areas for entertaining guests. Because these items are often strongly representative of the places they are from, they can become conversation pieces that in turn could lead into serendipitous opportunities for photo-sharing. Thus, they offer potential for usage as a part of a photo sharing system. Yet our further analysis, which builds on these descriptions and that of Petrelli et al. (2008), shows that such usage is tempered by several factors.

Fig. 5. Fragile or difficult to move collectibles.

The first problem is mobility. Some items are small and robust, so they could easily be moved around or used in conjunction with a photo sharing system. For example, the religious artwork in Fig. 4 (left) is highly mobile and unlikely to break. However, other items are heavy and fragile, which makes their use problematic. For example, the dishes shown in Fig. 5 (top) (which evoke cultural memories for another family in our study) are fragile: family members would not want to move or touch them for fear of breaking them. The second problem is location. Items like the dishes in Fig. 5 (top) could be in a hard to reach location – the shelf is approximately 6 ft from the floor. The third problem is that sometimes there is no option to move items at all. For example, the cloth art in Fig. 5 (bottom) is fixed to its location on the wall. A fourth problem is location. While individual collectibles would most commonly be displayed in areas for entertaining guests, they could also be located in other private or less convenient places around the house. If a desired item were not nearby, it would have to be retrieved for use with a photo sharing system. On the other hand, these more privately located artifacts may implicitly help to keep certain photos more private for viewing, e.g., a teenagers' photos that she only wishes to share with her friends.

Fig. 6. Group collectibles: pins kept in a drawer.

Fig. 7. Group collectibles: painted rocks gathered from hikes.

Group collectibles are another sub-category of collectables, where the owner has a special interest in a certain type of object and seeks to form a collection of them. Some of the items we saw were from trips the collector had been on personally, while others were gifts from friends who knew that the person had an interest in that type of item. Examples include money, stamps, postcards and even souvenir pins from various countries (Fig. 6).

> My husband especially likes to collect stuff. He wants to do a map and have a coin from every country. – P3, Mother

As another example, consider the "James" participant family. The James' had moved to Calgary in the last few years and had begun taking family outings to go on hikes. On these hikes they took many photos, some of which were put into a framed collage and placed on display in an upstairs hallway. The mother describes her enjoyment of the display:

> We did lots of hiking and I was so excited about everything we saw…and it's easy, every time I come out I pass [the photos] and I remember.

When we asked the James family about their souvenir collections they said they did not often like to buy souvenirs. They had, however, made a regular practice of collecting stones from their various hiking trips. The stone collection had been turned into decorative pieces – they had been painted and given a label underneath with the hike they were from. The collection had then been placed on display on the living room fireplace ledge (Fig. 7), and as the father noted it "*helped give them initiative to continue [hiking]*".

Group collectibles tend to consist of many small items, and as such they are often kept together in an out-of-the-way storage such as a drawer. For example, Fig. 6 shows how one family located their souvenir pin collection in a special desk drawer. Because of their likely location, certain group collectibles may not be amenable for linking to photo collections. Yet some of the more decorative group collectibles, such as James' stones, are placed together in a public display. As these items are small and tend to be kept together, they could potentially be kept in a collectible box in a convenient place that would allow them to be used as part of a photo-viewing system. Linking individual items from a group of collectibles would be suitable as part of a photo sharing system. However, if items were visually similar, it may be difficult to remember which item corresponded to which event or place. This is because group collectibles are sometimes mentally associated with a general event type (e.g., hiking) as opposed to specific outings.

4.4. Worn/consumed

Our next class of mementos, *worn or consumed*, includes items such as clothing, jewelry, or food that were acquired on trips and are representative of or unique to the place they are from. For example, one father described to us how he would routinely bring back chocolate from his travels, as he found chocolate differed between regions or countries. Like collectibles, worn/consumed items were representative of the place they were from; however, they were purchased for a more practical reason – to be worn or consumed. These types of items could again fall into several of Petrelli et al.'s (2008) categories, e.g., everyday objects, memorabilia, or idiosyncratic. However, we go beyond these categories with the realization that items may have a deterioration (e.g., if a clothing item is repeatedly worn) or disappearance (e.g., an item is eaten) factor. Given this, their long term availability is questionable. As such, these items would be unsuitable for linking with photos as part of a photo sharing system, so we do not discuss it further.

4.5. Personal accomplishment

Personal accomplishment mementos are items that commemorate personal achievements in activities such as sports or musical performance. Items in this class typically include trophies, medals, or certificates. These items do not appear immediately appear to fit within any of the categories as described by Petrelli et al. (2008). This could identify a cultural difference stemming from our participants where items representing personal achieved are valued as mementos by Canadians. Further investigation of the routines in the United Kingdom would need to be performed to validate this assumption however.

Fig. 8. Trophy and medal mementos of personal accomplishment.

Personal accomplishment items were commonly displayed on shelves or framed and hung on walls. In some instances they were displayed in public areas of the home, such as the living room. However, because they are personal, they are also often kept displayed in a personal space, typically a bedroom. For example, Fig. 8 shows a display of basketball awards kept on a shelf in a teenager's bedroom.

Personal accomplishment items may seem like an obvious fit for linking to photos given that they represent important milestones in peoples' lives. However, some of these mementos were too general to link to a specific set of photos. For example, a trophy won at the end of a basketball season reminded the participant of the more abstract notion of the basketball team rather than any one particular event. As such, it could be associated with several photo-sets, e.g., photos from the season, photos from the winning game, or photos of the team. This confusion could cause difficulties for creating and remembering associations for certain items used with the system. One could of course associate the item with all of these facets of the basketball team and season, but that could easily cause too many photos to be made available if one were interested in a more targeted photo sharing session. Personal accomplishment items also suffer from location problems, similar to individual collectibles, particularly when kept in personal spaces (e.g., bedroom). That is, items would be unavailable for prompting serendipitous photo sharing encounters.

4.6. Trip output

The final class of mementos, *trip output*, is comprised of items that are gathered as a result of a trip, but unlike collectibles are not deliberately purchased as a souvenir. Instead, they are accumulated as a result of planning and carrying out the trip. Typical trip output includes items such as tickets, maps, or pamphlets (Fig. 9). When comparing to Petrelli et al. (2008) work, we can see these items would likely fall within their idiosyncratic category as a sub-category of this group.

Trip output items are not immediately thought of as souvenirs, nor are they considered decorative items. Indeed, most had no immediate practical purpose after the trip, so they were often stored away and seldom brought out. However, they proved highly valued for the memories associated with them and were rarely thrown away. That is, many families kept trip output collections to recall memories of the trips they were from.

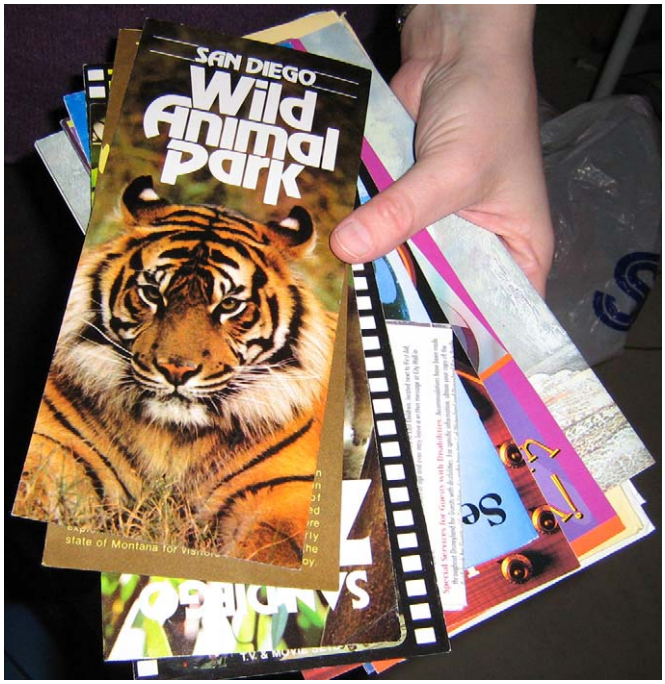

Fig. 9. Maps and brochures as trip output. *Note*: Fig. 10 is supplied as both single image (comprising 7 images and captions), and as a set of 7 separate images without captions. If the later set of individual images is used to compose Fig. 10 instead of using the single image, the captions for the individual images are below.

> I think I collect everything. I keep ticket stubs, receipts, brochures, and sugar packages…Originally it was because of the scrapbooks because I knew I'd have a way to save them all. And I guess it just invokes more memories of the vacation…sometimes they're funny or interesting – P7, Mother

Consider the example of the "Smith" participant family. The husband and wife went on many trips, as one was a teacher and the other volunteered and taught after-school childrens' programs. The Smiths had visited many places throughout Canada, the US, and worldwide. They wanted to avoid accumulating too much clutter around the house, and so they did not routinely buy souvenirs from their numerous trips. Rather, they preferred to take numerous pictures on their trips and stated that they did not have many physical souvenirs to show. However, our tour through their home revealed that they kept many trip output items, such as guide-books, tickets, itineraries, and maps. Because these items were smaller, they could easily be kept together, sometimes placed in out-of-the-way storage to avoid clutter. Fig. 9 is an example of some of Smith's items, which were kept in a storage box in the basement. The wife describes another of their trip output collections:

> They're just things that I can't throw away-this is from when I was in Japan-I don't want to throw them away, but I never look at them.

Trip output items often had associated photos, and the Smiths noted one of the advantages of keeping print photo albums was that some of the smaller related trip output items could be kept in with the albums:

> I like the ones that are actually in the album, because I can put all the other little stuff I keep – like tickets, postcards, or pamphlets – I can put right in with the pictures.

The husband in the Smith family particularly liked collecting maps from his trips, as they allowed him to visualize and recall the places he had been:

> I always keep maps from everywhere I go. The rest of the stuff…I kind of keep tickets and booklets. But I just like seeing the physical area I was in with the maps.

Trip output items provided a natural link to related digital photo-sets as they were highly representative and documented aspects of the various trips. While they were currently kept in out of the way storage, groups of them could potentially be easily moved and kept in a convenient place for linking with photo collections.

> I'd have to figure out some way to store my maps. A lot of times when I'm on trips-with band trips we do a lot of bus travel-I literally follow where we are on the map, and maybe get to the point of highlighting the routes we're taking and making references of where we go.

4.7. Summary and discussion

Table 4 gives a summary and recap of our souvenir classification. *Individual collectibles* seem to provide the best fit for linking with photo collections, as they are highly representative of trips or events that often have associated photos (Table 4, row 1). As well, they are commonly placed on display in the home, allowing them to become conversation pieces that could lead to opportunities for photo-sharing. However, their location throughout the home could lead to difficulties in moving them to a display for use with a photo sharing system. As typically used, grouped items, such as *group collectibles* (Table 4, row 2) and *trip output* (Table 4, row 5), were not immediately amenable for linking, given families' current routines. These were often kept out of the way in storage. Yet families may store such items out of the way simply because they have no practical and immediate purpose. However, the culture of how group collectibles and trip output are stored may change if systems that link physical memorabilia to photo-sets become available; we will discuss this further in Section 7. *Worn/consumed* (Table 4, row 3) and *personal accomplishment* (Table 4, row 4) items seem the least amenable for linking physical memorabilia to photo collections.

5. Souvenirs

We now move from our study of domestic routines surrounding photos and memorabilia to SOUVENIRS: a system that links memorabilia to photo collections as a way to promote collocated photo-sharing in the home. This section describes our first version of SOUVENIRS, created before the study was done. Section 7 describes how we revised SOUVENIRS based on our study results (Sections 3 and 4), and participant reaction to it (Section 6). Of course, there are likely many ways in which one could imagine linking souvenirs with photos, and SOUVENIRS is just one example in this design space. Other examples are described in the following related work section. A video illustrating SOUVENIRS in action is also available for viewing (Greenberg and Nunes, 2009).

5.1. Related literature

The idea of using tagged physical objects as handles to electronic information is well known in the tangible and ubiquitous computing fields. In particular, Digital Photo Browser (van den Hoven and Eggen, 2003, van den Hoven, 2004) is a hand-held device used as part of an in-home environment for memory recollection. Users view their photos on a portable display and when they wish to share photos with others, they can send photos to additional displays which are more public, such as a table display or TV. Thus, there are two different viewing displays: one intended for private viewing, and one intended for public sharing. This aspect contrasts the design of our SOUVENIRS system as we utilize a single shared display. Digital Photo Browser can also recognize physical souvenirs. Users can drag individual photos to be associated with a physical object, or browse the set of associated photos. Digital Photo Browser was not explicitly designed for to encourage

Table 4
Summary of souvenir amenability for linking with photos.

Souvenir class	Amenable for linking
Individual collectibles	Yes. However, mobility/location throughout the home may be problematic
Group collectibles	Possibly. Currently kept in storage together, but could conveniently be kept for use with system
Worn/consumed	No. Practical use makes linking difficult
Personal accomplishment	Similar to Individual Collectibles, but may be too general for linking a single photo-set
Trip output	Similar to group collectibles. Possibilities for creative re-purposing

photo-sharing: the focus of their research was for memory recollection (van den Hoven and Eggen, 2005). Here physical souvenirs are used as triggers to memories, where the memories can then be reconstructed with the help of photos. Our SOUVENIRS system is remarkably similar in design to the Digital Photo Browser, despite being designed without prior knowledge of it, and designed to trigger photo-sharing as opposed to memory recollection. The fact that similar systems came about through two separate yet related user goals and design strategies suggests great promise for general purpose technologies that are able to meet a variety of needs of users as opposed to a single need.

Stevens et al. (2003) created the Living Memory Box which allows users to associate digital information with physical memorabilia. Items placed in a box are digitally photographed and then media clips can be associated with the digital images of the object. Information is viewed and selected on a small LCD display (e.g., ~17–21 in diagonal) above the box. For example, one could place a child's first shoe in the box, record a narrative about the shoe, and then associate the audio file with the digital image of the shoe that is captured. The goal here, again, differs from our SOUVENIRS system in that we are interested in supporting the easy movement of people into collocated photo-sharing, whereas the Living Memory Box presents a method for preserving physical artifacts along with associated stories about them. That being said, the Living Memory Box could be used in the same manner in which we intend users to interact with the SOUVENIRS system. Users could link physical memorabilia to digital files, in this case photos, and use them as memory triggers for serendipitous or planned sharing. However, the lack of a large display in the Living Memory Box would present a challenge similar to PC-based photo-sharing: Groups would find it difficult to situate themselves around the display for easy viewing.

Memodules (Mugellini et al., 2007) is a framework for prototyping tangible interfaces by allowing links between RFID-tagged physical objects and actions taken in the digital world. For example, they describe how a colleague's business card can trigger actions such as opening up an e-mail composer to that colleague, and they also mention linking souvenir to photo-sets. However, their focus was on presenting their technical framework, while ours was on the detailed study and design rationale of how people might use such a domestic technology to encourage photo-sharing.

Frohlich and Fennell (2007) looked at how physical memorabilia are used to retain memories in the home, and presented two systems that support story-telling around these objects. The *memory shelf* links an object to a recorded audio message. The *anniversary plinth* prints out a textual record of the objects history. They do not draw the link between photos and memorabilia though they do argue that memorabilia and photos are both part of the same system of triggering memories and stories from material artifacts. Similarly, Petrelli et al. (2008) review and describe several methods for designing digital mementos that "bridge the divide between physical and digital memories".

Various researchers have also considered collocated story-telling over digital images through specialized devices. We know this happens regularly: people often use the preview mode of their digital cameras and cell phones to show particular photos to others. Special hand-held devices have been researched and prototyped for this purpose, e.g., Balabanovic et al. (2000). Many others are investigating special software for photo-sharing over digital tables, e.g., Shen et al. (2002). All these systems emphasis story-telling within a photo-set, while SOUVENIRS is centered on bringing particular photo-sets into action. Thus the related work is complementary to our own.

5.2. Scenario: souvenirs in action

The scenario described below and illustrated in Fig. 10 highlights the primary features of the first version of our SOUVENIRS system, as shown to our study participants. We do not delve deeply into its technical details, as such systems are not that difficult to build. The only unusual feature is our hardware; we used Phidgets to implement our RFID technology and to build our custom scroll wheel (Greenberg and Fitchett, 2001), and we programmed the Wii controller using Brian Peek's WiimoteLib package (http://www.codeplex.com/WiimoteLib).

On a recent hiking trip to Alaska with his family, Bob took many photos with his digital camera. Bob has also brought back an interesting-looking rock he found during his hike, something he does on most his trips. After Bob returned home, he downloaded his photos into a folder on his home media center computer that is attached to a large plasma television display in his living room. He also places the rock on a display shelf in his living room, alongside other memorabilia collected from other trips.

Bob decides to use this rock as a link to his Alaskan hiking pictures. He achieves this through the following quick steps, performed in under a minute:

1. He places a sticker – a small pre-glued RFID tag – on the bottom of the rock (Fig. 10a).
2. He starts SOUVENIRS so it is displaying on his television screen (Fig. 10b). He drags the folder containing his Alaska pictures onto the SOUVENIRS window. SOUVENIRS imports these photos, Bob renames the photo-set to "2007 Alaska". Alternately, Bob could have mixed and matched photos from several folders by dragging and dropping them into the SOUVENIRS window. This photo-set is now available to be linked.
3. He places the rock on a platform (an enclosed RFID reader) located next to the TV. It reads the RFID sticker identity, and associates that sticker (and thus the rock) with that photo-set (Fig. 10c).
4. He returns the rock to the display shelf (Fig. 10d).

Somewhat later, Bob's family returns home and are having tea in the living room. His wife, Alice, sees the rock sitting on

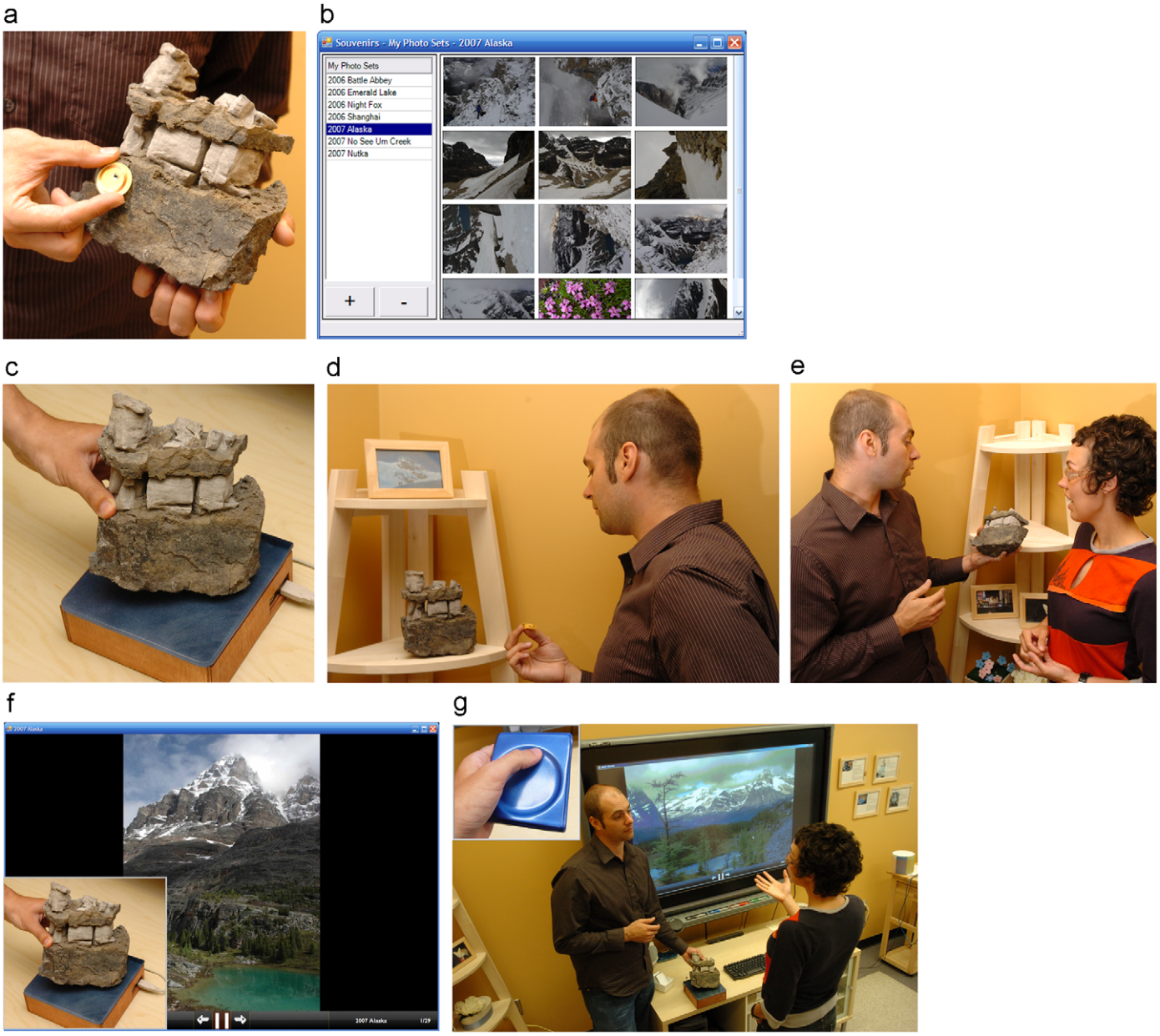

Fig. 10. Souvenirs in action, showing linking a memento and a photo-set, and the social use of the memento to activate a slide show: (a) tagging the rock, (b) adding the Alaska photos, (c) linking the rock to photos, (d) displaying the rock, (e) conversing over the rock, (f) starting the slide show from the rock, and (g) story-telling through the slide show.

the mantle, and mentions it. Bob picks up the rock, reminding her that it is his Alaska memento, and asks if she wants to see the Alaska photos (Fig. 10e). She assents, and he places the rock on the platform (Fig. 10f); the photo-set immediately plays as a slide show (Fig. 10g). Using a specially designed physical scroll wheel (Fig. 10g inset), or a Nintendo Wii controller, Bob and Alice can cycle through photos at various speeds and/or pause them (not shown).

Two months later, Alice has a book club event in her home. Coincidentally, the book being discussed is John Krakauer's *Into the Wild*, a non-fictional and ultimately tragic account of a young man who went off to live in the Alaska outback. Some of the book club members had never been to Alaska, and Alice asks if they want to see what the terrain looks like. While she has no idea where Bob has actually stored the photos, she easily remembers that the rock is linked to them. She shows the rock to the group and mentions that Bob collected it when he was up there. As she is discussing details of that trip, she places the rock on the RFID platform; the slide show begins as before. After the show (and several glasses of wine), the book club members talk about the other memorabilia on the display shelf, and Alice story-tells about some of the places the family has traveled to. She selectively shows a few photos from each place by passing particular memorabilia items over the platform.

5.3. Design rationale

In Bob's family, linking the rock to the Alaska photo-set makes the rock a symbolic link to the photo-set. Because the rock is then displayed in the home, it becomes a social instrument – an *autotopography* where the arrangement of these objects constitute "*a physical map of memory*, *history and belief*" (Petrelli et al., 2008). He and his family can take advantage of the rock's meaning, location and visibility, without being concerned of how photos are stored and how they can be accessed on disk. The result is serendipitous photo viewing and story-telling.

More generally, the design of SOUVENIRS assumes that physical memorabilia can become a *handle* to access particular digital photo-sets, just as a URL serves as a handle to rich sets of digital information. As personal artefacts, these memorabilia have physical presence, are positioned in the home in a meaningful way to its inhabitants, and can trigger recollection and story-telling in their own right (Section 4; also see Petrelli et al., 2008). Thus the linkage of photos is a natural extension of how people associate memories with the artefact, which then works as a natural lead-in to the photo show through opportunistic story-telling.

Of course, paper-based framed photos and photo albums serve similar purposes, as they too are memorabilia. The power of SOUVENIRS is that it works without requiring the home occupant to print and organize their photos, an operation that is increasingly expensive given that people take and store many more digital vs. film photos. In its stead, a single physical artefact serves as an access point for a photo-set.

In Section 3.6, we summarized several differences between digital and print photos, where these differences inhibit collocated digital photo-sharing. Here, we describe our design rationale for mitigating these problems.

Locations are exploited – Digital photos are located on computers that are hidden, hard to access, and not necessarily in locations amenable to sharing. By using memorabilia as a handle to these photos, the advantages and meanings of memorabilia location serves as a surrogate to photo location.

Serendipity re-occurs – Digital photos are not readily visible in the home to spark spontaneous sharing. The public location of memorabilia, particularly of displayed collectibles in public rooms, reintroduces opportunity for serendipity.

Accessibility by circumventing access control – We previously described how, in many homes, the primary digital photo organizer often stores photos on a personal password-protected account on a home computer. While a person may not intend to limit access to their photo-set, other family members may be reluctant (or do not have permission) to log onto another person's account. SOUVENIRS is constructed in a way where digital photos are automatically published in a public file store; no access control is required.

However, as mentioned before, the physical location of a souvenir item may bring implicit privacy controls for family members. For example, if a family member wants certain photos to remain private, they could place the linked object in a private location as opposed to a public one. In contrast, van den Hoven's (2004) Digital Photo Browser utilizes a portable display that acts as an initial viewport for photos prior to them being publicly viewed on a large display.

Accessibility by circumventing navigation problems – People often do not know about photo collections created by the primary organizer. Even if they do, they may not know how to find them, as they may be hidden in a hierarchy, have cryptic names, or stored in a database by a software system that they are unfamiliar with. Using memorabilia as a handle to photos circumvents these navigational problems, as the associated photo-set is immediately displayed.

Accessibility by removing time delays – With standard digital photos, people have to stand around and wait as follows: the person showing photos turns on and logs onto a computer; navigates through a traditional GUI system to find the photo-set; starts the software and navigate through its controls to display the photos as a slide show. With SOUVENIRS, one simply brings the memento to the display and the photos are retrieved immediately.

Viewing is in a social setting – Groups no longer have to view photos by crowding around small desktop computer displays located in out of the way corners of a home such as in a den or bedroom office. We assume that SOUVENIRS is permanently linked to a large display – a new generation television set such as a 50 in plasma display – located in a public home space such as a living room. Unlike home offices or spare bedrooms, these rooms and the display are already set up as a social space – a space that often contains family memorabilia. Family and visitors regularly inhabit that space (which creates social opportunities), and the display is easily and comfortably viewable by all (e.g., televisions are normally surrounded by couches). This contrasts with van den Hoven and Eggen (2003), which utilizes two displays: a private one for photo selecting and a public one for shared photo viewing. The challenge here is that two displays make photo-sharing a two step process. Users must first view photos on their personal display and then select which to view on the public display. While this can circumvent privacy issues, it could easily cause additional challenges for the speed and serendipity that one may normally desire in photo sharing activities.

6. Souvenirs as a technology probe

We showed the same participants from the study described earlier a video of the SOUVENIRS system described above (as part of the same study session). We wanted to elicit their reactions to SOUVENIRS, and gathered suggestion of how to improve its design. We chose this approach for its simplicity. First, we could have had participants use the

SOUVENIRS system in a lab setting though this would make it more difficult to imagine it within their own home environment. Second, we could have set up the system in each family's home for short testing but this would have been technically very challenging, especially given that not all families had a large format television. Additionally, neither strategy would provide long-term access needed for families to develop practices with linked photo-sets. Thus, we feel we struck a reasonable compromise where families could see the system in the context of their own home, yet unfortunately not be able to interact with it. As we will see, this technology probe re-affirmed some of our design rationale, but also suggested places where SOUVENIRS could be improved.

6.1. Sharing and tangible objects

Participants had positive reactions towards SOUVENIRS' affordances for digital photo-sharing within the home, and the use of memorabilia as tangible objects for retrieving photo-sets. They liked how the system was situated in the home's social context, i.e., the use of the large television display in a public home area to show the photos, and how this setting created an opportunity for multiple onlookers to view and discuss the photos. As one participant put it:

> That's something I'd show friends. More friends can watch at the same time, not like an album where only a maximum of two people can look at an album. I think it's good.-P1, Mom

Additionally, people liked how SOUVENIRS hid the technology and the tedium of retrieving and sharing photos as compared with traditional computer navigation. They liked how it was immediately "ready to go" at any time, and how it avoided the need to navigate and invoke applications to show digital photos. Some saw this as particularly useful for showing pictures to elder relatives who could have trouble with conventional computers.

> Where it would be useful is for the parents and grandparents. If they could just do that to their TV. Never mind the issue of having to transfer all of the pictures over. Once it was setup then my parents could just wave an object. – P7, Husband
>
> If you found an object to link it to or a picture it would be really easy to find an album. And because it is already connected to the TV or a big screen it is easier than connecting the camera. – P9, Fiancée

People were generally receptive to the idea of using tangible objects as a link to retrieving photo-sets. They said this would allow sharing "by chance" (serendipity) from displayed memorabilia. They liked the novelty of physical linking, and thought it was something they would want to show off to friends. They thought that linking photos to physical objects would be easy and would make finding/displaying photo-sets quicker and more enjoyable than with traditional computers.

> It seems a lot more fun and interesting to have a symbol from the actual place rather than having to go on your computer and start clicking on folders. They are a lot more organized this way and there'd be more memories. – P3, Teenage Daughter
>
> You don't have to sit down and try to find the picture you want to show friends, it's just there.-P1, Dad

6.2. Challenges

Participants also noted several concerns about the SOUVENIRS design. These are important, as they suggest redesign directions.

Fit to existing practices – Families stated that the utility of physical memorabilia as a link to photos depended on the actual practices they used to display souvenirs and mementos in the home. Some noted that they preferred not to have many mementos displayed around the home for aesthetic reasons, and thus questioned the overall usefulness of physical objects as a links. (Although recall that several families who thought they did not have many mementos actually did have quite a few.) In those cases, they still thought the large public display was very desirable.

> I would like it if all of the pictures that I had on the computer were on the TV and I could scroll them, have a remote, and look through them. That would be great. Linking them to objects would be trouble for me because I don't like to keep those kinds of objects…that part of it wouldn't work as well for me. – P13, Husband

Scalability was a related concern. People who did keep mementos were worried that religiously linking photos to physical mementos kept in accessible places would eventually lead to clutter and storage problems. They stated they took and maintained large collections of photos, which would exacerbate this problem.

> You would have to remember to get something each time…after a while you'd need a large storage area beside your TV…I'd have to store a lot. – P1, Father
>
> The amount of pictures that we take, we'd have boxes of items, you'd be literally grabbing things from boxes. For us I think a big screen like that if you could hook it up to this [remote]. The biggest problem we have is crowding when we show photos, but to be able to put that stuff on to a bigger screen would be good. – P16, Husband

However, people suggested a solution to this problem. As well as physical mementos, they wanted the option of having an "index box" containing single physical photos or descriptive cards, each tagged and thus linking to its associated digital photo-set. The box would allow many tagged photos or cards to be kept together without clutter. Others noted that an on-screen photo list might be just as effective.

> I'd have a hard time finding and storing those objects. Where would I put them all? One picture for each set would work. – P2, Mother
>
> The object thing is the thing that I'd find hard because you want to have the objects close to your TV…I'd almost rather have folders where you could just touch, but we're not really souvenir-type people…I guess a box of cards would work, but if you're just going to do that you may as well have folders on the screen. – P7, Wife

Evaluations of van den Hoven's (2004) Digital Photo Browser also revealed concerns about scalability. Their solution was to allow users to also browse graphic interfaces to find photos and not rely on additional "grouped" physical artifacts.

Appropriately associating physical items to photos was another concern. Some thought they might have difficulty finding a memorable item that appropriately links to a given photo-set. In some cases, there simply may not be any relevant item available.

> The only thing is it applies more to pictures from something special like maybe a party or wedding where you could have something that triggers the pictures. But with just regular family pictures it would be hard and sometimes you do take a lot of those pictures, and sometimes you do want to retrieve some of those pictures. – P8, Mother
>
> For the Turkey trip, we could link that [points to an item brought back], but for family photos it would be trickier to find something. – P9, Fiancé

Some also mentioned that the association between an object and a photo-set may not be known to other members of the family, and so it would be difficult for others to tell that an object was actually linked to a set of relevant photos. People also wondered if they would forget the association between a given memorabilia and its photos. Some even suggested writing descriptions on the physical items.

> Over time you might forget what souvenir was attached to what group of pictures, especially if you went somewhere twice. Like if you went to Seattle twice and took two sets of pictures. It's a good way to remember but also not organized enough for me. I'd maybe just have a normal object, like a stick with a sensor, then you could write the date, time, and event name and then just put that over the sensor.-P14, Daughter

One family was initially reluctant about the idea of Souvenirs for their own personal use, as they thought it would be more useful for families that routinely bought souvenirs and mementos. However, once they realized they could use the system with their trip output items, they caught onto the idea of repurposing them for use with the system.

> You could put tags on all the different places on your maps.
>
> That would be cool. Yeah. Or pages in a guidebook actually, that would be really neat.

Breaking and losing mementos – Participants were concerned that moving physical mementos around to use as links to photo-sets would increase the risk that fragile items could break, or expensive items lost. If this happened, they were also concerned that those photo-sets could then become inaccessible.

> So what happens if you lose the object that has the tag on it? Do you lose the photos?-P1, Father

Van den Hoven (2004) also found participants were concerned about missing items and solved this by permitting access to photos through a graphical user interface.

Privacy – Evaluations of the Digital Photo Browser by van den Hoven (2004) revealed issues of privacy where users were concerned about other family members accessing their photos through publicly placed memorabilia. They also said they preferred to preview photos prior to sharing them in a public setting; thus, the system's design incorporates an intermediary private display before public sharing. In contrast, none of our participants appeared concern about the privacy of their more personal pictures.

7. Discussion and system revision

Many of our findings supported the original Souvenirs design. However, they also introduced concerns. Here, we describe how several of these concerns, along with our own thoughts of other possible problems, resulted in design changes in the next Souvenirs iteration, which we have implemented. We also describe how social practices may change as systems such as Souvenirs is used in the home, and technical suggestions that make such systems more practical.

7.1. Souvenirs version 2

7.1.1. Creating public photo-sets

While people said they liked the idea of accessing photos from their TV (as well as from other computers), this begs the question of how the photos get there. The issue is that people, by default, store photos in their own accounts rather than in a public place, and that they likely will want to share only a subset of their photos rather than all of them.

To solve this problem, we revised Souvenirs to work across all computers on a home network. Individual home occupants can now start the photo management view of Souvenirs on whatever computer and account they want. Similar to other photo management software, this view allows them to create new photo-sets: as in Fig. 10b, photo-sets are displayed as a list, and photos are represented by thumbnails. When a family member starts Souvenirs on

another computer, that instance locates the photos on the original computer, downloads them, and caches them locally (through a configuration dialog, people can specify where SOUVENIRS should look for photos). Meta-data that describes associations between photo-sets and RFID tags are copied as well. Thus, all photos and meta-data are available to any other connecting SOUVENIRS client. At this point, other family members can view, modify, or even remove links and photo-sets as desired from whatever home computer they happen to be using. This distributed file acquisition is not available in van den Hoven's (2004) Digital Photo Browser.

7.1.2. Photo-sharing and linking is optional

It is unrealistic to expect every single photo-set to have an associated physical handle (Kirk et al., 2006). Somewhat similar to how people currently create photo albums around specific events or favored photos vs. organizing all photos, we now expect people to selectively choose photos to share and link, where a large bulk of photos will be left behind. In our changed version, only photos dragged into SOUVENIRS are used by SOUVENIRS. That is, unlike other photo sharing systems, SOUVENIRS does not search all hard drives within a home network for photos. Only those that are explicitly dropped into the system are made available across the various computers in the home.

We also changed SOUVENIRS so that people, by default, could access and display all photo-sets through traditional on-screen navigation. They use the modified photo management view in Fig. 11, which lists photo-sets and thumbnail samples. To start a slide show, people can now navigate and select a set from this list using standard input devices, or our physical scroll wheel control, or a Nintendo Wii controller. Thus, people can share a photo-set without requiring a tagged object. This is useful in the case the tagged object has been broken or lost, or when people have forgotten which object is associated with a photo-set, or when no associated object is available.

A further advantage is that these lists are usually in chronological order. Thus if a family brings up a photo-set using a tagged object, photo-sets – some which may be untagged – that are taken at the same time are shown on the list. This increases serendipity of a tagged object leading to serendipitous photo-sharing of multiple photo-sets.

At any point, people can decide to create a physical link to a photo-set simply by setting a tagged unassigned memento over the reader. In this way, people can adopt the technology to best fit their practices, using mementos as little or as much as they want.

7.1.3. Using other physical objects as links

People suggested that mementos were not always practical, e.g., because of size, or fragility, or because no memento is available, or because they are hard to organize. They also suggested other physical objects would be suitable, such as printed photos and index boxes.

We modified SOUVENIRS in two ways to make it easy for people to create custom mementos that can be linked to digital photos, where these custom mementos are easily organized. We now package SOUVENIRS with a dedicated small one-click photo printer, 5×7 photo sheets, a box of sticky-backed RFID tags, a box of credit-card sized RFID cards, and a marking pen. As shown in Fig. 12, these should be located by the large television. First, a person can now quickly print an exemplar photo from the photo-set being viewed and stick an

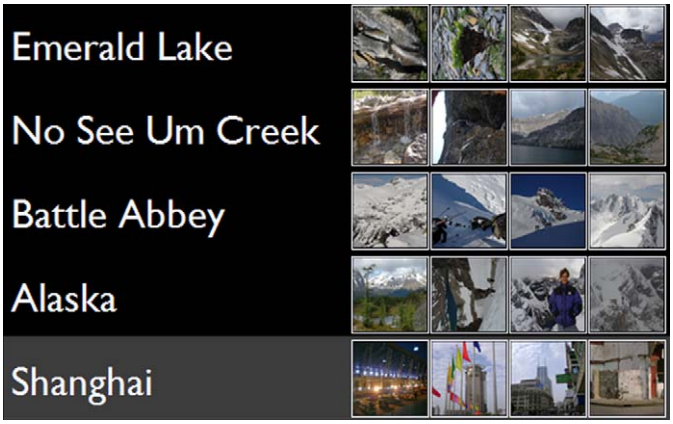

Fig. 11. The revised navigation screen.

Fig. 12. Photos, RFID cards, and printers.

RFID tag onto that print. Second, people can annotate the RFID cards with written descriptions and text. For both print photos and cards, people then quickly link them to a photo-set by passing it over the RFID reader. Both print photos or cards could perhaps be stored and organized in time/event order in attractive boxes kept next to the display (Fig. 12, bottom left), or in booklets dedicated to particular types of events, or (for photos) even within photo albums or framed on a nearby photo wall. This goes beyond the design of van den Hoven's (2004) Digital Photo Browser by allowing users to rapidly create new physical artifacts for photo-linking.

7.1.4. Using other displays, particularly mobile ones

While we envisaged SOUVENIRS as running on the public family television screen, it became apparent that this was overly restrictive. As mentioned by our participants, some mementos are not movable, either because they are fixed in place, or are too large or heavy to move, or are too fragile, or are too far from the public screen. Clearly, people need to be able to view photo-sets associated with such objects spread around the home. As well, there may be opportunities presented by computers in other home locations. While these obviously include personal computers, we are especially interested in mobile displays such as laptops and tablet PCs, as these can be moved around the home.

As mentioned, we modified SOUVENIRS so that it works over a home network. Consequently, people can now access photos from any computer on that network. As a SOUVENIRS client connects to the server, any new photo-sets since the last connections are cached on the local computer to make navigation and display responsive.

Next, we created a mobile photo-frame by attaching a small RFID reader onto a tablet PC. Although this is technically identical to the large display configuration, this mobility leads to a different social practice of photo-sharing akin to how people show snapshots while sitting around a table. As shown in Fig. 13 (top left), a family member has just retrieved photos attached to a displayed collectible (a small statue) via the mobile photo-frame. She shows it and manually passes it around people sitting around her. Thus, SOUVENIRS no longer demands that the physical object be moved to the large screen. This approach of using a smaller portable display is similar to van den Hoven's (2004) personal display in the Digital Photo Browser. Here we intend the portable display to still be used for sharing however, much the way physical photo albums can be passed around and viewed by family and friends.

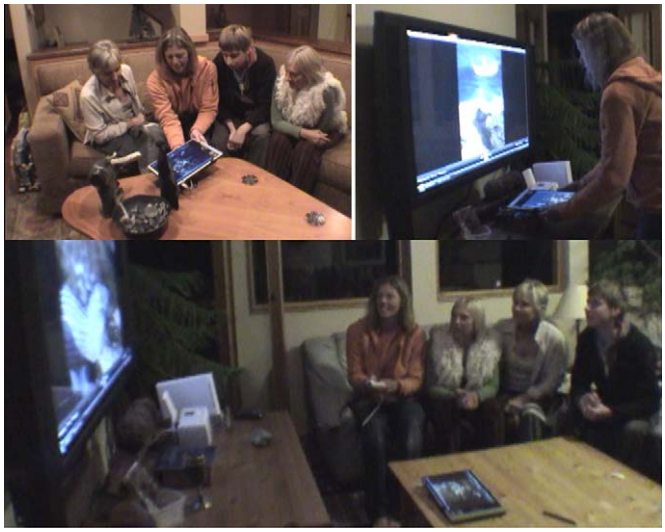

Fig. 13. SOUVENIRS, the mobile photo-frame, and pick and drop.

7.1.5. Pick and drop

The small screen size and limited viewing angle of most mobile devices means that they are comfortably viewed by perhaps two or three people. For larger groups and for easier viewing, we still believe that photos are best seen on the large display. To let people move from small devices to large displays, we designed the mobile picture frame to act as a go – between the tagged artifact and the large display using a "pick and drop" strategy (Rekimoto, 1997). We already saw how the mobile picture frame raises the photo-set associated with a tagged object (Fig. 13, top left). If this group decides to move to the large television, the person simply moves the picture frame to the platform by the large television (Fig. 13, top right), and the photo-set will then appear on that display for all to see as before (Fig. 13, bottom). Technically, we embed an RFID tag on each mobile device. When a photo-set is selected on the mobile device, the device's tag is temporarily associated with the chosen photo-set. In this way, the device can be passed over an RFID base attached to the large display and the photo-set will be triggered. Of course, there is no reason as to why this transfer must be done by physically moving the portable display near the television. Just as equally, this could be performed using a method similar to van den Hoven's (2004) where images can be dragged and dropped within the portable display for transfer.

7.1.6. Remembering and knowing associations

Another concern was that people said they may not know or remember what a physical item is linked to. While we argue that shared knowledge would develop as items are displayed and families adopt the system, we do have alternate solutions that encourage discovery of particular photo-sets attached to memorabilia. In particular, a person can use the mobile photo-frame to serendipitously "examine" what photos are attached to mementos as one moves around the home. Indeed, we envisage games where children in the family could play a form of photo "hide-and-seek" or "hot/cold", where they have to find particular photos attached to objects around the home. Hiding photos engages the parents, while finding them engages the children.

However, the issue remains that these objects do not directly show that they are being used as links – particularly as they might co-exist with other displayed

items that are not being used in this way. One other option is to have geo-located RFID tags, where the mobile computer could show a photo index of all tags in its field of view. However, such technology is currently prohibitively expensive and thus we did not implement such features.

7.2. Evolving creative and social practices

Thus far we have discussed design revisions to our SOUVENIRS prototype with the intent of providing a better fit with the existing practices seen in our study interviews. Here, we consider how the introduction of a SOUVENIRS style system could change a family's cultural and social practices over time. While we have yet to observe how the system is adopted through long-term installations in family homes, the interviews and our own self-trials also allow us to speculate on how families might develop new practices given the availability of a system such as SOUVENIRS – particularly in encouraging creative use of tagged objects.

Family practices are not static; we expect they will change (hopefully positively) to create meaning around the technical and social artifacts we introduce. If adopted, a system like SOUVENIRS could increase a family's desire to collect memorabilia specifically for use as links to photos. As well, a family's practice of displaying memorabilia could change, where they specifically locate memorabilia with the benefit of keeping them near the public display. Similarly, a family might put greater consideration into how their homes are arranged to naturally allow story-telling through displayed souvenirs and photos.

What is tagged could also change. We hypothesized that displayed collectables are the most amenable memento for photo-linking, but other memorabilia types could be exploited. For example, trip output items (e.g., guide-books, maps, etc.) are typically stored away as they have no practical purpose after the trip. Yet, they are strongly linked to memories, and often have related photo-sets. The opportunities of photo-linking may change family storage practices of these items. In our own experience setting up SOUVENIRS in one of the researcher's home, the family tagged and moved some of their travel guide-books (previously stored in a cupboard) to a shelf near the television. This shelf of guide-books became the mementos linking to photo-sets of the major trips they had been on over the years. Indeed, multiple tags were placed on one of the guide-books, where each corner represented a different subset of photos taken on that trip. Other ideas include tagging a wall map.

Similarly, people may reorganize their photographs to match particular memorabilia types. For example, while we argued that personable accomplishment mementos are unlikely candidates for linking, a family may (for example) decide to select highlights from photos taken over a season to portray their child's successes. That is, the memorabilia may introduce new meanings into how people structure their photo collections.

Changes in technology can spark further creative ideas. For example, if representative photos could be printed with a barcode, they could be immediately used as links (assuming barcode reader technology). These photos could then be organized as an album, which in turn serves as an index to various digital photo-sets. Or the family could intermix photos and trip output in a scrap-book (as is often done), where a barcode label could be affixed near the particular trip output item.

Another possibility is to associate physical objects with a time period rather than a particular photo-set. Instead of jumping directly into a slide show, the system could show the set of photos taken around that time period (e.g., similar to Fig. 11). Objects could include diary pages or calendars, each with pre-printed barcodes.

While these ideas may be speculative, they illustrate the creative potential of linking physical memorabilia to digital photos, and how they could change the practice of collocated photo viewing.

8. Conclusion

We have investigated how physical memorabilia can be used as opportunities to move into home-based collocated digital photo-sharing. This work covered three major stages: investigating family photo and memorabilia routines through contextual interviews, a design exploration by building a system that links physical objects and photos, and design reflection through a form of technology probe. Our findings show that there is indeed promise for using memorabilia to encourage collocated photo-sharing. We believe that systems such as SOUVENIRS could eventually be used by families to overcome the current limitations of digital photo-sharing in the home, and those new social practices will evolve over time.

We recognize that SOUVENIRS represents only one possible design direction. We encourage other researchers to build on our findings and explore other design possibilities for utilizing physical artifacts found throughout the home as links to abstract digital collections.

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