Requirements for Photoware

David Frohlich, Allan Kuchinsky, Celine Pering, Abbe Don & Steven Ariss

david_frohlich@hp.com allan_kuchinsky@agilent.com cpering@stanfordalumni.org
abbe@abbedon.com smba100@york.ac.uk

Hewlett Packard Laboratories

Filton Road, Stoke Gifford,

Bristol BS 34 8QZ, U.K.

+44 117 312 8800

ABSTRACT

Eleven PC-owning families were interviewed at home about their use of conventional and digital photos. They also completed photo diaries and recorded photo-sharing conversations that occurred spontaneously over a three month period after the in-home interviews. From an analysis of the resulting materials we illustrate the strengths and weaknesses of past and present technology for photo sharing. These allow us to prioritise user requirements for a range of future photo-sharing technologies or 'photoware'.

Keywords

Digital photography, storytelling, photoware, photo sharing, cameras, user requirements, communication

INTRODUCTION

In the last few years there has been an explosion of products and services for doing 'digital photography'. Initially, the industry focussed on the provision of digital cameras, photo scanners and photo-quality printers, which essentially emulated the conventional photography paradigm in order to facilitate home development of photos. However, more recent offerings bite into further stages of the conventional photo life cycle, especially to support the storage, sending and sharing of photos on-line. These second generation offerings might be referred to as *photoware*, since they can be seen as providing different forms of groupware for collaboration around photos. Borrowing from a well-known framework for groupware

[9] we characterise various photoware technologies in Table 1. These turn out to include conventional as well as digital tools (digital shown in italic font). The first column of Table 1 shows that photos can in principle be exchanged synchronously between people co-located in time and place or separated by distance. We refer to this kind of real-time interaction around photos as photo *sharing*. The second column of Table 1 shows that photos can be exchanged asynchronously between people (i.e. at different times), by accessing a shared photo archive in a fixed location or by sending photos to others in a remote location.

One question that hangs over these developments relates to the consumers' view of all this: *Q1. What do users want to do differently with photos once they have captured them into the digital realm?* Ultimately it is this question that holds the key to predicting the success of all the digital technology in Table 1, and to designing future photoware that satisfies real user need.

In this paper we address this question through a classic user requirements approach. We talk to customers and observe their behaviour in the target domain of photo sharing, in order to understand the prospects for enhancing and extending that behaviour through new technology. However, in recognition of the existing impact of first generation digital photography products, we chose to work with people already engaged with this technology to some degree, and actively struggling to integrate it with their existing practices of conventional photo sharing. This allowed us to examine at least some aspects of present as well as past photoware use, in order to make recommendations for future photoware. The limitation of this approach is that we cannot comment on the uptake of the very latest second-generation photoware, which might have radical unforeseen effects on the behaviours we describe. Our findings and conclusions should therefore be read in conjunction with other studies on the latest technology, which test these effects directly.

	SAME TIME	DIFFERENT TIME
SAME PLACE	Prints Slides & projector **CO-PRESENT SHARING** *Photo viewing software & devices*	Shoeboxes Albums & frames **ARCHIVING** *CD-ROM* *PC filestore* *Photo website*
DIFFERENT PLACE	Telephone **REMOTE SHARING** *Application sharing* *Instant messaging* *Video conferencing*	Mail **SENDING** *Email attachment or website reference* *Internet photo frames*

Table 1. Dimensions of photoware with example products and services - adapted from [9].

Our primary research question throughout the study was therefore Q1, and a related question about current practices: *Q2. What do users do with conventional and digital photos once they have captured them?* Armed with some answers to these questions we aim to prioritise user needs for new technology in each cell of Table 1, and begin to indicate the kinds of solutions required in the highest value cells. In the main body of the paper we describe the methods and results of the study, before returning to the design implications in the final section. But first we acknowledge related work in this field.

RELATED WORK

One of the few detailed investigations of conventional photo sharing was carried out by the anthropologist Richard Chalfen [3]. Drawing on a series of field materials and interviews about home photo and video use, Chalfen explores the question of what photos and video are for. He proposes that these materials operate not as copies of reality but as statements people can make about themselves in 'home mode communication'. A number of sociologists have taken up this theme by showing how photos are used to convey overly positive impressions of family life. For example, Spence & Holland [19] note that family albums never contain pictures of sick people or unhappy events such as funerals.

Although these researchers acknowledge the importance of conversation around photographs for bringing out their meaning and value, there has been little direct investigation of what might be called 'photo-talk'. While ethnographic field researchers have long used photographs to elicit memories, clarifications, and stories from "informants" within a culture [e.g. 4] they have failed to study naturally occurring conversations of this kind between members of a culture. The study of naturalistic conversation within Conversation Analysis has begun to identify salient features of storytelling, but in the absence of photographs and other image-based materials [e.g. 16].

Digital photo sharing practices are even less well researched. Despite much discussion of digital storytelling technology there have been only a handful of studies attempting to show how it is used. Typically these are based around the use of particular prototype systems or services, such as the Blacksburg Nostalgia website [2], a digital photo viewer [1] and a photo-email exchange [10]. A strong finding of all these studies is that communication with images is an enjoyable activity that can help to deepen personal and community relationships.

METHODS

The study was funded by HP. It was therefore oriented towards current and potential owners of HP digital imaging technology. At the time, this market was highly PC-centric, leading us to select PC owning families with children living at home. A total of 11 families were recruited from the Northern California area by a professional recruitment agency. Our decision to target families already involved in some form of digital photography led us to filter on the basis of family ownership of scanners, cameras and photo-quality printers. Families had to own at least two of these three pieces of equipment to take part in the study. In addition, they had to consume at least 10 rolls of conventional photo film a year. Outside these criteria, we also recruited to achieve a spread of household income levels (between $50,000 -$150,000 a year), number and ages of children, and overall levels of computer experience.

We used a combination of ethnographic field observations, interviews and self-recording techniques in order to identify photo-sharing practices. This was organized into two phases:

Phase 1. In-home interview survey. Families were interviewed together at home during the fall of 1998. Each interview covered organization and sharing practices, and incorporated a home tour and photo inventory. Some examples of the questions we asked were; How do you store materials? What prompts you to share photos? Describe the last three times you shared your photos, What do you find most enjoyable/frustrating about sharing? What would you like to do if you had the means? What are your expectations about the emerging technologies?

Phase 2. Photo diary and logging period. At the end of each Phase 1 interview, participants were given tape recorders and requested to record as many subsequent photo-sharing conversations as possible. In addition, they were given 'photo diaries' prompting them to provide some basic information for each episode, and whether or not they managed to record the conversation. These details included the names and relationships of the participants, together with the venue, occasion, and photo sets shared. These materials were then left with families for 3 months spanning the Christmas of 1998.

RESULTS

For the purposes of this paper, we step through an analysis of the findings on each activity represented in Table 1.

Archiving

People stored and organized their photo collections to be viewed by themselves or others at a later date. The **filtering and arrangement of 'favorite' prints into albums** was seen as the best way of archiving conventional photos for future sharing. However, this activity was seen as complex and time consuming. In addition, it appeared to be an isolated task without any immediate emotional payoff, which often fell to the wife or mother in the families. The discipline required to do this was too much for many mothers who reported frustration in wanting to making up albums while lacking the time and motivation to do so:

SR: I would like to have them all in binders, it would be nice to have them all in binders, maybe someday when I'm 80! I'll get around to it!

RM: Yeah, my frustration is about time, I really would like to spend more time putting it together and doing even more than I do to it

Some people were motivated to at least do **some basic organization immediately**, because otherwise the photographs remain undocumented and disorganized. They put recent photos into a temporary album in order to share them more easily with family and friends. Although they often promised themselves they would go back to annotate and organize the album later, they seldom did.

CM: That's right, Chris will shuffle through them, and then immediately put them in albums right away. As soon as they come in. So we keep continuous, running albums. Absolutely. Otherwise it would get out of control and it would never happen.

As life gets more hectic and as additional children are born, it appeared to get **harder for families to keep up with the backlog of images**. A typical pattern reported by families was to begin by creating full albums with handwritten annotations. Over time they would fall further and further behind the incoming photo sets, sacrificing first the annotations and then the albums themselves.

Some of the busiest families with children had given up organizing their photos completely. This is vividly illustrated in Figure 1, which shows a sofa bed stuffed to capacity with hundreds of packs of photos stretching back 20 years or more. In some ways this was actually a *more* organized storage strategy than that adopted in other homes where the photo packs were scattered throughout the house!

Aside from the difficulties of finding particular photo sets stored in this way, people complained most about **forgetting details of people and events** depicted in old photos. When the images are recent and everyone who participated is still alive, there is not as much "demand" or "perceived value" for detailed annotations. As time goes by and people begin to forget the details, they wish that the annotations existed. Ironically, the quality and accuracy of the annotations would probably be better if they were captured earlier in the lifecycle of the photo, either during creation or during the first few "sharing" episodes.

JN: It's so much more interesting to look at the pictures when there's some sort of caption to it.

S: My mom [has] more time to organize her pictures, and she has taken the time, and now she'll tell me, "you'll be really sorry, later on, Sherry, that you haven't put dates on the back of those." And I know I will. I know I will
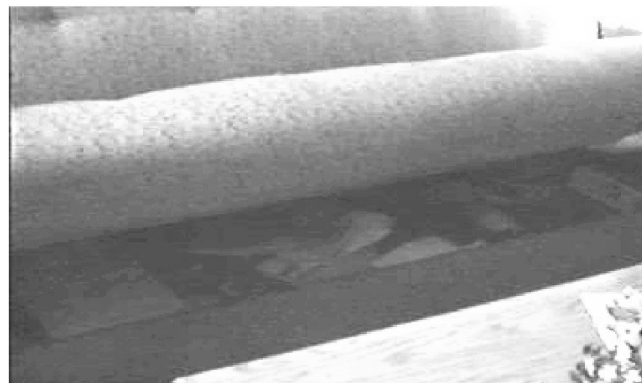

Figure 1. The 'sofa album' used by one family for photo storage

While most people focused on issues around creating chronological photo albums, several people described more **specialized photo activities** such as creating collages, putting together special "milestone" projects to mark a significant life event such as a birthday, graduation, wedding or anniversary, and creating an autobiography (often for a school assignment). While these activities shared the complexity of creating standard photo albums and often took more time to complete, people seldom complained about them. In fact, they seemed to enjoy them.

JN: Larry's parents celebrated their 50th wedding anniversary, and as part of that, we did 50 Years of Memories for them, and we had people write letters, send old photographs of the time that they knew them during the 50 years....

Some reasons for the differences might include the "one time" nature of the special activity whereas creating photo albums appears to be a constant activity that needs to be "kept up." In addition, since the milestone has a specific deadline, often affiliated with a party or other large, public, social event, there is a fixed time frame in which the project must be completed. Similarly, there is often an extremely big emotional payoff when someone creates a collage or milestone project.

In short, archiving practices for conventional photos oscillated between the systematic culling and arrangement of current photos in albums for 'posterity', and the active selection of special collections of photos for particular social purposes or events. In contrast, the **archiving of digital photos appeared to be limited to active selection**. Very few families reported systematically organizing their digital photo collections on the PC, and inspection of PC file stores revealed miscellaneous folders full of numbered photos downloaded in the same session. We struggled to find any PC-based photo albums at all. If Windows folders are viewed as the equivalent of development pack sleeves then most families treated the PC in the same way as the sofa shown in Figure 1: essentially as a convenient container of their digital photo packs. This was despite a vague but widespread hope that digital technology might help with the organization and retrieval of photos in the future:

N: I mean you are dealing with the idea of having like a digital database of all your pictures and all your photographs. You could just, you know, have it categorize and you could call it up whenever you want to.

One reason why families paid so little attention to the presentation and arrangement of digital photos on the PC was that they never saw the PC screen as a convenient vehicle for synchronously reviewing and sharing those photos with others (see section on Co-Present sharing). However, the main reason was that **digital photography had not replaced conventional photography** in the families we studied, especially for the archiving of the families' most precious memories. Instead they used the new technology as a vehicle for duplicating and distributing those memories to families and friends, and also for the immediate communication of more casual images to remote acquaintances. It is to these activities that we now turn.

Sending

Compared to archiving practices that were sporadic and varied widely between families, **sending practices were remarkably common and consistent**. All eleven families

we interviewed described ordering conventional reprints to give or send to family and friends. Indeed, for families with extended family members in another city or town, the ordering and mailing of reprints had become a routine part of taking photos:

PB: What I generally do is I have double copies made. So I take one set and put them away. And the others I usually give away to the people that are in them.

RM: And I always get 2 prints when I get it back.

M: We get double exposures of everything, sort out the ones that are going to go in the album and any that are good enough to send, forward to grandparents and friends.

When we asked about the sending of digital photos the same families were quick to praise the technology for making it easier to duplicate and send photos, and increasing the immediacy of the experience for recipients. Again, **all families reported some level of digital photo sending behavior** over email or web channels, and great joy in receiving digital photos from others:

SM: We're already talking on the computer, and so I can send (photos) to her instantly. That certainly is something that you're never gonna do with an SLR, so that was fun.

ML: And now, with email, it's just SO much fun. Because as soon as we got these wedding pictures back, I scanned some of them ones I thought were the most interesting to them, since none of them were here.

An important characteristic of these photo-sending activities is that they are embedded in ongoing interactions and relationships. Hence we found that families experience as much **joy from the feedback and subsequent conversation around the photos** they have sent, as they do from sending or receiving the photos themselves. This is neatly summarized in the following quote from one mother who reflects on the value of photos in conversations with distant relatives:

SC: I think the web is kind of neat because my family and some of my friends are back on the East Coast, so I rarely see them. So I get some comments like from my brother-in-law, like "whoa, Rachel's really getting old!". We live with them so it's really easy to look at a picture and remember what they were like, but for them it's like "whoa, from this little thing to this adult woman!"...Sorta helps you really remember how short life is.

The 'embedded' nature of digital photo sending made **email attachments preferable to web publishing** for sending individual images or small photo sets. This is because email is designed to support an ongoing textual conversation that can be enhanced with images. The web on the other hand is designed to support the exchange of images, and doesn't automatically provide support for commentary and feedback. In fact, the timing of our study

(mid 1998) pre-dated many of the current photo websites that attempt to make photo publishing easy. This meant that in order to share digital photos over the web, families had to put up photos on their own home pages. Some families in our sample *had* been using this mechanism to 'send out' large sets of photos that would be difficult to attach to email messages. For the most part this seemed to be used as a workaround to emailing, and was often followed up with email messages as the last quote shows, or with telephone calls as described below. We did *not* find that the web was used for archiving personal digital photo stores.

Finally, there was some evidence of **publishing unusual digital photos to a wider audience** than just family and friends. Typically this involves sharing photos relating to hobbies or other special interests with a worldwide audience. Again, feedback from the audience appeared to play a significant role in people's motivation to put new material onto the web.

Remote sharing

Many participants told us that they frequently send and receive photos to or from remote locations, and then **discuss those photos synchronously over the telephone**.

DK: And with my mom I do it all the time, because I have a very large extended family. We get pictures of my nieces and my nephews and school pictures and stuff from my brother and my sister, but I would say I probably do it maybe 6, 7 times a year. We don't actually share the pictures in person; we talk about them over the telephone.

S: I guess probably the last time I shared photos was actually over the telephone which sounds sort of silly I suppose, but I have a couple of nephews, they're in the service. One lives Back East and one lives in Colorado. I received photos in the mail, and mom did also. So we explained to each other who got what over the telephone.

Apart from these reports, and the observations in the previous section about people receiving feedback on photos by email, there were no accounts of people trying to use technology for photo conferencing. The closest account by one family was of organizing a family videoconference on New Year's Eve, using PC cameras and specialized desktop videoconferencing software. However, this did not involve sharing images of photos.

Co-present sharing

Of all the methods of interacting around photos, **sharing photos in person was described as the most common and enjoyable**. Such co-present sharing was seen as a way of re-creating the past and reliving the experience with others who were there at the time:

If they're pictures of something we did that was fun, like a camping trip, it brings back the camping trip and gets everybody talking about their memories.

Showing prints was also seen as a way of showing off experiences and events to those who weren't there at the time. This appeared to involve teaching, showing progress, making an impression and conveying information:

Just about anywhere that I take photographs, it's usually in a place that's interesting to me, or exciting, like a vacation or someplace I haven't been. In showing those photographs to other people, you're helping them at least to some extent experience the same thing, see things that maybe they haven't seen or places they haven't been."

In contrast, **many participants reported being "turned off" by the notion of looking at digital photos on a computer** screen when sharing with friends and family. To these participants, images on a computer screen were too abstract, lacking the tangibility and manipulability of physical photographs. One participant described this situation as follows:

To me, that wouldn't be any fun. I don't want to go sit in front computer screen and look at the pictures. I want to look at them and point to things, and compare this one to that one.

This state of affairs is reflected vividly in the photo diaries completed by families over a 3-month period following the home visits. Only 7 out of 127 co-present photo sharing episodes related to 'digital' photos (4 on a camera LCD and 3 on a PC). Interestingly, families interpreted 'digital' to mean 'screen-displayed' for the purposes of filling in the diaries, and 'conventional' to mean 'printed' photos. Hence the figures are missing for the sharing of printed digital photos. This misperception is revealing of a broader feeling that once a digital photo is printed it somehow ceases to remain digital and becomes 'conventional'.

Analysis of the diary codes for the 114 printed photo sharing episodes, (excluding 3 slideshows and 3 frames), begins to indicate the context in which printed photos are shared. A number of key summary statistics for this set are shown in Table 2. An organising factor for the table is whether or not all, some or none of the participants **share the memory** in the photographs being discussed. This turned out to be a key determinant of the kind of ensuing talk, as we will shortly show in relation to the recorded conversations. For the time being, we can see that printed photo sharing took place about every 9 days, and involved significantly more sharing of loose photos than albums (df=2, χ^2=19.75, p<0.001). It was also more common for the conversations to take place in a home context (df=2, χ^2=32.54, p<0.001) and with family and friends than with others (df=2, χ^2=32.86, p<0.001).

80 of the 114 printed photo-sharing episodes were recorded on tape. This corpus contains over 15 hours of conversation, in which each conversation lasted an

average of 11 minutes 15 seconds. Although these recordings don't give us access to the images being discussed or the visual conduct of participants, they nevertheless indicate the kind of things people talk about when sharing photos and the ways in which that talk gets put together over time. While a full treatment of these data is not possible here, we use them to highlight a few key features of co-present photo-talk, which have implications for technological enhancement and support.

COUNTS	All share memory	Some share memory	None share memory	Total
No. Episodes	68	13	33	114
Frequency	1 every 15 days	every 72 days	every 30 days	every 9 days
..with loose photos	50	9	21	80
..with albums	18	4	12	34
..in home	52	12	29	93
..elsewhere	16	1	4	21
..with family	30	2	13	45
..with friends	32	9	16	57
..with others	6	2	4	12

Table 2. Some technical characteristics of printed photo sharing conversations (N=114)

A basic assumption about photo-talk is that it involves a kind of *storytelling* with images [c.f. 3]. As we began to listen to the recorded photo-sharing conversations we quickly realized that **storytelling was only present in a subset of conversations**; namely those in which the photos are being shown to others who were not there at the time the photos were taken and hence do not share the memory represented by the photos. We also noticed that in situations where more than one person is present who shares the memory represented in the photo, this story telling often becomes a collaborative project. However, as Table 2 shows, these account for only 46 of the 114 conversations and are therefore a minority of the set (i.e. 40%). The majority of conversations involve sharing photos exclusively with members of the original 'capture group'. These comprise **another sort of talk that we refer to as *reminiscing* talk**.

Some differences in people's attitudes toward reminiscing and storytelling in conversation are actually reflected in the first two quotes of this section (respectively). The value of reminiscing is in recalling the details of experiences with others while the value of storytelling is in communicating status, experience and wisdom to

others. The different ways in which these values are realized in conversation are illustrated in Extracts 1 and 2 below. Extract 1 is a fragment of reminiscing talk between four members of a family who are going through some prints recently developed from an old roll of film. The photos show Christmas scenes with the extended family and discussion revolves around which Christmas they relate to.

Extract 1. (I2,15:16) Reminiscing talk within a family over some Christmas photos.

```
1     Mar:    [  i t   i s  [ christmas look at the]re's jake
2     Joh:    [There's the [    d    o    g    ]
3             (1.0)
4     Nie:    Well if it's
5             a [year and a  h[af ago he wasn't  quite gro]wn=
6     Mar:       [( Look at th[e     l o o k    at    ju-) ]
7     Emm:          [      A    h    r    r    ]
8     Nie:    =was h[e t h e ]
9     Mar:          [  n  o  ] you know what is that last year's
10            presents  though?
11    Emm:    Yeah  those are last [   y  e  a  r  s   ]
12    Joh:                         [What's that  big b]ox
13            (1.4)
14    Nie:    Yeah well we must have had that roll in there
15            fo[r a long  ti[me]?
16    Emm:      [No th]at's la[ s ]t years]=
```

A typical feature of reminiscing talk is that it involves **jointly 'finding' the memory together**, only to leave the memory unelaborated. Hence in Extract 1 various features of the scenes are noted simply as clues to the timeframe, such as presents, a big box, stockings by the fireplace and so on. In other extracts participants comment on technical features of the photos, on unusual subjects, on whether a photo shows them in a good light and how their appearance has changed over time. Once these features have been used to place photos in a time and context, it is rare for members of the capture group to re-tell the story of what they did together. In fact, treating such matters as non-topical and leaving the story untold is one way of demonstrating mutual understanding or common ground in conversation [c.f. 5]. Another characteristic feature of this type of conversation is that it contains **symmetrical** contributions from each participant, often with overlaps between successive utterances (shown with square brackets in the transcriptions).

In contrast, Extract 2 shows how **stories get told explicitly to others who weren't present at the time**. Tracy has returned from vacation with her friend Annabelle and is showing Annabelle's photographs of their trip to her husband Simon. In this extract the roles of storyteller and audience are clearly visible, and the participant's unequal status of knowledge claims regarding the subject matter of the photographs is reflected in the form of the talk.

Extract 2. B1:1.00. Storytelling talk by a wife to her husband

```
1     Tra:    And  (1.1) here's
```

2	Sim:	That mus[t be your beau]tiful
3	Tra:	[Anna b e l l e]
4		(0.8)
5	Sim:	beautiful face right there
6	Tra:	Annabelle and me anyway we ate at the painted
7		(0.8) lady erm (1.0) tea room
8	Sim:	Uhum
9	Tra:	And we were sittin' out [en this]
10	Sim:	[Is thatone] of the rooms
11		in the house?
12	Tra:	Uh no t[his wa]s th[is was uh] in still in=
13	Sim:	[oh this] [o k a y]
14	Tra:	=Atlanta springs and urm (0.5) this was a real
15		interesting thing can you tell what's in that tree
16		right there?
17	Sim:	They look like pumpkins
18	Tra:	Well those are actually lights (1.0) An um (0.7)
19		but what's hanging in the tree is a cup an she an-
20		thuh there was little tea cups hanging all over this
21		tree an then underneath it in the yard there were
22		little like dishes to match the tea cups so
26	Sim:	Why?

The conversation in this extract is clearly **asymmetrical**. Whilst Tracy's talk is characterized by extended narrative sequences, Simon's talk is characterized by occasional single turns, usually in the form of questions or minimal observations. Although Simon's contributions are minimal, they nevertheless serve to steer the unfolding of Tracy's story by directing her to details Simon is interested in or doesn't understand. In this sense, they act like rocks at the bottom of a fast flowing river, diverting the trajectory of the water at critical points. This kind of conversational storytelling is very different from a storytelling performance in which the audience is passive and largely redundant to the telling of the story. Although the author can partially suspend the turn taking organization of conversation in order to produce extended narrative sequences, it still involves the **active participation of other parties** [16].

Further evidence for this was discovered twelve days later when Tracy showed the same photos to a girl friend. Tracy told a similar story about them, but in quite a different way. For example, there was some joking about the name of the 'Painted lady café' and its appropriateness for the two holiday makers, and a more direct reporting of Tracy's observation that it was "a dish garden". Many of the differences between these two accounts are clearly identifiable as the sequential consequences of conversational contributions by the story recipients. These comparisons also demonstrate that story telling photo-talk is subject to **'recipient design'** in the same way that ordinary conversation is. Recipient design simply means that the talk displays an orientation and sensitivity to specific co-participants, and can be seen to influence such aspects as word selection, topic selection and the ordering of sequences [17].

Further complexities enter into this kind of storytelling talk when more than two participants are involved. In fact the average number of participants for the 80 recorded conversations was about 4 . Typically, a couple of people who share the memory of the photos will be showing them to another couple who don't. This leads to a **mixed reminiscing and storytelling conversation** in which a story gets told collaboratively. In these conversations we hear many of the corrections and elaborations that go on between couples at a dinner party when they are telling a shared story. Collaborative storytelling of this kind has been described elsewhere in the literature as a method of **collective remembering** [14] which demonstrates social cohesion [15]. This adds a further level of interactivity to the conversation in which the story is 'found' as well as told through the talk.

A final observation from these records is that **not all stories relate to the photographs at hand**. Some spring off an individual photo which triggers a memory of some related event. A good example of this occurred around a photograph of a campsite, while a young couple were showing their parents photos of a recent camping trip. The campsite was the place they eventually stayed after trying a previous campsite infested with raccoons. It was the story of being attacked by raccoons that was told over this photo, rather than anything related to the photo itself. This shows that it is the memories and the conversation that are of primary importance in photo sharing, rather than the consumption and description of the images themselves. In this respect **the talk is similar to a visual anthropology interview**, in which images are used to elicit historical descriptions and stories from an informant (c.f. 4). Each photograph makes relevant certain topics of conversation but their development is a matter of questioning and negotiation between the informant and the interviewer.

DISCUSSION

Returning to the original aims of the study, we can now provide answers to our two research questions and specify some requirements for future photoware technology.

The previous section has shown in some detail what the people in our sample did with conventional and digital photos (Q2 in the Introduction). We have found that both kinds of photographs are taken ostensibly to capture memories for future personal reference, but in practice are used to review and communicate experiences with others. This means that whenever photos are used as reminders of the past, it is usually within the context of some other social activity, which can add further layers of meaning and memory to the photos. In this 'embedded' social context, the photo material itself assumes subsidiary importance.

In general the most successful past and present photoware technologies have been those with the greatest affordances for image-based communication. For example, loose photographic prints can be recruited quickly and flexibly into face-to-face conversations, written on and sent easily

to others. Image attachments to email speed up this latter process. They enhance already existing channels of informal communication and provide an automatic method of receiving feedback and comments on photos. In contrast, technologies that place the photo material center-stage have been less successful. Photo albums are difficult to produce and maintain without the encouragement and participation of others. Digital photo albums and websites are no better, when presented as a method of organizing, storing and retrieving images. Indeed, people appear to subvert and socialize these technologies wherever possible, by printing out digital photos to share, emailing each other about website content, and using web-based images to start up global interest groups.

With regard to what people want to do differently with digital photos (Q1 in the Introduction) we believe they would like to use them more extensively as catalysts for conversation in extended family and friendship contexts, and to improve individual relationships over distance and time. This desire can be seen as a natural outgrowth of the current niche application of digital photography within conventional photography, as a convenient method of capturing photos to share in particular ways. Future technology should help users in their *socialization* of digital photography products and services, in order to extending the sharability of digital photos across a range of use contexts. Given the centrality of spoken conversation in ordinary photo sharing, we believe this will ultimately involve a much greater integration of voice data and services with imaging technology.

Prioritizing user requirements for different classes of future photoware on this basis leads us to the following list. The major categories are shown in order of importance and attraction to consumers, with associated recommendations for the kinds of functionality required. Because technology has moved on since we carried out the study, we also place these requirements in the context of recent technical developments (see again Table 1).

A. REMOTE SHARING

- #### *Photo-conferencing tools*

Perhaps the biggest gap in the photoware market today is support for simple methods of remote photo sharing. People are already successfully exchanging digital photos with each other asynchronously, but reverting to use of the telephone in order to discuss them live with remote partners. Hence there is an opportunity to enhance current photo-sharing practices over the telephone with what might be called 'photo-conferencing' tools. These might be telephone, PC or TV centric, and should support the kind of active audience participation that is typical of co-present photo sharing. *Microsoft NetMeeting* and *Instant Messenger* services come closest to enabling this behaviour on a PC platform, by allowing remote family and friends to establish live internet connections with each

other and share a photo viewer application with one way pointing and control over the images. However, this implementation requires considerable set-up with a high bandwidth connection, and cannot support the kind of mixed initiative conversation typical of co-present (printed) photo sharing.

- #### *Multi-user album software*

Some kinds of album-making could be turned into a social activity if remote partners could select and organize photo collections together. This would require a photo conferencing link as mentioned above, but also a photo album package designed for synchronous operation by multiple authors. The objective of the call would be the generation of a joint photo album, copied to all the participants. A similar approach is used today for physical album making by the Creative Memories community, which hosts local seminars and workshops where people can come to make their albums with or alongside each other.

- #### *Instant photo sharing*

The immediacy of photo sharing achieved on the back of a digital camera might be reproduced remotely, by adding live photo capture to a photo conferencing call. In a home-based situation this would allow remote participants to quickly exchange viewpoints and describe live events in their local domestic environment [7]. In a situation where one partner is mobile, this would allow the mobile partner to share aspects of a live experience with a remote family member or friend. Related facilities today include the incorporation of a PC camera feed into a NetMeeting conference, the relay of refreshed still images from a web camera and the prototyping of 3rd Generation Wireless services with mobile video conferencing [e.g. 13]. However, these concentrate on the relay of live video images or repeated static images, rather than the sharing of live still images.

B. SENDING

- #### *Reprint mini-albums*

The web publishing model of sending photos by announcing their web location does not fit the user requirement to send miscellanous collections of reprints to particular people with a personalized message. Although email works better for this, it is cumbersome to add several photos to an email message and may fill the recipients mailbox. An intermediate solution is required which either compresses a mini-album attachment to an email message, or points to a virtual mini-album generated from a larger photo archive on the web. The latter facility was simulated in the FotoFile system as a method of generating mini-stories called 'scraplets' from within a photo archive [11]. The former facility is provided by the Email VoiceLink software from InChorus (www.inchorus.com). This supports the kind of animated

voiceover that has already been found to be effective for business documents [8].

- ### *Joint accounts on photo websites*

Current photo websites such as www.hpphoto.com are reflections of the traditional family album which can be viewed remotely by restricted groups of other people. However, the practice of circulating reprints relating to particular occasions suggests a more radical possibility of extended family and friendship albums. The provision of ad hoc joint accounts shared by more than one household would facilitate this behaviour. These would allow groups of individuals to create shared albums out of the overlaps between their respective collections.

- ### *Instant photo sending and feedback*

More instantaneous sending of photos from the original capture location would be valued for many of the same reasons as instant photo sharing (described above). It would establish a more immediate connection to distant family and friends. This can be done in a relatively straightforward way today by taking a photo on a smart phone or wireless PDA and sending it as a message attachment by wireless transmission. An internet picture frame from *Cieva* fulfills a related function in a different way and over a longer time period (http://www.ceiva.com/). It poles a private photo website overnight to automatically display any new pictures which have been published within the last 24 hours. Although this is not instant photo sending, having the frame ensures that the owners are kept aware of any significant developments in the sender's lives around the time that they happen. This arrangement is taken further in a research prototype system called *KAN-G*. This system not only makes recipients aware of new photographs arriving on the web, it also collects feedback responses from recipients and feeds them back to the photographers [12]. This begins to address another requirement from our study, to support commentary and feedback on sent photographs. Integrating discussion facilities within a photo website would be another way of addressing this need.

C. ARCHIVING

- ### *Special project mini-albums*

Active selection of small photo sets for special projects such as homework assignments or anniversary gifts was a relatively frequent activity, and already linked with digital photography. Future technology should capitalize on this link and target such behavior. (Note that this is a different aspiration to 'computerizing' the process of chronological album making). The facilities required will be similar to those recommended for 'Reprint mini-albums' above, but with extended capabilities. For example, photos might be arranged in a montage which indexes accompanying audio or video clips, and can be printed economically by the

recipient as a permanent token and reminder of the project. Alternatively, a small photo collection might be set to music and animated in a self-playing slide show. This facility is provided in recent CD writing software from HP called *HP Memories Disc*. A directory of digital photos can be set to music and recorded on a CD-ROM in a format which can be replayed on a DVD player. This allows users to create special projects cheaply on their PCs to keep or give away for consumption on a TV.

- ### *Indexing and audio-annotation*

Since we found that people forget details of the context in which photos are taken, there is a requirement to store as many of those details as possible with the photo for future retrieval and reference. This is a problem that has been addressed in a variety of ways by camera software, operating system design (such as Windows XP support for photos) and commercial photo management systems such as ACDSee (http://www.acdsystems.com). Most of these systems support chronological numbering, arrangement, and display of photos for visual browsing, storage of time, date and other information on each image, and the manual labeling and key-wording of photos. While this imposes some organization on photo collections, the kind of details that users require goes beyond the technical information that can be stored automatically. The overhead of adding this information in keywords is too high for people who may not even get around to putting their best photos in albums. One approach is to lower the overhead by improving the interface techniques for labeling [e.g. 18]. However, we suggest a looser kind of labeling in the form of audio-annotations on collections. These might be provided on or off the camera and at different levels in a collection - rising above the individual photo level to the episode and photo set. Furthermore, such annotations might be provided by photographers themselves or those who share the memories of the image, spreading the responsibility for annotation within the capture group.

D. CO-PRESENT SHARING

- ### *Augmented prints*

In general, we found few actual or reported problems with co-present sharing of printed photos. This was despite apparent inefficiencies in the angle of viewing images in a group and drift in the focus of visual and narrative attention for any individual. In fact, these very inefficiencies are what makes 'flicking through photos together' so enjoyable, since they encourage forms of audience participation which keep the talk from becoming monotonous. For this reason, we recommend considering ways of building on the foundation of printed photo sharing rather than replacing it with forms of screen-based photo-sharing. One way of doing this would be to explore alternative ways of printing photos specifically for sharing, such as in small themed collages or on banner strips which could be unfolded or stretched across the

floor or table. Another way of augmenting prints would be to support the playback of associated audio information from paper. This might be done in a number of ways including audio-enabling printed cards and albums [6]. The same approach might be extended to the sharing of video clips represented by printed index shots.

- *Recording of storytelling conversations*

We have seen that some photo sharing conversations incorporate comments about the meaning and value of photos to those who took them. Typically these are storytelling conversations that include participants who didn't share the original experiences represented in the images.   Furthermore, many storytelling conversations happen quite soon after the original event when details and impressions are still fresh in the authors' minds. These comments and conversations would be good to save and associate with the photos for future personal reference and consumption. This could be an additional method of audio-annotation as discussed above.

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