

AUGMENTING PHOTOGRAPHS WITH SOUND FOR COLLOCATED SHARING

An exploratory study of the Audiophoto Desk

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Abstract: The Audiophoto Desk is a tangible interface. It plays a sound that has been associated with a photograph when a printed version of that photograph is placed on the desk's surface. This study explored how three groups of four friends used the desk to share photographs in the context of two types of photo-talk: reminiscing and storytelling. The study had three aims. The first was to investigate the types of sound that users would choose to accompany their photographs. In particular it was of interest to see whether recipient design would be relevant in explaining why the participants chose some of their sounds. The second aim was to examine the effect that different types of audio would have on the conversations during photograph sharing. Music, sound effects and voiceovers were found to have different effects on the latency before the conversation began and the extent of the conversation. The third aim was to understand the user experience of the groups. Despite the use of printed photographs, some participants felt that the Audiophoto Desk made photograph sharing too formal a process for the home.

Key words: Photographs, music,

1. INTRODUCTION

A recent development in digital photography is the introduction of cameras that can record sound as well as images, producing 'audiophotographs' (Frohlich & Tallyn, 1999). The sharing of this type of photograph necessitates some form of technology to allow the sounds to be played back, something that is possible using photoware for the PC. However, a number of researchers have noted that while the advent of digital photography has

made it easier to share photographs remotely, it is less appropriate for supporting face-to-face conversations, largely due to the limitations of available display technologies (e.g., Balabanović *et al.*, 2000; Shen *et al.*, 2002). This may be one reason why users tend to print out their digital photographs for the purposes of sharing them (Frohlich *et al.*, 2002, Crabtree *et al.*, in 2004). This study explores how groups of friends used an interface that has been designed to support the sharing of 'audioprints' (Frohlich *et al.*, 2000): the Hewlett Packard Audiophoto Desk (Frohlich *et al.*, 2004). This is a tangible interface that plays sounds to accompany printed photographs, and enables users to share audiophotographs without sitting around a computer monitor. Photographs that are placed on the desk's surface are recognised by a computer via a webcam. The computer then plays the appropriate sound to accompany the photograph. However, from the user's perspective, the computer plays a minimal role in the experience. This study aims to explore a number of aspects of audiophotography in the context of photograph sharing using the Audiophoto Desk. Whereas previous studies have used audio CDs, PC photograph albums and even handheld audioscanners (Frohlich *et al.*, 2000) to enable groups to play back sounds, no other research known to the authors has used the Audiophoto Desk in this way.

Previous work on audiophotography has used various types of audio, which have been used for different purposes. Research by Frohlich and Tallyn (1999) shows that ambient sounds recorded at image capture were perceived as enlivening photographs and acting as triggers for memory. Further work by Frohlich (2004) shows that simply recording conversations about photographs can be useful, making the photographs themselves more personalised and providing details that might otherwise be forgotten. Here, audio can be seen as an alternative to the written annotations often found in photograph albums, but one that is easier to create than explicit verbal annotations. However, it is also noted that:

"Participants ... were most reticent of recording voiceover when they could not imagine an appropriate audience. In fact the most difficult audience to record for was oneself, since participants already knew the story of their photographs and found it hard to anticipate what details they might forget." (page 165)

A study of a portable device that allows audio to be recorded alongside sequences of photographs (Balabanović *et al.*, 2000) confirms this finding. Users did not record vocal annotations for their own purposes, instead envisaging voiceovers as a way of supplementing photographs to be sent to others. Moreover, users did not take the opportunity to record their own

photo-talk, although they did note that new behaviours could evolve over time.

The main aim of the present study is to explore the types of sound that will be chosen by users to accompany their photographs. Here, audio will be chosen to accompany existing photographs rather than recorded at image capture, and the users will know who they will be sharing their photographs with when they select their sounds. This may help overcome some of the problems in choosing sounds noted by Frohlich (2004), in that users will be able to design their sounds for a particular audience. The notion of designing audio for known listeners can be seen as an extension of the recipient design found in ordinary conversation (Sacks *et al.*, 1974) and also in photo-talk (Frohlich *et al.*, 2002). Frohlich *et al.* note that conversations about photographs often represent a trade-off between the stories that the photograph owner(s) want to tell and the interests of their audience. It is hypothesised that the selection of audio in this study will reflect the interests of the audience that it has been chosen for.

A second aim of the study is to investigate what effect various sounds have on groups' conversations. It is hypothesised that ambient sounds, such as background music or the sound of the sea, will encourage conversation, whereas audio that requires attention, such as verbal annotations, will inhibit it. A third aim is to investigate how the Audiophoto Desk is perceived and, in particular, whether it is seen as an appropriate domestic technology. The groups' perceptions of how compatible this type of technology is with the informal approach to photograph sharing that is adopted in the home will be considered in this.

The study involved three groups of four friends. The groups were split into pairs, with each pair being asked to provide a set of photographs to be shared with the rest of the group. One pair was asked to bring in a set of photographs of an event that involved the whole group, to allow reminiscing to occur (see Frohlich *et al.*, 2002). The other pair was asked to bring in photographs of an event that one of them had done without the others, allowing storytelling to occur. The pairs were also asked to choose a sound to accompany each photograph. They were provided with a sound effects CD and a CD of ambient music to help them to do this, but they were also able to choose music from their own collections. Additionally, they were supplied with a MiniDisc recorder so that they could create their own sound effects and voiceovers. Their behaviour while sharing the photographs, and their perceptions of that experience as measured by questionnaires and interviews, form the basis of the study.

2. METHOD

2.1 Participants

The participants were three groups of four friends, who were all undergraduate students at the University of York. There was one all male group, one all female group, and one mixed group of one male and three females. Each group had known each other for at least a year prior to the study. The mean age was 20.70 years, with a standard deviation of 0.71 years.

2.2 Materials

The study was run in the dining room of the York Responsive Home, a smart home recently developed at the University of York. The Audiophoto Desk was set up on the dining table. The groups' behaviour was recorded using an unobtrusive camera on the opposite wall. The setup of the room is shown in Figure 1.



Figure 1. Experimental setup

Details of the desk's functionality are as follows. The Audiophoto Desk plays a sound that has been chosen to accompany a photograph when that photograph is placed on the desk's surface. The sound continues to play until the clip ends or until the photograph is removed. If two or more photographs are placed together, the accompanying sounds will be played simultaneously. Additionally, volume can be altered by moving photographs towards the front of the desk (increasing volume) or towards the rear (decreasing it), and sound can be panned across the two speakers on the surface of the table by moving photographs from left to right. When

photographs are obscured from the camera and then revealed again, the associated sounds restart.

Two questionnaires were administered to the participants during the study. The first gathered background information about the participants and their friendships with the other participants in their group. The second examined what the participants thought of the Audiophoto Desk by asking them to rate their agreement with a number of statements using a five point Likert scale. The questionnaire addressed five topics. There were two statements for each topic, one positive and one negative. The five topics were as follows:

- Ease of use
- Satisfaction with experience
- Perception of experience as fun
- Involvement within the group
- Perceived enhancement of photograph sharing.

2.3 Procedure

The study was split into three sessions for each group.

Session 1. At the first session the Audiophoto Desk was demonstrated to the group. The group was asked to form two pairs, and each pair was instructed to bring at least ten, but no more than 18, of their own photographs with accompanying sounds to the next session. This was because the Audiophoto Desk is limited to storing the information for 18 photographs and their sounds at any one time.

Session 2. The second session was run with each pair separately. This required the participants to bring in the photographs that they had chosen and the accompanying sounds, as well as a list to clarify which sound was to accompany each image.

Session 3. In the final session the participants were seated at the Audiophoto Desk in their two pairs. They were reminded how to use the Audiophoto Desk and then asked to share with their friends the photographs that they had chosen. Following this, each group member completed the questionnaires and was interviewed individually.

3. RESULTS AND DISCUSSION

Videos of the first eight minutes of the groups' behaviour for each set of photographs were examined. The value of eight minutes was chosen because the group who had the shortest conversation talked for just over eight

minutes. Events such as conversational turns, placement of photographs on the desk and audio playback were coded using 'The Observer', a software package that supports video analysis.

The results will be presented in accordance with the aims of the study. Data on the types of sounds that were chosen and their effect on the conversation will be given first, followed by questionnaire and interview findings to allow an insight into the users' experiences.

3.1 Types of Sound used to Augment Photographs

The sounds chosen by the participants to augment their photographs could be placed into three categories: music, sound effects and voiceovers (voiceovers were classified as containing spoken words). Sound effects and music could either be created especially by the participants or chosen from existing CDs. The types of sound chosen by the participants to accompany their photographs are given in Table 1, and some examples of each category are given in Figure 2

Table 1. Types of sound used to augment the 66 photographs totalled over the 3 groups, classified as created especially for the photograph or taken from existing recordings.

	Music	Sound effect	Voiceover
Created	2	6	17
Existing recording	23	18	-

Table 1 shows that whereas voiceovers were (by necessity) created especially for the photographs, music and sound effects were more likely to be taken from existing recordings. This is unsurprising, given that music is harder to create, and that the participants had their entire CD collections to choose from. The distinction between created sound effects and voiceovers was sometimes quite tenuous, with sound effects such as wolf-whistles being put in the sound effect category simply because they involved no words. An alternative approach to creating a sound effect is described below.

The photographs in Figure 1 illustrate some of the different ways in which sounds were used to augment the images. In some cases audio was used simply to enhance the scene shown in the photograph. For example, the sound of someone making a drink seemed to be created to represent the type of background noise that would have been present during a night out. Atmosphere could also be created using music. Chicane's "Offshore" was chosen as an upbeat piece of music that reflected and emphasised the action captured in the image. In these cases audio was used in a similar way to that

found by Frohlich and Tallyn (1999), in that it enlivened the scene shown and helped trigger memories. For one photograph, accompanied by "Happy Birthday", the music acts as a clear reminder of the depicted event.







	<i>Voiceover: Created</i> Reading of Dante's "Midway along the journey of my life"
	<i>Sound effect: Pre-recorded</i> Toy plane
	<i>Music: Pre-recorded</i> "Offshore" by Chicane
	<i>Voiceover: Created</i> Reading of Dante's "Midway along the journey of my life"
	<i>Sound effect: Pre-recorded</i> Toy plane
	<i>Music: Pre-recorded</i> "Offshore" by Chicane

Figure 2. Examples of photographs and their accompanying sounds for each category.

However, audio that had a more tenuous connection to the photograph was also sometimes chosen. Such sounds triggered memories that were not

directly relevant to the events shown in the photograph. For example, the sound of a toy plane was chosen because one of the people in this photograph liked planes and had been known to the photograph owner since childhood. In this way sounds could be very personal and largely meaningless to people who did not know the background to them (including other members of the group). The explanation of why these sounds had been chosen supplemented the conversation, and introduced topics that might not otherwise be covered in typical photo-talk. However, the majority of photographs were augmented with audio that was at least meaningful to the people within the group. Many of these seemed to be 'in-jokes'. For example, the use of the word "Legend!" to accompany one photograph was met with a great deal of laughter, and seemed to be a catchphrase of the person shown. In cases where the audio did not represent a known joke to the group, it was still often chosen with the other group members in mind. For example, the Dante reading in Figure 2 was chosen to reflect the "calm before the storm" depicted in this photograph, and once this was explained it seemed perfectly suited to the group's sense of humour. Similarly, much of the music that was chosen was selected because it suited the tastes of the group that would be listening to it.

One type of audio that was conspicuous in its absence was the type of voiceover that involved someone explicitly describing the scene. There were only two instances of this (both from the same pair), both of which were greeted with laughter and were seemingly inappropriate for the task of sharing audiophotographs as a collocated group. It can be seen that in addition to the participants showing recipient design in their choice of sounds, they also largely chose audio that would be suited to the situation of photograph sharing, and avoided vocal annotations that might be more appropriate in a photograph album.

3.2 Effect of Sounds on the Conversation

To give an indication of how long and how often different types of sound were listened to, the duration for which they were played and the number of instances of a sound being restarted are given in Table 2. As these statistics are totalled over the photographs viewed by all three groups in the first eight minutes of conversation, not all of the audiophotographs that were developed are included. The number in each category used in the analysis is given in first row of the table.

Unsurprisingly, music was played for longer than any other type of sound before either reaching its end or being removed from the desk. The music clips tended to be the longest and therefore obviously had the potential to play for longer. Voiceovers tended to be very short, but there were a couple

of very long voiceovers, for example poetry readings, that have caused the mean to be higher than is representative of the data. The median gives a much more accurate indication of voiceover duration.

It was quite rare for any sound to be deliberately restarted. This may be partially due to the fact that once audio clips had stopped they would restart spontaneously if they were briefly obscured from the camera while the groups were using the desk. Voiceovers seemed to spontaneously restart much more often than any other sound, probably because, due to their short duration, they would be left at the front of the desk, where the potential for being overshadowed was greater. Participants tended to restart sounds for the fun of mixing them together, rather than for the sake of listening to them again. When mixing audio, they appeared to be fairly indiscriminate about what they were mixing, simply grabbing photographs that were within reach.

Table 2. Mean (with standard deviations) and median duration that different types of sound were played for, and the total number of instances that photographs from each category were restarted

	Music (N = 20)	Sound effect (N = 16)	Voiceover (N = 10)
Mean duration of sound (s)	67.27 (57.75)	22.37 (20.28)	24.99 (38.89)
Median duration of sound (s)	45.9	13.7	3.24
Total that were deliberately restarted	3	6	1
Total that spontaneously restarted	6	5	15

Table 3. Mean scores (and standard deviations) for the total amount of time the group spent making conversational turns and the latency before the conversation begins, when talking about photographs accompanied by different categories of sound

	Music (N = 19)	Sound effect (N = 11)	Voiceover (N = 10)
Mean latency before the conversation begins (s)	2.64 (2.66)	3.04 (1.78)	6.82 (9.43)
Mean total amount of time spent in turns (s)	42.41 (31.29)	32.62 (17.82)	37.13 (21.65)

To try to understand the overall effect of the different categories of sound on photograph sharing, the length of the conversation (measured by summing the total amount of turns in seconds, but not backchannels, laughter or side comments) and the time spent listening to the sound before any turns are taken are given in Table 3. Because only photographs that had been fully discussed within the eight minutes were used in this analysis, the number in each category is slightly lower than in Table 2.

As Table 3 shows, latency before the conversation begins is much shorter for music and sound effects than for voiceovers, as predicted. Voiceovers must be attended to if they are to be understood, resulting in the conversation being suspended while they are playing. As shown in Table 2, the median duration of the voiceovers is 3.24 s, so it seems that in many cases the participants listened to the full sound before the conversation began. In contrast, music tracks, which are most likely to be familiar to the group, are quickly recognised, allowing the conversation to begin.

Music is associated with more time spent in conversational turns than the other two sound categories. The fact that music clips were listened to for the longest amount of time may have encouraged the conversation to go on for longer by making silences less awkward. Furthermore, the end of a clip often signalled a chance to introduce a new sound and therefore move the conversation on. The fact that this was delayed with music clips may also have contributed to the longer conversations. It was hypothesised that sound effects would be similar to music in encouraging longer periods of conversation compared to voiceovers. In fact, voiceovers stimulated more time spent in conversational turns than sound effects did. Voiceovers were more likely to be meaningful, as opposed to simply providing background noise, than sound effects, and it may be the case that this stimulated more conversation. However, it should be noted that the variance across the different categories is extremely large, making it possible that the pattern found is not reliable.

3.3 Interview Findings and Observations relating to Different Types of Sound

Participants were generally positive about the addition of sounds to photographs, saying that it “made it more enjoyable” and “added humour”. However, some of the sounds were deemed to be more suitable than others by the participants. Music was popular overall and could easily be integrated into the conversation. One participant said, “Using music’s better because the voices distract you more”. Another disadvantage of voiceovers compared with music was that they tended to be very short. One participant commented, “It would have been cool if we’d had more music files going on

in the background and we could have talked over them, instead of waiting for this three second sound but then it would be gone”.

An unexpected finding was that listening to the audio sometimes took precedence over looking at the photographs: “Some photos were probably preferred more than others, because of the [sounds], you know they were funny or the song was good, so maybe the other ones got discarded”.

On some occasions the addition of sounds was thought to detract from the experience of photograph sharing. Sometimes this was related to the functionality of the desk, which had a slight delay before a sound played. One participant said, “Sometimes you’d put the photograph down and then you were waiting for the sound effect to come up, or things got confused and lost, and you know something didn’t come out so [you] wanted to put it down again”. This seemed to be an extra burden on the people who had provided the photographs, who seemed to feel in some way responsible for the smooth running of the experience. One of these participants commented, “We were very conscious of the way the pauses kicked in”.

The use of sound also made it difficult for participants to hold photographs to get a closer look once they had been placed on the desk; “If you picked them up you interrupted the sound effect and if you put them down again they started all over again”. Some of the sounds that were recorded were thought (in hindsight) to be inappropriate for the actual sharing of photographs. This was particularly true for voiceovers giving information about the photograph. As one participant said, “Like saying ‘this is me with so-and-so’, that didn’t really work cos he was here so he could say, ‘this is me with so-and-so’”.

Participants felt that adding sounds “made the conversation a lot easier” and made the experience of photograph sharing “more personal”. One participant said that it “made you engage a bit more because immediately you start to try to think of the link which means that you look at the photo”, and another commented, “Because the sounds were from different people it kind of brought them into the experience of it more”. However, not all of the participants thought this. One said, “I wouldn’t say it makes you read anything more into the photo or really look at the photo in a different way”.

3.4 User Experience

3.4.1 Questionnaire Results

The results of the questionnaire are shown in Figure 3. The scores for the positive and negative statements on the same topic were combined by subtracting the score for the negative statement from that for the positive

statement. This resulted in all scores falling on a scale from -4 to 4, where a positive score represents a positive experience.

Figure 3 shows that all groups rated their experience positively, with no scores falling below 1 on the scale of -4 to 4. In general, the highest ratings were given to questions about the experience being fun and relatively low ratings were given to questions about satisfaction. It is possible that the lower ratings for satisfaction may be related to the participants' expectations of the desk. As the initial demonstration of the desk used photographs that were designed to be played together, and was performed by an experienced user, the technology appeared to be quite seamless. This was not always the case when the participants themselves used the desk for photograph sharing.

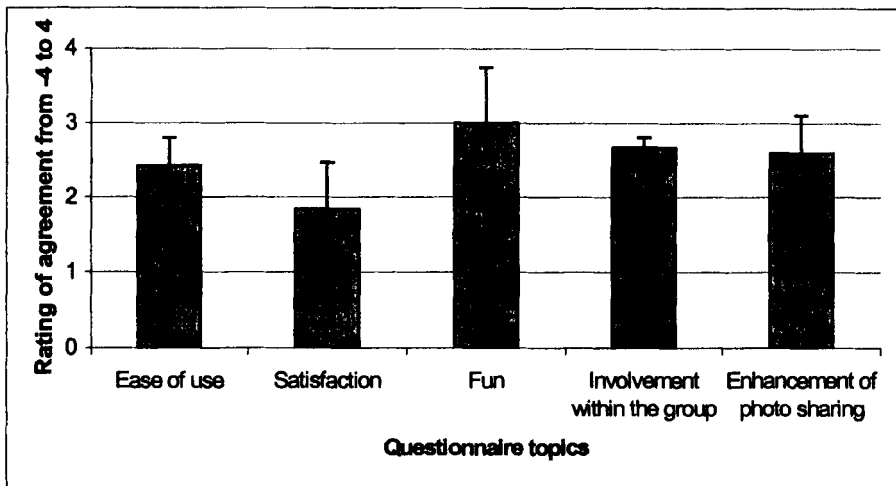


Figure 3. Graph to show the mean questionnaire results. The error bars indicate standard deviations (N = 12).

3.4.2 Interview Findings and Observations relating to User Experience

Size of display. Having one photograph at the front of the desk meant that everyone was able to look at the same photograph at the same time. Most of the participants felt that this was a positive aspect of using the desk, with one saying, "Normally when you share photos you look at it and then you pass them to the next person, so you're only describing it to the next person, rather than everybody being able to look at it". However, not everyone accepted the positive aspects of viewing one photograph centrally. A contrasting view was that "it's a bit strange the way we had four of us sitting

round [...] when you hold it in your hands you've got people in closer, it's a closer experience". This may be another reason why the ratings for satisfaction were relatively low; although the desk was perceived as fun it may not have been seen as supporting the intimacy normally found in photograph sharing.

Interacting with the desk. A number of the participants developed misconceptions about how the desk worked. In particular, restarting sounds proved to be difficult. One said, "we were placing it down and kind of pressing it down quite firmly so that it would play", and another noted that "when you tap them they come back on again". In fact neither of these strategies were correct; to restart a sound it was necessary to hide the photograph from the camera before revealing it again. Members of the same group tended to share similar misconceptions about how the desk worked, and this may account for the high ease of use ratings given in the questionnaire; clearly they felt that they understood how to use the desk. The difficulties that the participants had seem to be a problem of this tangible interface not actually being responsive to touch (Lindley & Monk, 2004).

Using the desk in the home. The participants were asked how they would feel about using the desk in their own home. The general feeling was summarised by one participant who said, "It would have to be a fairly special thing for you to set it all up, but if you were doing a presentation, or maybe showing some people you didn't know [...] then I think it would be good". Most of the participants felt that using the desk added a formality to photograph sharing; "It sort of comes across as a bit like a presentation in the work place". One said that it would be "a bit forced, to say to people let's come round and look at my photos". Another issue was the amount of time viewed as necessary to set up the Audiophoto desk. It was viewed as "quite labour-intensive, a bit time-consuming" and therefore something that might be used "now and then, but not regularly". One participant summarised the feeling of audio sometimes being unnecessary in photography by saying, "It would have to be a very special occasion... I wouldn't take out a video camera for instance and video a night out with the guys".

4. SUMMARY AND CONCLUSIONS

The main aims of this study were to investigate the audio that users would choose to accompany their photographs and to explore the effect of different sounds on the conversation. It was hypothesised that recipient design would be reflected in the selection of audio and that whereas ambient sounds such as music and sound effects would encourage talk, voiceovers would inhibit

it. An additional aim was to understand how the Audiophoto Desk would be perceived by the participants who used it; particularly in terms of its appropriateness as a domestic technology.

The results generally support the first hypothesis. While some sounds were selected to serve the purpose (previously noted by Frohlich and Tallyn, 1999) of enlivening images and triggering memories, most audio was chosen specifically to suit the audience. Music was often selected with the tastes of the group in mind, and voiceovers capitalised on in-jokes and knowledge that was common to the group. Explanations of why these sounds were amusing were left unspecified. This is analogous to the way that common memories associated with photographs are often left unelaborated (Frohlich *et al.*, 2002), and can be seen as a way of demonstrating common ground (Clark & Brennan, 1991) and friendship. In addition to designing sounds for a particular audience, the fact that photographs would be shared with a collocated group also seemed to have an impact on the participants' choice of sounds. The rare occasion of photographs being augmented by explicit vocal annotations was generally seen as being inappropriate, because it did not make sense in the context of collocated photograph sharing. The fact that only two out of 17 voiceovers consisted of this type of content indicates that audio was generally chosen to suit the situation.

In considering the second hypothesis it does seem that the different categories of audio have different effects on conversation. Although the small number of groups prevents statistical significance from being verified, the intent of the study was simply to explore possible effects of sound on behaviour. The results were surprising in that while music encouraged the longest conversations, the shortest conversations occurred when accompanied by another type of ambient sound: sound effects. It seems that although voiceovers did delay the beginning of the conversation, they were short enough for this to not be detrimental. Furthermore, it may be the case that their meaningful content actually promoted a good deal of talk.

The third aim of the study was to consider how appropriate the Audiophoto Desk is as a domestic technology. Surprisingly, the Audiophoto Desk was not seen as offering the flexibility of printed photographs, despite its use of audioprints. Instead the large display was perceived as too formal for the home. It may be the case that portable audioscanners, such as the one used by Frohlich *et al.* (2000), will be more able to maintain the advantages of printed photographs, because they can be easily incorporated into ongoing discussions or activities. Additionally, the task of selecting sounds for each image was seen as too much effort. This is something that may be overcome with the use of digital cameras that record sound, but obviously needs to be

addressed if sounds are to be tailored for audiences and situations as they were in this study.

The findings of this study have a number of implications for audiophotography. It should be noted that while vocal annotations are inappropriate for photograph sharing, and sound effects that add atmosphere are the least likely to facilitate conversation, these are the two types of sound most likely to be recorded with digital cameras. While these sounds may enhance the experience of looking at photographs in an album and be an enjoyable supplement in remote sharing, they are less suited to photograph sharing by collocated groups. This study has shown audiophotography's potential for recipient design and its capacity to provide a fun experience when photographs are shared by groups. However, to capitalise on this potential the development of technology that makes it easier to augment photographs with more than one sound, and to share them in a way that maintains the informality of printed photographs is necessary.

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REFERENCES

- Balabanović, M., Chu, L.L. & Wolff, G.J. (2000). Storytelling with Digital Photographs. *CHI Letters*, 2 (1), 564-571.
- Clark, H.H. & Brennan, S.E. (1991). Grounding in Communication. In L.B. Resnick, J. Levine, & S.D. Teasley (Eds.), *Perspectives on Socially Shared Cognition*, 127-149. Washington DC: American Psychological Association.
- Crabtree, A., Rodden, T. & Mariani, J. (2004). Collaborating around Collections: Informing the continued development of photoware. *Proceedings of CSCW '04*, 396-405. Chicago: ACM Press.
- Frohlich, D.M. (2004). *Audiophotography: Bringing photos to life with sounds*. London: Kluwer.
- Frohlich, D.M., Adams, G. & Tallyn, E. (2000). Augmenting Photographs with Audio. *Personal Technologies*, 4 (4), 205-208.
- Frohlich, D.M., Clancy, T., Robinson, J. & Costanza, E. (2004). The Audiophoto Desk. *Proceedings of 2AD, The Appliance Design Conference*. Bristol: Appliance Design Network.
- Frohlich, D.M., Kuchinsky, A., Pering, C., Don, A. & Ariss, S. (2002). Requirements for Photoware. *Proceedings of CSCW '02*, 166-175. New Orleans: ACM Press.

- Frohlich, D.M. & Tallyn, E. (1999). Audiophotographs: Practice and prospects. *Extended Abstracts of CHI '99*, 296-297. New York: ACM Press.
- Lindley, S.E. & Monk, A.F. (2004). DJing with Photos. *Proceedings of HCI 2004, Volume 2*, 179-180. Leeds: Research Press.
- Sacks, H., Jefferson, G. & Shegloff, E. (1974). A simplest systematics for the organization of turn-taking for conversation. *Language*, 50 (4), 695-735.
- Shen, C., Lesh, N.B., Vernier, F., Forlines, C. & Frost, J. (2002). Sharing and Building Group Histories. *Proceedings of CSCW '02*, 324-333. New Orleans: ACM Press.