

GRASPABLE CUES
FOR EVERYDAY RECOLLECTING

The work in this thesis has been carried out:

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Cover: Memories (depicted by the two cats at the top of the triangle) can be cued by digital sources, such as digital photos (the bottom left cat) as well as physical objects (the photo frame on the right). Cats are chosen as examples of everyday memories.

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PROEFSCHRIFT

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Een herinnering is een interpretatie van het nu.

(Sanne Wallis-de Vries, try-out van "Stuk",
8 nov. 2002, Stadsschouwburg Eindhoven)

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1 Introduction

Most people are actively dealing with their personal memories. Take for example the woman who just returned from a holiday. Probably she will talk about her experiences with various people, which in fact is the rehearsal and perhaps the fixation of her holiday memories. When she refers to other holidays in the same conversation she is trying to relate her new memories to other existing memories, thereby working on her old memories at the same time. There even is a fair chance that her listeners are doing the same thing. Reminiscing is a recurring process, continuously shaping people's personal histories and identities. Although recollecting often goes unnoticed it is an important phenomenon in people's everyday life and the topic of study in this thesis.

Today, with the increasing digitization of memory carriers, such as photos, this remembering or reminiscing can be aided in ways previously impossible. In this thesis the possibilities of supporting people in dealing with their memories are investigated.

1.1 Context

1.1.1 Project Context

The work described in this thesis has been carried out in a four-year industrial project (van Loenen et al., 2003; Overview of the Phenom project, no date; Phenom Perceptive Home Environments, n.d.) at the Philips Research Laboratories Eindhoven, the Center for User System Interaction (IPO) and the Eindhoven Embedded Systems Institute, the latter both of the Technische Universiteit Eindhoven. In particular the demonstrators that were built in this project are a joint effort, which never could have been realized without the project team at Philips Research. The core of the team consisted of six people: a project leader, a software

specialist and four Ph.D.-students. They worked on the following topics: Ambient Intelligence (van Loenen, 2003, van Loenen and van den Hoven, 2003, van Loenen et al., 2003), a software service discovery (de Jong, 2003), tracking technologies (Dijk et al., 2003a,b,c,d), learning systems (Teixeira and Faihe, 2002, Teixeira and Verhaegh, 2003, Teixeira et al., 2003), synchronization problems (Feijs and Qian, 2002, Qian, 2003, 2004, Qian and Feijs, 2003, Qian et al., 2001, 2002a,b) and the user interaction concerned with recollecting memories (van den Hoven, this thesis).

The project was called Phenom, short for Perceptive Home Environments. The initial aim of the project was to build a "Memory Browser" and a demonstrator to show this concept. The home, which was decided by the project team to be the context for the work of the team and thus the work in this thesis, is an interesting environment to study reminiscing, because it is a private and personal environment, where people are more inclined to deal with their emotions. At the same time, the home often contains many physical objects, such as souvenirs that are related to memories.

1.1.2 Industrial Context

The Phenom project was part of the Philips research program on Ambient Intelligence (Aarts et al., 2001, Aarts and Marzano, 2003). Therefore, the ideas behind the Ambient Intelligent vision on the future of electronic systems have influenced the research described in this thesis. Ambient Intelligence originates from Mark Weiser's concept of Ubiquitous Computing (1991), which foresees that in the future many networked devices will be integrated in the environment. Ambient Intelligence adds to this that those embedded devices together can (Aarts and Marzano, 2003, p. 14):

- recognize people and their situational context
- be tailored towards their needs
- change in response to them and
- anticipate their desires without conscious mediation.

One of the ways of implementing Ambient Intelligence is by digitizing everyday objects. These characteristics of Ambient Intelligence show an increasing digitization of everyday objects, which coincides with the increasing digitization of memory capturing (e.g., digital photography). This trend offers new opportunities for future memory recall systems, which are explored in this thesis. The possibility to couple the physical world to the digital world by tagging physical objects electronically. One of the challenges seems particularly interesting in this respect is to make future systems attractive for all kinds of people who recall memories,

not only for people who are experienced in working with digital or electronic devices. Souvenirs are everyday objects traditionally used by “ordinary” people to cue memories and share them with others. This makes souvenirs seem natural candidates to link physical and digital media involved in remembering.

Natural interaction can only be achieved in the actual physical, social and cultural context of use. Therefore a real living-room setting was created at the start of the project to implement and evaluate early concepts of the “Memory Browser”. Later, project results could be implemented and studied in a “real” home, called HomeLab (Eggen and Aarts, 2002). The interaction between inhabitants and networked, intelligent environments is envisioned to be intuitive and natural, and to fit the rhythms, patterns and cycles of everyday life. Such natural interactions seem extremely important for designing a device that supports the experience of remembering, since retrieving recollections can be a personal and emotional experience. In addition internal and external memories are often hidden in people’s lives, environments and belongings, which makes them ubiquitous by nature.

In short, the topic of this thesis lies at the cross-section of the following two areas: Autobiographical Memory recall, which is defined as “memory for the events of one’s life” (Eysenck and Keane, 2000, p. 217), and the increasing digitization as portrayed in the Ambient Intelligence vision on the future of electronic systems. Both areas are embodied by the use of souvenirs or “graspable recollection cues” which is the topic to be explored in this thesis.

1.2 Theoretical Framework

This thesis studies the relationship between people’s Autobiographical Memory and personal physical objects in their homes. The following theoretical framework served as an inspiration for the present study.

Autotopography (González, 1995) studies personal collections of physical objects that serve as a memory landscape to the owner. These objects, such as photos, souvenirs, furniture or jewelry, physically shape an autobiography because they link to memories that are important for the owner. Since those memories are important the objects that link to them are also important, but this link is invisible and often unknown to other people. The collection of objects, its arrangement (such as a home altar), and its location (stored in the attic or placed in the middle

of the living room) represents a part of the owner's memory, history and thus identity. At the same time, these objects might represent desire, identification and social relations, establishing a form of self-representation.

In addition to some descriptive work on Autotopography no investigations have been done on the real-world implementation of this concept. There is no data on the number of autotopographical objects, which objects can become autotopographical or what type of memories is attached to them.

A concept related to Autotopography is called Distributed Cognition (DCog). The term Distributed Cognition stands for a "system" of activity, which includes all relevant features, such as people, interaction between people, the media used and the environment within which the activity takes place, including tools and artefacts (for an overview of DCog, see Perry, 2003). Distributed Cognition is a new and not yet well defined framework for understanding human activity, which arose from the idea that cognition is not limited to the heads of people (internal cognition) but can also be brought into the real world (external cognition) of physical artefacts and their surroundings. According to Preece et al. (2002) external cognition serves three functions, 1 – to simplify cognitive effort by using tools to compute for you, 2 – to trace changes and 3 – to reduce memory load, for example by using reminders.

Although Distributed Cognition has so far only been applied to collaborative-work research, a challenge for this field is to take it outside the office and into the home, for example for in-home recollecting, which also involves cognition, people, physical artefacts and spaces. The challenge is to study the relationships between these different topics, which is done in this thesis.

One requirement stated by the concept of Distributed Cognition in the workplace is that artefacts or tools must have a universally understood meaning shared by all the users. This universally understood meaning, however, is not necessary for in-home recall since the owner of, e.g., a souvenir, is also the person who understands the meaning of the souvenir and uses that meaning for memory recall. That person should keep the freedom to change the meaning of the souvenir (consciously or unconsciously) depending on the context of the memory recall.

Based on the concepts of Autotopography and Distributed Cognition it became apparent that a distinction should be made between internal and external information and internal and external cues (see Figure 1.1). DCog's internal and external cognition describes cognitive processes, which can be initiated by internal and external information, respectively. DCog mainly uses external information

(such as dots, representing airplanes, displayed on a computer monitor) which is interpreted internally and can serve as an internal cue for the user to act upon. Her action (in the remainder of this thesis the term “she” and “her” will be used to refer to the user) is then based on internal information (e.g., professional knowledge) and will be translated into external information (e.g., telling a pilot about his location in the queue for landing). This situation is based on a work situation which is, on a higher level, not that different from a memory recall situation.

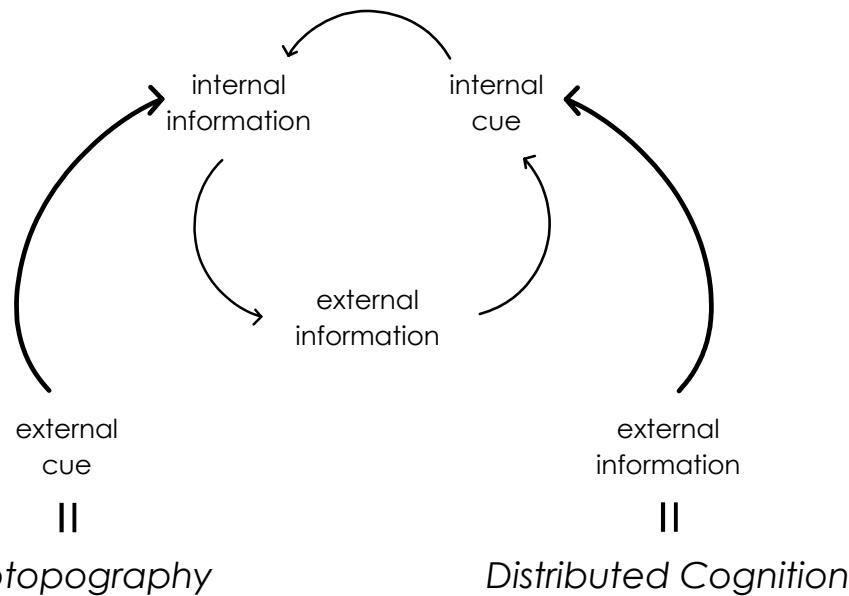


Fig. 1.1. A schematic representation of the cognitive processes involved in Autotopography and Distributed Cognition, which are only different at the start.

An autotopographical object (such as an old postcard) can in some cases contain external information (the writing on the card), but it definitely can cue its owner directly for internal information without reading the information on the card (e.g., the object as a whole remembers her of a specific situation in which the sender of the card made a fool of himself). The owner of the postcard can act upon this information by communicating it to someone else, which makes the story external information. Of course in the work situation mentioned before it is of the utmost importance that a complete procedure is followed, while storytelling or reminiscing does not have to adhere to any rules, therefore a lot of variations are possible on the example mentioned above. The main difference between the two concepts is that Autotopography does not need external information in order to

cue the owner to find internal information, since the added link of the object to a memory was created by the owner (see Figure 1.1).

Figure 1.1 shows a schematic overview of the processes described within the Autotopography and the DCog frameworks. Despite that DCog describes the workplace and Autotopography the home situation the theories behind them are related. On a higher abstraction level both frameworks discuss the interaction between internal and external information which initiates processing by people. The only difference between the two is that recalling memories, as mentioned by Autotopography, starts often with a cue, while DCog starts with external information. Once the process is started the steps are similar and can be repetitive, as indicated by the circle in the middle of Figure 1.1.

The concept of Autotopography comes from material culture studies, while DCog stems from the human-computer or user-system interaction field, which shows that different disciplines are working on similar topics. Both frameworks study the interaction between the physical world and human cognitive processes. In Chapter 3 Autobiographical Memory will be introduced as a third framework coming from psychology that mainly focuses on the internal cognitive processes relevant for recollecting.

Since this thesis covers several disciplines, it is necessary to explain some of the main terms that have different meanings in different disciplinary contexts.

1.2.1 Definitions

Autobiographical Memory is defined as “memory for the events of one’s life” (Eysenck and Keane, 2000, p. 217). If the terms *memory* or *memories* are used in this thesis, they refer to one or more personal autobiographical memories (unless explained otherwise), such as the things someone might remember from his or her wedding day, or the first day at school. *Human memory* is used as a container term for all the diverse memory systems mentioned in Section 3.2.2 of which Autobiographical Memory is only a subset. *Recollect*, *recall*, *remind*, *reminisce* and *remember* are all used synonymously meaning “to bring an image or idea from the past into the mind” (Merriam-Webster Online Dictionary, 2003). This remembering is always preceded by a search process, but this can be conscious, voluntary, explicit or unconscious, involuntary, implicit. Both types of searching can be supported by recollection cues (see Section 3.2.5).

The Distributed-Cognition framework adds some notions which need an explanation as well. Since the context of this thesis is on remembering, the terms *internal* and *external information*, which also refer to memory, because a memory consists of information, can be reduced to *internal* and *external memory*. The term internal means “mental” and external “physical”. *Internal memory* is a memory inside the user’s head, while objects and contexts in the physical world represent *external memory*. If those objects cause memories to pop up in someone’s head, they function as memory cues and they are called *external memory cues* or *external cues*. Anything that can be perceived outside the human being can serve as an external memory cue, for example a song or an odor. This is opposed to *internal memory cues* (or *internal cues*), such as thoughts or associations, which can both be a part of a memory search process. Although the term cuing is not used in the field of Distributed Cognition, the same effect is known. In the DCog framework “reminders” are considered as examples of one of the three functions of external cognition, namely to reduce memory load. In the context of this thesis a cue is a particular kind of information, information that does not need long or even conscious processing in order to activate internal information. For example, a memory cue leads directly to (a part of) a memory.

The terms *trigger* and *cue* are synonyms in this thesis, but cue will be used mainly, since this is the common term used in the Autobiographical-Memory field.

The term *association* is used in this thesis according to Chambers Dictionary (1993) “association of ideas” which is defined as “mental linkage that facilitates recollection, e.g., by similarity, contiguity or repetition”. If a media object, such as a digital photo, is linked to an object, such as a souvenir, this is termed a *digital association*.

Since this thesis not only focuses on physical objects, but also on digital objects, such as digital photos, external information is subdivided into physical external information and digital external information.

1.3 Thesis Outline

This thesis consists of five sections each focusing on one topic and composed of one, two or three chapters. The core sections (II, III, and IV) are preceded by an introductory section (I) and are rounded off with a concluding section (V). All sections have the following in common:

1. They all relate to how people recollect *memories* in their homes. The term home is defined as “a habitual dwelling place, or the place felt to be such; the

residence of one's family; the scene of domestic life, with its emotional associations; a separate building occupied by a family, a house" (relevant quotes from Chambers Dictionary, 1993). In Chapter 2 examples will be mentioned of recollecting memories, varying from storytelling to creating scrapbooks to taking photos and more. When people talk about their memories of a holiday, they reconstruct their memories from their Autobiographical Memory. Recollecting memories can be done alone or together with other people, by showing holiday photos to friends or giving souvenir gifts and explaining their origin. The majority of these examples appear to happen at home. Therefore, most of the issues discussed in this thesis should be considered from the "home" point of view.

2. They all deal with *souvenirs*. With souvenirs, physical objects are meant which reside in the home and which can be used in the process of recollecting memories. Since this process as well as the objects are personal, examples can be manifold, e.g., an old chair inherited from grandpa reminds someone of him, or whenever a person asks a friend where she got that piece of artwork she will start talking about the holiday during which she bought it. In addition to the physical objects mentioned, also virtual objects can play a role in recall, take for example the growing number of digital photos taken, or digital video recordings made. They should be presented to the user, such as e.g., on a display. In terms of the theoretical framework discussed in Section 1.2 souvenirs are an example of external memory cues and memories are examples of internal information.

In general, the four content sections can be divided into two groups, the first one (Sections II and IV) studying more in-depth topics in order to gather knowledge and the second group containing sections that mainly describe a design process (Sections III and V). Because user-centered design involves people using the "end" product, those people are called "users". In Sections II and IV people are not asked to "use" anything but they filled out questionnaires and joined in an experiment, therefore they are called "participants". But all these terms stand for the same group of people, namely the future users of a device that supports recollecting.

Section I starts with an introduction into how people deal with memories in everyday life (Chapter 2) and discusses what is currently known about the use of digital photos and what scientific knowledge exists on the working of human autobiographical memory (Chapter 3). Section II (Chapter 4) studies whether souvenirs can be seen as external memory, and whether they are suitable as part of

a Graspable User Interface (Chapter 5 and 6). The next step, Section III, describes the design of a wireless and mobile device which can be used to store, browse and view digital photos (Chapter 5). This device uses souvenirs as shortcuts to certain subsets of digital photos. Chapter 6 presents an extended framework for Graspable User Interfaces based on the work in Chapter 5.

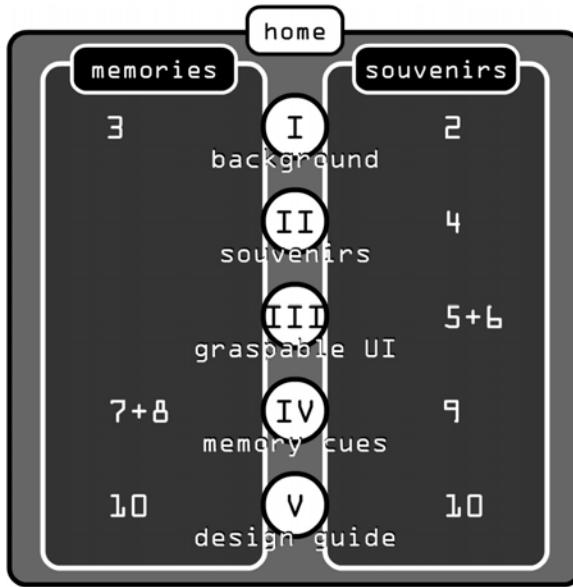


Fig. 1.2. Schematic overview of the different chapters (the white numbers) and sections in this thesis (the black Roman numerals) and how they relate to several topics including home, souvenirs and memories. For more information, see text.

The Digital Photo Browser of Chapter 5 features two types of memory cues, namely digital photos and souvenirs. A logical next step was to test the effect of alternative types of physical objects and modalities, such as photos, videos, smells and sounds, on cuing Autobiographical Memory of a real-life event (Section IV). This extensive study (Chapter 7) was performed to find out which cues are most suitable for supporting memory recall in a future Recollection Supporting Device. Additional research was conducted to verify whether the participants regarded the physical objects in this study indeed as souvenir (Chapter 9). For analyzing the data of the cuing study a new method was developed (Chapter 8). The last section (Section V) of this thesis gives recommendations for the design of a future device which supports recollection (Chapter 10). This design-relevant knowledge was formulated based on the work described in the previous sections.

SECTION I – BACKGROUND OVERVIEW

The following two chapters contain background information for this thesis. The main topic of this thesis is autobiographical memory and in particular graspable or tangible objects that can cue autobiographical memory in the home environment. Chapter 2 presents examples and observations taken from everyday life on how people deal with personal memories. This often includes the use of graspable or tangible objects. Chapter 3 reviews the state of the art and available knowledge on the use of digital photography and presents an overview of the scientific literature on human memory.

2 Everyday Recollection Examples

"Just as a photograph can take me back to a specific time and place, so can a pressed flower, a small seashell, or even a theater ticket stub. Reminiscences and sweet dreams are made of such things, and I travel to experience and to record and sometimes to re-create later what I have seen and felt."

This is a quote from the book "Souvenirs de Voyage, A Traveler's Keepsake Book" (Kollenbaum, 2002). It describes how people can gather interesting souvenirs-to-be, such as the examples mentioned above, it gives advice on how to preserve them at home, and it suggests how to make collages. In addition to pages for note taking, the book even has transparent pages glued together such that this book can serve as a depository for small objects. A complete guide is created for people who collect small souvenirs and use them later to remember their travels. Another example on memories and souvenirs is an online museum explaining the stories behind objects or souvenirs which are in its collection and that can be viewed on the museum's website (Smithsonian Without Walls, n.d.).

This chapter presents ways in which people deal with memories or recollections in everyday life.

2.1 Scrapbooking

Another way of dealing with small souvenir memories is *scrapbooking*. Scrapbooking appears to be a popular hobby in the United States. According to Cantonrep.com (2003) scrapbooking was in 2002 the fastest-growing hobby in the US with a 1-billion-dollar industry, consisting of scrapbook courses, books, special materials, complete stores on scrapbooking, workshops, software and even

conventions. So what is scrapbooking? Simply put: it is a more creative way of gluing family photos in an album. In practice this means that “croppers” (people who do scrapbooking) go to a special store to buy photo albums which have a certain topic, for example, the beach. This theme album is only suitable for a beach-related event and can hold a limited number of photos, mostly only one or two per page. The rest of each page is not blank, such as in the old-fashioned photo albums, but it is used completely for creating a beach-atmosphere by adding other “flat” material, such as tickets or maps. The additional space can be filled with self-made name tags (including decorated split pins to make holes through a page), self-written texts printed on special beach paper and waves made of several colors of blue material. The layout, colors and materials in such a scrapbook are carefully chosen for two adjacent pages, the result being more a professionally designed book than the old-fashioned photo albums people used to have (see Figure 2.1).



Fig. 2.1. An example of a page in a scrapbook from a hobbyist who used seashells and sand-colored paper for decoration (dMarie Layout Central, n.d.).

According to several online sources (Cantonrep.com, 2003, News Journal, 2002, The Sun News, 2003 and Utah News, 2003) the predominantly female croppers have several reasons for putting so much energy and time in their hobby. The first is their urge to be creative, the second is to “save their family history”, the third is

the opportunity to talk about their memories with other croppers at cropping clubs (where they create their scrapbooks together), the fourth is, for some, to make money and finally some people use it to get through rough times, e.g., when a loved one passed away or when a tragic event happened (see Figure 2.2).

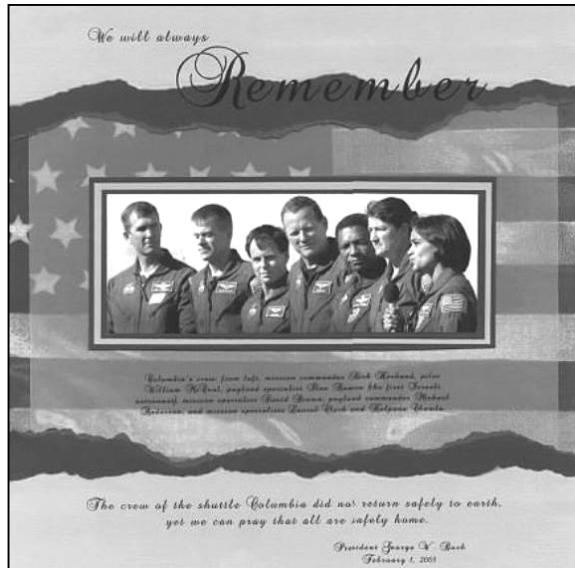


Fig. 2.2. A hobbyist scrapbook page on the disaster with the shuttle Columbia (dMarie Layout Central, n.d.).

2.2 Photos

Other things people do with printed *photos*, in addition to scrapbooking, is putting them in "regular" photo albums, boxes, photo frames or even jewelry, showing them to others, giving away copies, talking about the associated memories often while holding the photo, cherishing photos of lovers or the deceased and even tearing them to pieces out of anger or sadness. Some facts on everyday photography: Maypole-researchers estimated that in 1999, worldwide, every second 2700 photographs were taken. An employee of a Dutch photo-development lab estimated that around 80% of the photos they develop are created during holidays (Pemberton, 1999).

With the appearance of the digital photo camera, and thus *digital photos*, new options have emerged. In Section 3.1 an overview will be given on research related to digital photos and digital photo applications.

On most digital cameras photos can be viewed and browsed by means of a small LCD-screen and arrow buttons. Because of the small size of these LCD-displays a number of devices and applications are on the market for viewing and browsing through digital photos on a bigger screen or display. Of course, the TV is one, which can be used together with a DVD-player, an archiver or a PC. This is a device that can display photos, play movies and MP3s from memory cards. Sony has created a special LCD-TV and monitor, which can not only display photos from a MemoryStick but can also record still images from TV or video.

In addition to the TV there are also dedicated devices for viewing digital photos, which are called digital photo frames such as (e.g., PacificDigital, 1998-2002, Sony, 1999, Vialta, 1999-2003). Those photo frames get their photos from solid-state memory cards. This memory card can be used as a storage device in a digital camera, which, in principle, makes the intervention of a PC unnecessary. Ceiva's Digital Photo Receiver (2003), which is also a digital photo frame, can be remotely controlled via a special website. The frame can change the pictures it displays, which makes these photo frames suitable for example, to show grandma the latest photos of her grand children. In addition to these digital photo frames there are devices with exactly the same functionality, they only do not look like photo frames, but more like Personal Digital Assistants (PDAs), e.g., VideoChip Technologies' Photo Wallet, Matsushita's Pocket Library and Sima's C.PIX Portable Digital Photo Viewer.

Another new application is showing photos on TV, which can be done directly by connecting the digital camera to the TV, or via specialized devices, such as Microsoft's TV Photo Viewer (2003). DVD-players can also show photos stored on optical discs on TV. For most applications that show photos on TV a remote control is used to navigate through the photos.

A lot of software has been developed for organizing personal collections of digital photos on a PC (e.g., Canon Photo, MGI Photo Suite, Microsoft Picture it!, GatherRound.com, Kodak PhotoNet, see Prebula, 2001, for an evaluation and ACDSystems, 1996-2003). Some of these software packages are even shareware, such as the PhotoFinder (2002) and PhotoMesa (n.d.). In addition to organizing photos most people also want to show photos to others. For this purpose software is available that supports the creation of automatic slide shows (Duckware, 2000-2003). All these applications consist roughly of the same four building blocks, namely a photo display area, a thumbnail overview, a navigation frame and a button bar for additional options, such as printing and zooming. The differences can be found in the graphics, the layout and the features.

In addition to digital photo software and devices also online photo albums exist. They can be viewed remotely by friends or family members via the Internet (such as ImageStation, 2003, Picturetrail, 2003, Photofun.com, 1998-2000 and Webshots, 1995-2003). There are also communities creating photo albums together about special topics, e.g., cats (The Cat Album, since 2001) or photo art (Kodak Picture Center Online, n.d., Kodak: The PicturePlayground, 1994-2003).

Digital photos can be stored on different storage media: optical (e.g., CD or DVD), hard disk (e.g., Microdrive), or solid-state memory (e.g., Compact Flash, Smart Media or Memory Stick). The digital photos can be easily transferred from these media to the PC.

As an alternative for the PC, picture archivers exist, which are dedicated devices that make it possible to transfer photos or pictures from solid-state memory cards directly to optical storage media.

2.3 Text

Sharing memories can be important to people, for example to the person who came up with the following quote (Heartland, n.d.): "We live as long as we're remembered". Or for the characters in the novel One Hundred Years of Solitude by Gabriel García Márquez (1970). This book deals with a village where the inhabitants start to lose their memories due to a plague. The main character of the story first forgets his childhood recollections, then names of objects, followed by people's identities and ending with his own identity. He suffers from his memory loss and tries to overcome it by writing everything down. *Telling or writing stories* is a need not limited to fiction characters. Storytelling is a habit, mostly of the older people in the community, in order to convey their wisdom of life to the following generations, trying to help them overcome problems similar to the ones they once faced. Probably this custom of sharing memories is as old as spoken language. Something less old is the habit of writing down memories. One old example comes from the Renaissance in Italy where the heads of the families (the "pater familias") started to keep track of their possessions and related memories in a new literary genre called Ricordanze (meaning "memories") (Ajmar, 1999). Nowadays "much of the world's literature is in fact autobiographical, written not only because readers buy such books, but because the authors felt compelled in the first place to investigate and record their own memories" (Wagenaar, 1986, p. 226). Life stories can end up as literature in books, but, nowadays, stories can be placed on the web for easy sharing (e.g., Bubbe's Back Porch, 1996-2000) or people can even keep their diaries online for anyone to read (e.g., Rememory.com, 1999-2001). Of

course, the hand-written diary still exists and people keep writing books about their memories. On a higher level artists reflect on the importance of memories, such as the examples in Appendix 1.

2.4 Music

A student project on “Music in your life” revealed that most of the people interviewed had memories associated with music (Muziek in je leven, 1998-1999). The majority of these memories was about love, e.g., the first kiss. When hearing certain songs some people (mostly women) remembered also funerals or people that passed away. In addition to this student project a book was published on the same topic: Rememories: The Music and Memories that Shaped Our Lives (Gold and Morrow, 1999). An interviewer visited famous and unknown people from a certain age group, played them music from their youth and in this book the authors collected all the memories that popped up.

2.5 Odor

Another modality which recalls memories, consciously and unconsciously, is *odor*. Most information on this phenomenon is anecdotal (except for some literature on this topic: see Section 3.2.6), similar to the following example which comes from “Memoirs of a geisha” (Golden, 1998, p. 409):

With the dim lighting and the reddish cast from the tea-colored walls, the atmosphere was really quite pleasant. I'd forgotten the very particular scent of the room—a combination of dust and oil used for polishing wood—but now that I smelled it again, I found myself remembering details about that evening with Nobu years earlier that I couldn't possibly have called to mind otherwise. He'd had holes in both of his socks, I remembered; through one a slender big toe had protruded, with the nail neatly groomed. Could it really be that only five and a half years had passed since that evening?

A famous book on smells is “Das Parfüm” by Süskind (1985), which describes the life of a boy who has an extraordinary sensitivity for odors.

The everyday examples described in this chapter present clear evidence that memories are important to people. They also show the broad palette of possibilities people have at their disposal to reminiscence or communicate memories. The next chapter will review knowledge available in the scientific literature on this topic.

3 Related Research

The previous chapter presented a collection of everyday examples about how people deal with memories. These examples were not based on scientific evidence, simply because, in most cases¹, there is no such research. There is one exception, namely how everyday people deal with digital photos. Digital photography is one of the most popular digital media for recording and recollecting memories and it is the only medium for which an extensive body of research exists. Therefore, this chapter starts with an overview of research carried out on the use of digital photography. An overview of state-of-the-art digital photo products and their use was presented in the previous chapter.

The second part of this chapter reviews the literature on human memory in general and autobiographical memory in particular (Section 3.2).

3.1 Digital Photos

3.1.1 Introduction

As mentioned in Chapter 2, digital photo cameras (or other devices with a digital camera in it, such as mobile phones) are getting more and more popular. Several reasons contribute to this development: 1 - a new digital camera is equally expensive as a traditional one, making each digital photo cheaper than its physical counterpart, 2 – often digital cameras have a display showing thumbnails of the photos just taken, which offers the opportunity to view pictures immediately and delete the ones that do not live up to expectation, 3 - with a digital camera one can decide which photos to print and which not, something impossible with a

¹ With the exception of research into the *history* of media, e.g., the history of scrapbooking (Bias et al., n.d.), which is not particularly relevant for this thesis.

traditional camera (unless when using a darkroom), 4 – one can easily make copies of digital photos and send them to friends, 5 – a digital camera only needs batteries (which can be recharged at home) and a memory card (which can be emptied at home), therefore the camera owner can take an unlimited number of photos without having to visit a store for photo rolls or new batteries, 6 – PCs are getting more and more available in households to download and look at the photos, 7 – digital photos can be edited by anyone with a PC and some knowledge of photo editing software, 8 – the process of making pictures and viewing them is much shorter, since there are no photo rolls involved which need development.

In addition to all these advantages there are also some disadvantages to digital cameras, such as: 1 – a user needs to have at least some basic knowledge of PCs, 2 – individual photos lose their exclusiveness, because so many are made, 3 – photos have to be viewed behind a PC, which is often not a location where people want to look at their photos, and 4 - in contrast to printed photos (no matter whether their origin is digital or physical) digital photos do not yet have traditions, such as for example that people glue printed photos into photo albums. However, new traditions are starting to emerge, which makes this an interesting area to study.

This part of Chapter 3 focuses on research and applications on storing, viewing, browsing and retrieving digital photos in the home. The term “browsing” is used for ad-hoc viewing of photos without a clear goal, while “retrieving” stands for a specific search. Of course, browsing can become retrieving and vice versa in a real “viewing” session. For literature on digital-photo browsing devices, see Chapter 5. Only a small part of the literature on digital photography explicitly addresses the use of digital photos as carriers of personal *memories*, which will be mentioned in Chapter 10.

3.1.2 Digital-Photo Research

A growing group of companies and universities conducts research into viewing and browsing digital photos, where most of them focus on photo applications and devices. Only a few studies investigated how people use their physical and digital photos at home. Frohlich et al. (2002) studied “photoware”, which “supports the storage, sending and sharing of photos on-line” (p. 205) and came up with four photoware categories divided over the dimensions time and location. The category about in-home photo collaboration was called “co-present sharing”, which can be explained as collaborating at the same time and at the same place. This stands in contrast to “archiving”, which means keeping photos at the same place for viewing

them at a different time. This category contains photo albums, photo frames and shoeboxes. The last two categories are about remote collaboration at the same time ("remote sharing") and at a different time ("sending"), but remote collaboration will not be addressed in this thesis. The following sections show that the majority of studies focus on the categories based on the same location, which are called "co-present sharing" and "archiving" for collaboration.

Maypole (Pemberton, 1999) was a large European project, which investigated how family members interact with each other and the role digital photography plays in this social interaction. The Maypole project focused on devices which could create and send digital photos and developed a prototype for children, called Pix. One important conclusion from this work is that sharing photos with relatives, especially with the ones that live far apart, is important since it adds value to written or spoken communication.

Below, the literature review of research on digital photography is structured around several phases involved in digital-photo management. Relevant phases for the present study include: viewing and browsing (Section 3.1.2.1), retrieving or searching (Section 3.1.2.2) and organizing applications (Section 3.1.2.3), where the latter might encompass several phases.

3.1.2.1 Digital-Photo Viewing and Browsing

Rodden (1999) studied how people organize their printed photos and whether they would want to do this in the same way with digital photos on a computer-based system. According to the results, computer-based systems could be useful, since the participants indicated that they would like their photos to be categorized and ordered for them, e.g., categorized per event and ordered chronologically. Additionally, participants wanted to add typed annotations and search for photos based on those texts. Another result was that participants valued the possibility to make multiple copies of some of their digital photos in order to use them in slideshows and other subsets of photos without disturbing the original folder. For browsing photos, viewing lists of thumbnails were preferred. Browne and Carver (n.d.) investigated the preferred size of photo thumbnails. It turned out that it is faster to work with a thumbnail overview without a scroll-bar, despite the small size of the thumbnails. However, when a scroll-bar is needed anyway, participants preferred bigger thumbnails.

Rodden and Wood (2003) studied how participants handled their digital-photo management software called Shoebox. The results showed that participants found

their digital photos much easier to manage than their non-digital ones, because of a few simple browsing features, such as automatically sorting photos in chronological order, and displaying lists of thumbnails. One function was used often, which was changing folder names. The main photo-browser design requirement from this study was to keep the functions simple. Another finding which is important for the design of a photo browser was that in many cases photo collections did not belong to an individual but to a household.

In addition to studying the viewing and browsing of digital photos containing visual information only, a new possibility arose, namely adding digital audio to the digital photos. Audiophotography, a concept developed by Hewlett Packard (Frohlich and Tallyn, 1999), is defined as the combination of sound and photographs. One of the claimed benefits is that it "enhances memories", since participants in their trial user study talked more about events when they had photos with sounds, than when no sound was present, but numbers or percentages are not mentioned. Several ideas were presented of how the sounds attached to the printed photos could be played (Frohlich et al., 2000). One idea concerned a solution with a written number on the back of each photo and a regular hi-fi unit to play the right numbers from an audioCD. Another idea showed the photos on a PC and the individual photos could be clicked to play the associated sounds. The audio scanner was a small and portable device with speakers, which could read an embedded chip in a printed photo and sent information to a hi-fi unit. In a user study it was found that the PC option and the audio scanner were preferred over the solution where numbers were written on the back of each photo. The PC-album was favored because of the clear control by the user, since the audio can be paused at any time. The audio scanner was liked because of the tangible print, its portability and the simplicity and the compatibility with already existing printed photos.

Martin and Gaver (2000) describe four concepts for creating and playing audiophotography: small wireless displays (Placeholders), invisible cameras that make photos and record audio without anyone noticing (the Eavesdropper Camera), a camera that could make photos of itself (the Objective View Camera), and intimate cameras which zoom in on their object (the Intimate View Camera). The last three concepts were prototyped and in addition a Digital Shelf was created, which was inspired by the Placeholders-concept. This physical shelf could be used to "listen" to audio postcards by sliding a screen and associated speakers along the length of the shelf, resulting in a "flipping" through the audio photos and their sounds.

3.1.2.2 Digital-Photo Retrieving

Rodden et al. (2001) investigated which kind of thumbnail organization was favored for searching photos in a thumbnail overview: random, based on image similarity (colors and textures) or based on caption similarity (keywords and titles). Caption-based overviews proved to be preferred over image-based similarity, and image-based overviews over random photo arrangements, although the ranking depended somewhat on the task the participant was trying to fulfill. For example, when the search was unspecified, the random arrangement was most useful, since strong images would stand out, while they might be masked by similar neighboring photos in a system ordered according to image similarity.

Gargi et al. (2002) studied the usefulness of camera metadata in digital photo searches. They used three different camera metadata fields, the time/date stamp, the aperture number and the subject distance. From these data they calculated the smallest distance between the target picture and the picture to be retrieved from the database. A comparison was made between four types of searches, namely based on: 1- time, 2- visual-similarity, 3- visual and camera-metadata, and 4-visual, camera-metadata and face-recognition based retrieval. The most valued retrieval system was the time-based one and then the combination of visual-similarity and camera-metadata information. Face-recognition based photo retrieval did not do well, since the recognition software is not yet flexible enough to handle faces photographed from different angles. Mills et al. (2000) also studied various ways of retrieving photos with their own photo-managing software called Shoebox (the same application as the one used by Rodden and Wood, 2003). They concluded that retrieval by means of date-information or annotations resulted in more useful photos than visual-based retrieval. Text annotation can be done in several ways, one of them (“click and type”) is typing information in a fixed text-entry box, e.g., for the names of the people in the photo (e.g., MGI Photo Suite, see Prebula, 2001). Another way of adding people’s names is called “direct annotation”, which means the user points at the person in the photo she wants to name and starts typing (e.g., PhotoFinder, 2002). Despite the fact that direct annotation appeared to be slower than other means of text annotation, the participants liked it most (Goto et al., n.d.).

Another more recent study (Rodden and Wood, 2003) showed that annotating was hardly done by participants. Spoken annotations were not used, because of the low quality of the speech-recognition engine and typed annotations took too much effort. Perhaps, this was caused by the fact that people often do not realize the benefit of annotation since at the time of taking the photo it is obvious what is on

it, only some time later they notice that they cannot recall the name of a person or location and then it is too late for remembering.

3.1.2.3 Digital-Photo Organization Software

Digital-photo management applications can be split up in two groups, the first one focusing on the desktop PC (see below). The PC has been the first device available for viewing, browsing and searching digital photos. The second group focuses on alternative devices for digital-photo handling, such as digital-photo frames and handheld devices. This second group emerged after the digital camera became a success and people noticed that the desktop PC was not ideal for all the different contexts of handling digital photos, such as the home. For example, Frohlich et al. (2002) conclude that participants did not find the PC-screen suitable for viewing their digital photos. In addition, the digital-camera market would benefit from applications that do not need users to have experience with PCs, since there are still a lot of people who do not have PCs but who do take photos.

Two software-based research projects deal with digital photos on PCs. The first example is from Liechti and Ichikawa (2000), who studied computer-mediated communication technologies in domestic settings. They built a computer-based photo-sharing application, which supports social interactions while being physically separated. They built a framework for taking and sending photos from a camera to publication channels on the internet, which can be tuned into by family or friends to observe the photos on their PCs. The digital photos can also be annotated before sending.

Based on an ethnographic study, Edvardsson (2001) developed prototypes to help people remember their personal experiences in an art museum. The chosen solution enabled visitors to save photos of the objects they were interested in. This was implemented by teaching the visitors to collect labels of objects they liked. Those labels would then be associated to photos and other information online.

To summarize, a considerable number of studies have been done on users handling digital photos, mostly in the home environment. Most of them focus on photo retrieval and not on photo browsing. The digital photo browsing studies are mostly PC-based and deal with software, therefore leaving a challenge for the work in this thesis, which is building a portable touch-screen device and its user interface for browsing digital photos in the social context of the living room (see Chapter 5).

3.2 Human Memory

Digital photos are, just like printed photos, links to memories. Recollecting memories is only possible when events or experiences that people go through are recorded and retrievable. The following section explains the state of the art on how a piece of information which might become a recollection moves through the different memory systems in the brain (Feldman, 1993).

3.2.1 Recollection Recording

An event enters the memory system from the environment and is stored during the processing of this item, e.g., visual information is dealt with by so-called iconic memory and auditory information by echoic memory. This event is processed by the **Sensory Memory** system (SM). In SM the event stays for less than one second. The working of sensory memory becomes apparent when one watches a movie in a cinema. The movie appears to consist of fluent and moving scenes, while in reality still pictures alternate with brief periods in which the screen is black. The reason for perceiving motion is that SM stores the individual picture information during the brief periods of picture absence.

After the Sensory Memory the event information goes to **Short-Term Memory** (STM) also known as working memory, named after its supposed function (Baddeley, 1999), where the event will stay between 1 to 25 seconds depending also on the modality of the item. Short-term memory is used, e.g., whenever one reads a sentence, since the beginning has to be stored in order to be able to understand the end of the sentence. The same holds for speech: without STM people would not be able to produce coherent utterances. After each sentence STM is emptied again unless the item is rehearsed.

If the event in STM is either rehearsed, appeared to be unique or important it will move to the **Long-Term Memory** (LTM). There the event will be stored for a longer time. Some researchers (e.g., Wagenaar, 1986) even believe memories are stored permanently, they only become less accessible over time, depending on the strength of the associations.

3.2.2 Types of Memory Systems

Various Long-Term Memory systems have been proposed over the past years, each pair of systems being independent of other memory systems. The following overview is based on Eysenck and Keane (2000).

The first two types of Long-Term Memory involve the content of the memories, since **Semantic Memory** stores general knowledge or organized facts about the

world (for example mathematical and historical data) and **Episodic Memory** stores information relating to personal experiences.

Two other types of Long-Term Memory, more related to the process of remembering, are **Explicit Memory** (sometimes called “direct memory”), which requires conscious recollecting, versus **Implicit Memory** (sometimes called “indirect memory”), which does not require conscious recollecting. If a person is asked, e.g., how was your holiday in Greece, then this requires explicit memory. On the other hand, if someone is cycling to work, memories might pop up without a specific request or search activity, and this is called implicit memory.

The last two types, mentioned in this thesis, concern the future and the past, since **Prospective Memory**, helps remembering to carry out intended actions (see, e.g., van den Berg, 2002) and **Retrospective Memory** remembers past events. Both types of memory can be supported by external memory, for example the souvenirs described in Chapter 4 can serve as retrospective memory cues.

3.2.3 Theories on Recollection Storage and Retrieval

How does one store and retrieve recollections from memory? Guenther (1998) gives a thorough overview of the two opposing (groups of) theories, namely the Record-Keeping Approach and the Constructionist Approach, which are summarized below.

3.2.3.1 Record-Keeping Approach

The oldest theory for recollection storage and retrieval (already described by the Greek philosopher Plato, followed by Locke and Ebbinghaus [Guenther, 1998]) is called the **Record-Keeping Approach**. The main idea of this approach is based on the metaphor that like a library is filled with books, human memory is filled with memories. In this library each book stands for a memory and every new experience creates a new book. Searching for a book represents the retrieval process and in the case a stored book is not found, one speaks of forgetting. According to this theory the more memories a person has the harder it gets to retrieve the right memory.

3.2.3.2 Constructionist Approach

The Record-Keeping Approach is especially suitable to “preserve the past”, while the second theory is more suitable for “anticipating the future”. The **Constructionist Approach**, mentioned by Bartlett, Freud and later by Neisser (Guenther, 1998), describes a constantly adapting memory system. Since memories change connections between ideas and concepts, mainly recent events, patterns and unique events are stored. By repeating or rehearsing events (talking

about them or experiencing similar events several times, such as eating breakfast every day) the connections get stronger (e.g., between cereals and breakfast). This explains why a person remembers information relating to her expertise with less effort compared to new information; the ideas, concepts and connections are already present.

Memory recall happens by means of reconstruction. Take the example that someone tries to remember what she did on a specific Friday around 6 p.m. First, she goes back to what she usually did on Fridays, she went to work. Usually she stopped working at about 5:30 p.m., thus she must have been on her way home by 6 p.m. Unless it was a very exceptional Friday, this person does not remember at what time she went home that day, but she infers it from her regular pattern. Although this person might be sure that she was on her way home that day, she might have had a day off, instead.

Because of this reconstruction process memories change over time according to current knowledge and beliefs and no two recollections of a specific event are the same (Conway, 1996). Forgetting occurs when reconstruction is no longer possible due to too many adaptive changes.

Currently, the constructionist approach is taken forward by the majority of memory researchers (e.g., as in connectionism, Baddeley, 1999). This theory is supported by both psychological and neurophysiological investigations (Guenther, 1998). From this constructionist approach and the general knowledge of the relation between memories and emotions (Oatley and Jenkins, 1996), it follows that central components in memory foundation are: prior knowledge, personal importance and affect (Rubin, 1996). In addition, enduring memories should be: strongly emotional, a turning point in the life of the individual or (remain) relatively unique (Neisser, 1982). According to Oatley and Jenkins (1996), in general, pleasant events are recalled better than unpleasant events. For more information on the state of the art with respect to models trying to explain the relations between emotion and memory, see for example Philippot and Schaefer (2001). The category "unique memories" contains a specific type of memory which is remembered well, namely **Flashbulb Memory**. Flashbulb memories are memories for dramatic world events, such as the death of Lady Diana, the Princess of Wales, and the 11th of September 2001 World-Trade-Center attacks. Those memories are vivid, detailed and long lasting (Brown and Kulik, 1977).

3.2.4 Autobiographical Memory

For the research in this thesis, concerning people recollecting personal experiences at home, episodic memory and in particular **Autobiographical Memory** (AM) is most important. The definition of AM is “memory for the events of one’s life” (Conway and Rubin, 1993), which includes all the memories people have that have something to do with themselves. Since episodic memories can exist without being autobiographical and vice versa it is not yet known how these two memory systems relate to each other, but it is certain that those two systems have a large overlap in memories (Conway, 2001).

3.2.4.1 Functions of Autobiographical Memory

According to Cohen (1996) six functions of Autobiographical Memory can be distinguished:

1. The construction and maintenance of the self-concept and self-history, which shapes the personal identity;
2. Regulating moods;
3. Making friends and maintaining relationships by sharing experiences;
4. Problem-solving based on previous experiences;
5. Shaping likes, dislikes, enthusiasms, beliefs and prejudices, based on remembered experiences;
6. Helping to predict the future based on the memories of the past.

Note the wide range of functions, from solely internal usage, to communication between people.

3.2.4.2 Phenomena of Autobiographical Memory

When people are asked to freely recall as many Autobiographical Memory details as possible of a specific event, in 60% of the cases these details are listed in forward chronological order, which is the fastest way of accessing memory details compared to backward and random order (Rubin, 1996).

Another phenomenon of Autobiographical Memory is called the *reminiscence bump*. This bump represents the increased number of memories people remember from when they were between 10 and 30 years old. The favored explanation for this phenomenon is that most experiences in that period are new and thus more easily accessible afterwards (for an overview of the considered reasons, see Conway and Pleydell-Pearce, 2000, p. 279).

3.2.4.3 Levels of specificity

A recent contribution to the constructionist theory on storage and retrieval of autobiographical memories comes from Conway and Pleydell-Pearce (2000). In

their model they describe that autobiographical memories can have three levels of specificity:

1. *Lifetime periods* consist of temporal knowledge about the duration of a certain period and thematic knowledge about common features of this period. Often such a period lasts for years, for example “when I was at school”. Several lifetime periods may be grouped to form a higher order theme, such as “work” or “relationships”.
2. *General events* cover both repeated and single events, which lasted for days up to months, for example “I used to play with my best friends after school”. Groups of general events can form clusters, such as “learning to ride a bike” or “being best friends with X”.
3. *Event-specific knowledge* (ESK) concerns detailed information unique to a single event (which can again be subdivided into “microdetails”), with a duration of seconds or hours, for example “once when sleeping over at my friends house I fell very hard and hurt myself when trying to do a somersault”. ESKs are often accompanied by “images that pop into mind” and ESKs are presumably used to convince listeners that the speaker really remembers.

It is thought that lifetime periods and general events are stored in a different structure in the brain compared to ESKs, since ESKs, and also the links between general events and ESKs, are easily forgotten except for rehearsed memories. Lifetime periods and general events are remembered better than ESKs (see Conway and Pleydell-Pearce, 2000, for a more complete explanation).

Memory retrieval, as demonstrated in laboratory conditions, happens in cycles. This means that recollecting starts with a cue or a short memory description, a dive into long-term memory and then a cycle starts going through lifetime periods, general events and ESKs. During and after each cycle the Supervisory Attentional System (SAS) checks whether the information retrieved does not conflict with the constraints imposed on the memory search, which include the mental model of the task, the current self concept and the active themes, goals, and plans of the self. The SAS determines to inhibit or increase certain activities and eventually to terminate the search (Conway, 1996).

Sometimes recall is accompanied by a “recollective experience” (Tulving, 1983), which means that the memory includes having in mind images, feelings, highly specific event knowledge, and a sense of “pastness”. Recollective experiences therefore include ESKs. When a memory is not accompanied by a recollective

experience, the memory might be characterized by a sense of familiarity or a belief that the recalled information is simply “known”. In this case no ESKs are present in the memory.

Summarizing, the last two sections gave an overview of human memory, more specific Autobiographical Memory and memory retrieval. It serves as a context to this thesis and more specifically to Chapter 7, which describes cuing Autobiographical Memory in more depth.

3.2.5 Cuing Retrieval

Cuing memories is one way of retrieving memories. A cue (or trigger) is a stimulus that can help someone to retrieve information from Long-Term Memory, but only if this cue is related to the to-be-retrieved memory. The stimuli most often used in studies are photos, smells or text labels (see Section 3.2.6 for an overview of cuing literature). But anything could be a cue (a spoken word, a color, an action or a person), as long as there is a link between the cue and the to-be-remembered event. A combination of cues increases the chance of retrieving a memory, especially when a subject in a cued-recall experiment has to perform activities, such as to write with a pen or close a door (Engelkamp, 1998, Baddeley, 1999).

There are two types of cue-usage, namely generative and direct retrieval, respectively caused by a conscious, cyclic memory search process and unconscious memory cuing (Conway and Pleydell-Pearce, 2000).

3.2.5.1 Contextual Cues

What kind of cues might work best for memory retrieval? Three memory-type categories exist on this topic, namely context-, state- and mood-dependent memory (Baddeley, 1999). They are all based on overlap of internal or external conditions during the encoding of a memory and the retrieving of the same memory. The first example is called the encoding-specificity principle (Tulving, 1983) and falls within the category *context-dependent memory* (Baddeley, 1999). Both principle and category refer to the idea that a memory is easier to retrieve if the physical context during retrieval is (partly) the same as the physical context during encoding. A famous example of context-dependency comes from Godden and Baddeley (1975, as mentioned in Baddeley, 1999). They instructed divers to learn words either under water or on the beach. They found that the number of words recalled correctly was high if the retrieval context was the same as the encoding context, meaning if the words were learned underwater they were best recalled underwater and the same held for the beach condition. The performance dropped

significantly when the context was changed from underwater to beach or vice versa.

The second category explaining a relation between cue and retrieval result, is called *state-dependent memory*, including the state-dependency effect (Baddeley, 1999). This category does not focus on the external context, but the internal one, which is tested often with participants who are drugged or drunk. In general, it appears that when something is learned when drunk, it is best remembered when drunk.

The third and last category is called *mood-dependent memory*, which states that retrieval is best if the mood at recall is similar to the mood at encoding, because of hypothesized distinct emotion modes (Oatley and Jenkins, 1996). Although this effect, which can be studied with depressed people for example, has been found to be strong for free-recall, the effect was not present in cued recall (Eysenck and Keane, 2000).

3.2.5.2 Forgetting

Sometimes cuing does not help recalling a specific memory, and then one might speak of forgetting. Although forgetting is not yet understood completely, there is evidence in support of cue-dependent forgetting, which means that memories are still present in memory but they cannot be accessed, i.e. the right cues cannot be found (Tulving, 1974). Also people can think they forgot something when they are searching for a memory they do not have but they are convinced they do.

3.2.6 Cuing Autobiographical Memories

A number of studies looked into the effects of cuing on recall (e.g., Wagenaar, 1986, Burt et al., 1995, Herz and Schooler, 2002). However, most of the previous work relied on college student samples, studying (non-existing) words in laboratory settings (e.g., Rubin et al., 1984, Vaidya and Gabrieli, 2000, Chu and Downes, 2002). These studies tested other types of memory than memory of everyday-life events and in addition to that they often used artificial stimuli. The results from these studies might be interesting from a fundamental standpoint but the relationship and generalizability towards everyday recollecting is unknown. Only a limited number of studies cued Autobiographical Memory and used real-life cues originating from everyday life, such as photographs or food odors. Since the aim of the research of Chapter 7 is to find out whether real-life cues can help people recalling their autobiographical memories, these studies will be discussed below ordered by the type of cue tested.

The first type of cue is *written or spoken text*, which is a specific type because it is always an intrinsic part of the instruction and can not be left out. Although this cue

is not mentioned explicitly it is always used. In an influential case study, Wagenaar (1986) used only text as cue. He kept a diary of remarkable events happening each day over a duration of six years. He answered for each event the following questions: "who", "what", "when" and "where" and wrote them down. Later he tested which category of information was most efficient in cuing the complete set of information. He found that "what" information was most helpful in retrieving the other categories, especially when followed by "when" information. However, the presentation of "when" information alone appeared quite useless.

Burt et al. (1995) aimed at extending Wagenaar's findings employing photographs as cues. The *photos* contained various combinations of what, where and who information (activity, location and participants, respectively). The authors concluded that the uniqueness of a cue determined, at least partly, its efficiency for retrieval (in terms of recall delays). "Activity" cues rendered the shortest and "participants" cues elicited the longest recall delays. Taken together, presenting people with information of *what* happened benefits memory more than any other information.

Another, particularly effective, cue for facilitating direct retrieval is *odor*. The phenomenon that odors quickly bring back memories has been dubbed Proustian memory (see e.g., Chu and Downes, 2002), following novelist Marcel Proust's description of how smelling a madeleine biscuit dipped in tea resulted in the sudden emergence of a powerful childhood memory. This Proust phenomenon has found support in several laboratory studies (see Chu and Downes, 2002 for a short overview). Likewise, odors seem to facilitate Autobiographical Memory in a number of different ways. Rubin et al. (1984) presented participants with either an odor, a verbal label or a photograph corresponding to 16 common objects (e.g., baby powder, banana, peanuts, coffee and cigarettes). After cue presentation, participants had to describe the memory that it evoked and rate different qualities of that memory (e.g., vividness, emotionality, rehearsal). Although memories brought about by different cues were similar in terms of vividness and emotionality, odor-evoked memories were less rehearsed (i.e., thought of and spoken about in the past) than memories cued by verbal labels and photos.

Herz and Schooler (2002) carried out another cross-modality autobiographical-memory cuing experiment. They came up with a new "repeated measurements paradigm" consisting of two phases. In phase 1 they asked participants, who were visiting an exhibit about memory, to think of a personal memory associated with an item that was named (phase 1). After a memory was identified, participants had to rate it on six scales, such as memory vividness and the specificity of the memory. Phase 2 started immediately after this rating with a second cue, either a

photo or an odor. Participants had to think about the memory again and rate it on four scales. The main conclusions from this study was that odor-cued memories were more emotional than the visual and verbal-label cues and odor tended to make participants feel more “brought back” to the original event. These results on odor cuing seem to suggest that odor-evoked memories may differ from memories cued by other cues with respect to subjective qualities, such as vividness and emotionality. The question arises whether odor-evoked memories also differ from other memories in a more quantitative fashion, meaning the number of memories cued.

3.2.6.1 Autobiographical Memory Cuing of Real-Life Events

All studies mentioned above were unable to compare memories from different participants, since they asked for “randomly” retrieved autobiographical memories or, as in Wagenaar’s case, they only tested one person. A solution to this problem, suggested by Chu and Downes (2002), is to arrange a series of *naturalistic or real-life events* for participants to experience.

In the literature, four studies could be found which included memory retrieval for naturalistic events. The first one is a study testing memory cuing of a real-life event, performed by Hudson and Fivush (1991), who joined kindergarten children on a two-hour class field trip to a museum of archaeology. The children had to perform tasks, such as: digging for artefacts with archaeological tools, and making clay models of the objects they found. Free recall was tested at the same day, six weeks later, one year later and six years later, with the question “what happened when we went to the Jewish museum”. If free recall did not retrieve enough information, two additional open questions were asked and finally photos of the trip were shown. One conclusion was that after one year children did not remember the event from free recall, but when they were presented photo cues, even after six years, 87% of the children retrieved details from the event that could not be seen in the photos. There was one set of activities that was recalled by the majority of the children at all four time delays, namely the activities that made this event distinctive, such as the digging for artefacts and not the walk to the museum. Another interesting fact was that even after six weeks the information recalled with photo cues added up to 39% of the total of activities that the experimenters had previously identified. This percentage was stable over time. This indicates that these photos cued a lot of memories that would not have been remembered otherwise and this happened independent of the delay since the event.

The next two studies on cuing a real-life event are related, since they both involved pairs of children that took part in a magician’s act. One of the two

children had to observe (observer role) while the other child was taught how to be the magician's assistant (participant role). Ten days and 10 weeks later, the children were interviewed. In the study by Pipe and Wilson (1994) there were four interview conditions: a) without cues, b) with object-cues related to the context (the interviews took place in the same room as the event with the magician, including for example, pink curtains and the magician's hat), c) with relevant object-cues (in addition to the contextual cues, also all items relating to the magic tricks, e.g., a magic wand and magic gloves), and d) with irrelevant object-cues (in addition to the contextual and relevant cues, also items were present that could have been used in the magic tricks, but actually had not been present). The interviews started with free recall and ended with specific questions about the event. A striking finding was that very few statements in free recall related to the context and that none of the cue conditions facilitated recall relating to people or context. In addition to this the main conclusion was that action and object recall were facilitated by the presence of relevant cues during the interview but not by contextual cues. The second study with pairs of children joining in a magician's act by Gee and Pipe (1995) focused more on the type of questions in the interview. They asked the children for free recall, followed by prompted recall and by leading, misleading and specific questions. Half of the children were interviewed with object cues (both relevant and irrelevant) and the other half without object cues. One result was that children that participated in the event (participants) and were interviewed with objects recalled more correct information than the participants in the without-objects condition and, more importantly, the participants with object cues recalled more correct information than the observers in any of the two conditions. Related to this, but unexpected since previous research (Pipe and Wilson, 1994) did not reveal this, was the finding that participants in the object condition made more errors than participants in the without-objects condition. However, when the incorrect information is taken into account the object condition still resulted in more correct memories than the without-objects condition. An interesting footnote by the authors explains that "objects did not simply encourage children to repeat more correct information in free recall; rather, objects prompted children to report information that had not previously been reported" (p. 751).

The last study investigated the long-term effect of *odor* cuing on adults. Aggleton and Waskett (1999) tested participants who had visited a specific Viking-museum on average six years before. During their visits the participants had followed a fixed tour through several scenes with distinctive odors ("burnt wood", "apples", "rubbish acrid", "beef", "fish market", "rope/tar" and "earthy"). The experiment

consisted of two phases per participant, each consisting of a questionnaire in one of the following conditions: a) no odor, b) an odor that had not been present in the museum, or c) with one of the seven odors mentioned before. The questionnaire contained questions about the various displays in the museum tour, concerning for example, types of clothing and jewelry worn by the Vikings. For both phases the questionnaire was exactly the same. One of the results found was an order effect. The participants scored better overall for the second questionnaire. Still, comparing the first and the second questionnaires showed that the biggest improvements were caused by the original museum odors offered together with the second questionnaire. The results suggested that even after six years the unusual museum odors rendered better recall of information than no cue or wrong cue conditions. Thus, in addition to evoking qualitatively different autobiographical memories, odors seem to improve the recall of details of real-life events.

From the literature overview it is clear that cues are important for recollecting memories. One might wonder what kind of cues people use in everyday life. Examples of such cues have been mentioned in Chapter 2, such as: photos, theater tickets, seashells, music and odors. All these examples illustrate that objects as well as sensory cues are instrumental in helping people to remember related events. According to the Merriam-Webster Online Dictionary (2003) a souvenir is something that serves as a reminder (see Chapter 4 for a more extensive discussion on the definition of a souvenir). Based on this definition most examples taken from everyday life that were described in Chapter 2 as well as the memory cues that were discussed in this chapter are captured by the “souvenir” concept. In the next chapter this concept will be studied in detail.

SECTION II – SOUVENIRS

The previous chapters gave examples of everyday life and discussing related research on digital photos and human memory. It was suggested that Autobiographical Memory cues could be called souvenirs. In the following chapter souvenirs are studied more extensively to find out more about the everyday use of souvenirs in the home. The outcome of this study will be used as input for the design of a Digital Photo Browser (Chapter 5) and recommendations for a future Recollection-Supporting Device (Chapter 10).

4 Souvenir Study

4.1 Introduction

"An enlightening example is provided by the vast array of Renaissance objects – such as accouchement sets and birth-trays – constituting the material culture of childbirth. These were entirely new typologies of objects, designed to reassure and comfort women before giving birth, reward them after and remind them of this event in the long term, as they were usually preserved and often displayed in the home for generations. They were connected with the rituals associated with childbirth, such as the first meal consumed by the mother after giving birth, and often they were made of new materials such as maiolica."

This quote (Ajmar, 1999, p. 79) gives an example of early souvenirs, originated from the changing roles of physical objects in the households of the fourteenth to the sixteenth century. During the Renaissance a new literary genre emerged for the purpose of describing family memories (known as Ricordanze, meaning "memories"). This literature shows an increasing importance of physical objects as connections to memorable events, such as births, deaths and marriages. And for the first time in history objects are created and decorated in order to create a physical instantiation of an event as a memory cue: a souvenir (Ajmar, 1999).

The word souvenir originates from Middle French from (se) souvenir (de) meaning "to remember", which again comes from the Latin word subvenire meaning "to come up, come to mind". The definition of the word souvenir differs across dictionaries. For example, the Merriam-Webster Online Dictionary (2003) defines a souvenir as something that serves as a reminder, whereas the Cambridge International Dictionary of English (1995) defines a souvenir more specific as something you buy, give or receive to help you remember a visit or an event.

According to Hitchcock and Teague (2000, p. xii) “souvenirs, broadly conceived, are generally thought to be the material counterpart of travels, events, relationships and memories of all kinds”, “all gifts are souvenirs in the sense that they remind the recipient of the donor (and the occasion) and that is the purpose of many gifts” and a souvenir’s “function is to store or stimulate memories”. Csikszentmihalyi and Rochberg-Halton (1981), who tried to categorize physical objects in the home, describe a souvenir in their book “the meaning of things” as a “memory of a place” (p. 271). The reason for their narrow description is the choice for two additional related categories, namely memento² which stands for “memories in general, not associated with a particular occasion”, and recollection which is defined as “memories of specific occasion(s) in a respondent’s life-time”.

Since many definitions of the word souvenir exist and this might confuse the people who participated in the experiment described later in this chapter, it was decided to choose one single definition. All definitions share the general idea that a souvenir is about memories or remembering. Some focus on different aspects of a souvenir, such as location or event. For the purpose of the work described in this thesis, it was decided to adopt the “memory” part and include the relation these memories have with physical objects. The reason is that the results presented in this chapter indicate the opportunities objects offer for use in a future Recollection-Supporting Device (RSD). The type of memory remembered is not relevant, since a future RSD should support whatever memories people want to recall, whether it is a memory of an object, a person, a place or an occasion. The physical objects are important, because they can potentially be used as part of a Graspable User Interface for an RSD. In this chapter souvenirs are defined as “*physical objects to which memories are attached*”. This definition is synonymous to the term “memorabilia”, which is rarely used in the Dutch language, but is defined in English by the Chambers Dictionary (1993) (amongst others) as “objects associated with a (usually famous) person or event, by which the memory of that person or event is kept alive”. The word “memento” and its synonym “keepsake” do not exist in the Dutch language, but both fit in this wide definition for the word souvenir.

The remainder of this chapter will focus on evaluating whether it is realistic to use souvenirs as part of a Graspable UI (see Chapters 5 and 6). First, practical questions about the everyday use of souvenirs are investigated, such as: how many souvenirs do people have in their homes, are they available for use in a Graspable user interface and do people have memory-related media-types associated with

² Coming from Latin, meaning “remember” in the imperative mood.

those souvenirs, such as photos, soundtracks, video recordings or perhaps even smells. According to Bationo et al. (2003a,b) physical contact with objects gathered during travels (which can be souvenirs) is more important for story telling travelers than visual presentations, such as photos. This might indicate that people prefer to recollect memories by using souvenirs rather than using photos. On the other hand, a study by Sherman (1991) investigating which objects were used by elderly for reminiscing, showed that the object most often mentioned (42% of the cases) as "stirring recollections" was the photograph. From these two studies, one might conclude that a combination of souvenirs and (digital) photos seems a particularly powerful combination for recollecting memories.

The second topic of interest in the context of the current study is whether souvenirs can serve as external memory for users of an RSD, because if they could these souvenirs could help people to recall memories and support storytelling. In this way, aside from their role in a Graspable User Interface, souvenirs could obtain a second function as a physical handle to digital information (see Chapter 5 and 6).

There are some indications that souvenirs might serve as external memory, the first being the definition of Hitchcock and Teague (2000) saying that a souvenir's function is "to store or stimulate memories". Another strong indication comes from Stevens (personal communication) who studied how people store their memories (Stevens et al., 2003) and her estimate is that 90% of the physical volume is caused by physical artefacts (e.g., souvenirs), 8% by printed photos and 2% by other media, such as video tapes. When instead of the physical volume the number of items is estimated then printed photos take up 60% of the number of memory-items, 25% are physical artefacts and 15% are other media, such as videotapes. These results show that people do associate "souvenirs" with memories (without giving the participants a definition of a souvenir), a conclusion supported by the results from a Memory Workshop (which was conducted by the author and is briefly described in Chapter 5). Perhaps people use those souvenirs as external memory, consciously or unconsciously. Another indication comes from an interesting and large-scale study by Czickszentmihalyi and Rochberg-Halton (1981) who investigated what people thought was their most cherished object in the home. The three categories of objects which were most cherished were furniture (36% of the participants mentioned at least one piece of furniture), visual art (26%) and photographs (23%). Table 4.1 shows the reasons why these objects were special.

Table 4.1. The three most cherished objects categories are shown together with their three most-mentioned reasons for being special.

	Furniture	Visual art	Photographs
Reason 1	Memories (15 %)	Memories (16 %)	Memories (27 %)
Reason 2	Style (12 %)	Style (16 %)	Immediate family (26 %)
Reason 3	Experiences (11 %)	Immediate family (16 %)	(N/A)

Later the authors did the opposite of giving meanings to objects, they tried to categorize the mentioned objects according to their object type. The category Memories consisted of five sub-categories, namely: memento (general memories), recollection (memories of occasions), heirloom (inherited object), souvenir (memories of a place) and “had it for a long time”. Within this Memory category the most often mentioned type of object was furniture (66%), sculpture (44%) and visual art (40%). Apparently, furniture can be special to people, because of the memories associated with it and most cherished objects are cherished because of associated memories. Since this study asked participants “what is your most cherished object in the home”, and the objects were later classified according to their meaning (one of them being “souvenir”), it is not known which objects would be chosen when asked directly for the “souvenir” meaning. Therefore this chapter investigates what the most valuable souvenir is in the home of the participant. This question is part of the exploration on the everyday use of souvenirs. Those souvenirs can belong to any of the above-mentioned memory-subcategories as used by Czickszentmihalyi and Rochberg-Halton (1981).

The topic studied in this chapter, to find out more about the everyday use of souvenirs, needs a better insight on how people interpret a souvenir’s meaning and function. Do people’s opinions vary as much as the definitions mentioned above or is there a straightforward and common agreement? In order to investigate this a souvenir focus group was organized with a small group of discussants. As a next step, the lessons learned from this focus group were used as input for developing an extensive questionnaire to find answers to the question formulated above.

4.2 Souvenir Focus Group

A focus group study was conducted to explore the meaning and functions of souvenirs. A focus group seems particularly suitable for this purpose because it

only requires a limited number of people who can discuss personal topics in an intimate and secure environment.

4.2.1 Methodology of the Souvenir Focus Group

The focus group took place in a living room, since it was assumed that most living rooms store souvenirs and living rooms are often used to discuss souvenirs in everyday life. For example, showing holiday photos and their accompanying souvenirs mostly happens in living rooms.

Five highly educated people (two men and three women, with an average age of 29 years) with good communication skills, together with two facilitators, participated in the focus group, which lasted three hours. The participants each had to bring five souvenirs from home and at the start of the focus group they had to complete a questionnaire, individually, with four questions about each of these souvenirs (see Appendix 2 for the original Dutch questionnaire). This short questionnaire asked them to describe the souvenir, to explain how they got it, whether it was already a souvenir when they received it or whether it became one later and which one of those five souvenirs was most valuable to them. In addition to this questionnaire the focus group consisted of four group tasks. During those tasks all the souvenirs were placed in the middle of the table, visible and perhaps inspiring to all. The first task for the group was to come up with criteria for an object to be a souvenir, in order to have a shared definition of souvenirs in the end. The second task was to cluster the souvenirs into different types. The third task was to pick a souvenir from someone else and to try to guess what the story could be that went with that souvenir. This task was based on an assumption by Gonzalez (1995), who claimed that one of the functions of a souvenir is to hint at its meaning. This would make it possible for people to identify souvenirs in other people's homes. The fourth and last task for the participants was to create a souvenir themselves that would help them to remember the "focus group" event on a future occasion. The participants could use materials, such as paperclips, wooden sticks and rubber rings, to realize the souvenir.

4.2.2 Results of the Souvenir Focus Group

The first assignment for the participants of the souvenir focus group was to bring each five souvenirs. Those souvenirs (question 1 in the Souvenir Focus Group Questionnaire, SFGQ 1, which can be found in Appendix 2) were diverse in origin, size, color, material and function (e.g., a pebble, a pipe, a medal, a video, a ring, a CD). It followed from the answers on the focus group questionnaire (SFGQ 2) that all of the souvenirs were bought (57%), received (33%) or found (10%).

Also the souvenirs chosen to be most valuable to the participants (SFGQ 3) were selected for different reasons, namely: a painful event, the first holiday without parents, symbolizing a friendship, it is unique, or it symbolizes reaching adulthood. Most objects got the souvenir function (SFGQ 4) as soon as the participants owned it, but some of them became a souvenir later, varying from one month to years later. Sometimes objects became souvenirs initiated by an event, such as finding a lost item again, experiencing a special holiday with this object or after having decided not to throw it away. (For all answers to the focus group questionnaires see Appendix 3.)

After the individual questionnaires the group tasks were carried out. The first task concerned gathering criteria for an object to be a souvenir. A total of 49 criteria were gathered, which were categorized by the two facilitators separately after the focus group session was finished. In Table 4.2 the resulting categories and some example criteria are listed.

Following the criteria exercise the participants had to come up with a definition of the word souvenir. Unfortunately, they did not come to an agreement, since the opinions varied. Three definitions were selected as candidates by subsets of the participants:

1. A souvenir symbolizes a *relation* between people, moments, feelings, phases, locations or situations
2. A souvenir is something which has *emotional value* to you
3. A souvenir is something with which someone can consciously evoke *memories*.

The participants reached consensus when they had to group souvenirs into different types, see Figure 4.1 for the result. When asked which types of souvenirs had most memories attached to them, the answer was "souvenirs that are not from a holiday".

The third joint task required the participants to select one of the souvenirs, which was brought by one of them. They selected the object which is shown in Figure 4.2. Next, the participants, excluding the souvenir owner, had to come up with the true story behind this souvenir. The owner later verified this story. It became clear that the participants did not agree on any of the aspects of the story. Some thought it came from Africa, others from Asia, some said it was from a holiday, others said it was too big and therefore it must have been a longer stay, some people thought

the object was bought, others thought it was a gift. The participants clearly did not get any further than guessing and their ultimate conclusion was that it is easy to recognize a souvenir in other people's homes, because it stands out in the interior or looks like a "standard" souvenir. But one can never guess the complete story behind the souvenir, unless the owner is a close friend or relative.

Table 4.2. Categories of criteria for an object to be a souvenir, mentioned by the focus group participants.

Categories	Examples of criteria		Number of criteria
Subjective characteristics	Something keeps you from throwing it away; A souvenir is fun to find/discover; A souvenir is special; What can become a souvenir is person-dependent		23
Memory function	General	A good souvenir evokes a memory	8
	Emotional	The material value is lower than the emotional value	2
	Location-based	Objects from a different country do not have to be souvenirs	1
	Time-based	Memory of a moment; memory of something that never comes back	6
	Event-based	Link to a ritual; Memory of a painful moment	2
	Social relation-ships	Symbolical of friendship; A souvenir can bring people closer	3
Objective characteristics	Typical for a certain country		4
Total number of mentioned criteria			49

After this task the participants were asked whether they used souvenirs, consciously, for recollecting or remembering. Two people answered positively, one person explained that it "just happens to you" and that she did not do it consciously. The other two participants said they only sometimes used souvenirs for recall: e.g., in case the souvenir is a useful object, such as a bottle opener from Italy, they sometimes use the souvenir for opening bottles and sometimes they use it for memory recollecting when they are reminded that it came from Italy.

Another question asked was “why do you use a souvenir for recollecting”? “Because”, participants explained, “a souvenir strengthens the effect, looking at, touching or smelling the souvenir can activate all senses”.

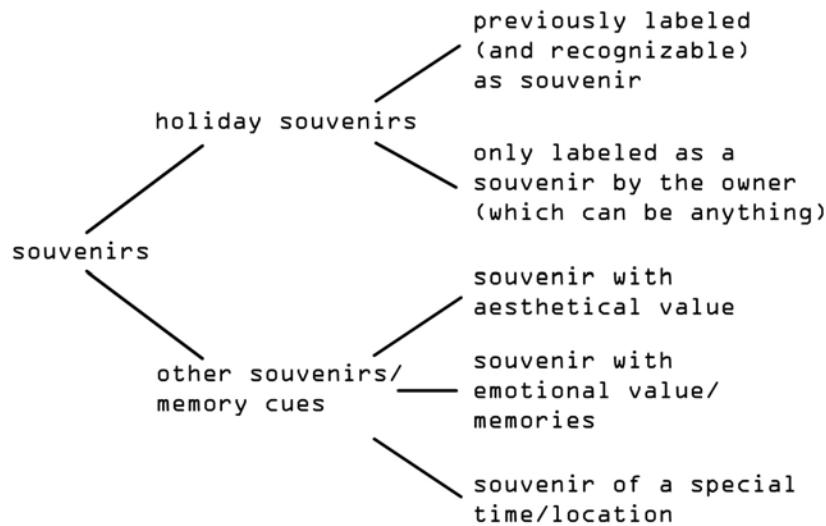


Fig. 4.1. Grouping souvenirs into different types of souvenirs.

The last assignment, creating a personal souvenir of the focus group, resulted in a range of creative and diverse objects, which confirmed that the form and meaning of a souvenir reflecting the same event can be very different when created by different people.

4.2.3 Conclusions from the Souvenir Focus Group

In general, the opinions of the participants on the definition of a souvenir varied greatly. Some people thought everything (even locations) could function as a souvenir, whereas others limited it to physical objects. The definition of souvenirs mentioned in the introduction, “physical objects to which memories are attached”, is part of all participants’ opinions and will therefore be used for the souvenir questionnaires. Several participants told us they used souvenirs for story telling, while others only “used” them when accidentally bumping into them. One strength of a souvenir is that the memories linked to it are hidden which gives the owner the freedom to tell different stories to different audiences. One reason for doing this is that some stories are private and others public. Overall, a souvenir was believed to have more value when it was unique and not an object labeled to

be a souvenir before the owner got it (e.g., “souvenir shops” selling miniature Eiffel Towers).

After the qualitative souvenir focus group a more quantitative questionnaire was created to address some issues that required a larger group of participants, such as “is a souvenir personal”, “what do people do with a souvenir in relation to remembering” and, more practically, “how many do they possess”.



Fig. 4.2. A souvenir of one of the participants, the other participants had to guess the story behind it. The souvenir is a water pipe from a 2.5-week holiday in Tunisia, bought by the owners since they liked the smoking ritual and taste of the tobacco.

4.3 Souvenir Questionnaires

4.3.1 Methodology of the Souvenir Questionnaires

The participants for the souvenir questionnaires were recruited via e-mail and a company newsletter among technology-interested and well-educated people.

The questionnaires started with a short instruction defining a souvenir as “a physical object to which memories are attached” (see above) and continued with 23 questions (see Appendix 4 for the original Dutch questionnaire). The questions

concerned the following topics: how many souvenirs do people have and where are they located in the home³, what do people use their souvenirs for, can self-made objects be souvenirs and which souvenir is of most value to an individual. In the instruction it was explained that the time for completing the questionnaire was estimated to be 30 minutes and that the participants should do this at home within four weeks from the reception date.

4.3.2 Results of the Souvenir Questionnaires

30 Participants (15 men, 15 women) completed the souvenir questionnaires in the period of one month. The average age of the participants was 40 years at the time of completion, ranging from 18 to 72. The average age of the female participants was 37 and of the male participants 43 years.

In the description of the results below sometimes the number of participants does not add up to 30. In this case one or more of the participants did not answer that particular question. If the answers add up to more than 30 or more than 100% then multiple answers were allowed and given.

The first part of the questionnaire (Souvenir Questionnaire question 1 till SQ 13) focused on one selected souvenir, namely the one most valuable to each participant. The individual answers can be found in Table 4.3. From the total of 30 souvenirs, 50% was categorized as “bought on holiday”, one was found during a holiday and one was received as a gift during a holiday. The 13 remaining souvenirs were gifts (7), inherited objects (5), and the last one was both a gift as well as an heirloom. This means that 57% of the most valuable souvenirs are from a holiday (SQ 2 and SQ 7). As can be seen in Table 4.3, some participants explicitly mentioned furniture to be their most valuable souvenir, e.g., a night table. Also Csikszentmihalyi and Rochberg-Halton (1981) found that people cherished their furniture because of the memories associated with it. Therefore, it seems useful to support small souvenirs, such as shells, as well as furniture together with the Recollection-Supporting Device, e.g., in a Graspable User Interface.

The answers to the question “why is this souvenir so valuable to you” (SQ 2 allowed for multiple answers) indicate that most people value their souvenirs because of the memories attached to them (57%) (for an overview of all the answers see Table 4.4). 14 Participants said that their most valuable souvenir was

³ Souvenirs can be found in other locations, e.g., at the office or in the car, but this investigation focused on the use in the home (see also Chapter 1).

also a souvenir to other people (SQ 3), 15 participants said their most valuable souvenir was only a souvenir to themselves.

Table 4.3. The most valuable souvenir of each of the 30 respondents (SQ 1). Some of the participants mentioned more than one souvenir.

Valuable souvenir	Souvenir category
Jade bird figure	Bought on holiday
Prayer rugs from Turkey	Bought on holiday
Crystal vase	Bought on holiday
Goddess figure from Malaysia	Bought on holiday
Silver bracelet from Thailand	Bought on holiday
Bronze goddess statue from Nepal	Bought on holiday
Abstract painting from the US	Bought on holiday
Key ring with a photo in it	Bought on holiday
Jade bird figure	Bought on holiday
Concentric "balls" from China	Bought on holiday
Baseball cap from the US	Bought on holiday
Saxophone from famous US player	Bought on holiday
CD from the US	Bought on holiday
Pyramid figure from Mexico	Bought on holiday
Pottery from Suriname	Bought on holiday
Stones from India	Found on holiday
Tropical shell from Grenada	Received on holiday
Rosary and a night table	Inheritance
Tin sugar spoon from Canada	Inheritance
Mantel clock	Inheritance
Musical instrument	Inheritance
Polished mirror	Inheritance
Gramophone player	Present & Inheritance
Doll won on a fair	Present
Collection of figures	Present
Necklace with a heart-shaped pendant	Present (from a holiday)
Cuddly toy	Present
Writing desk	Present
Watch	Present
A lamp made from heating pipes	Present

Most of these valuable souvenirs can be found (SQ 4) in people's living rooms (66%), bedrooms (7%), studies (7%), attics (7%), bathroom (3%), hallway (3%), or around the wrist of the owner (7%). 86% of the souvenirs were placed in the room in such a way that they were visible from the middle of the room, which indicates they were on display (SQ 5). The remaining four souvenirs were not, because two of them were stored in the attic, and the other two were in use. For example, a souvenir spoon was in use as a spoon and therefore temporarily stored in a kitchen drawer.

Table 4.4. Categorized answers to the question “why is this souvenir so valuable to you”.

Categories	Participants		Example answers
	(%)	(n)	
Memories	57	17	It reminds me of a pleasant holiday
Heirloom	17	5	I inherited it from my grandmother
It was a gift	10	3	I got it for my birthday
Monetary value	10	3	It represents a reasonable value
Aesthetics	7	2	I think it is beautiful
Special event	7	2	I bought it during my honeymoon
It changes my mood	3	1	It gives me a feeling of security
Story	3	1	It links to a nice story

43% of the most valuable souvenirs have always stayed exactly in the same location in which they currently are (SQ 6). 32% moved around in the same room and the remaining 25% moved around the house, because they have been stored in the attic, or because they were in use.

Figure 4.3 shows the distribution of the years the souvenirs are in possession (SQ 8). The average souvenir was at least 7.3 years with its current owner. (For the category “>10 years” 12 was used in the calculations, which is probably lower than the actual number.)

In the field of Autobiographical Memory a phenomenon exists which is called the “reminiscence bump” (see Section 3.2.4.2). This bump appears when the number of memories people have is plotted against the time since the memory-producing event. Apparently significantly more memories are stored between the ages of 10

to 30 years than later. To investigate whether this phenomenon also occurs for souvenirs one should ask people how long they possess all their souvenirs. This was not done in the current study because a questionnaire is not suitable for such a study and the verification of the souvenir reminiscence bump was not the main aim of this investigation. Still the age of receiving the most valuable souvenirs (SQ 8) already shows an indication of a reminiscence bump (see Figure 4.4) only with a delay compared to the memory reminiscence bump.



Fig. 4.3. Histogram showing the number of years the most valuable souvenir was in the possession of its owner.

When watching their souvenirs (SQ 9) the majority of the participants experienced immediate memories popping up (47%) or relived their memories (17%). Some participants realized how much they liked the souvenirs (20%) or started thinking about related issues (10%). Only one person did not think of anything. Of the 20 people recalling memories immediately (SQ 10), seven (35%) thought of a person, six of a location (30%), five of a holiday (17%), two (7%) of a special occasion (such as a birthday).

On average souvenirs have more than one function. The type of functions they have (SQ 11 permitted multiple answers) are shown in Table 4.5.

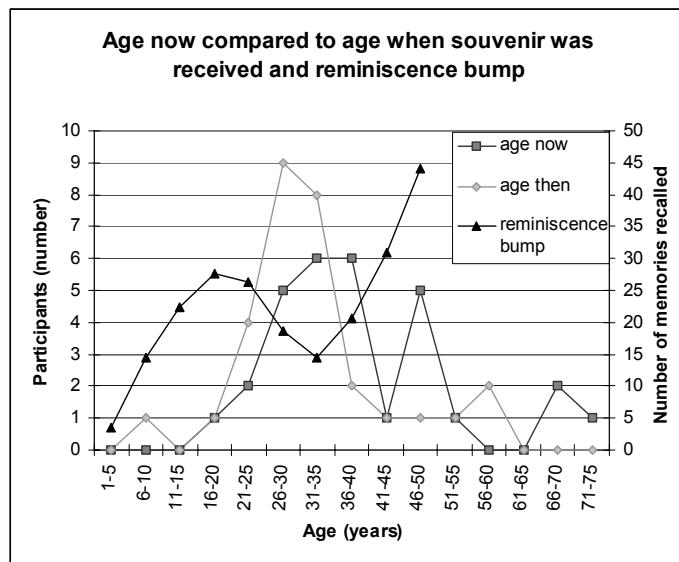


Fig. 4.4. The number of participants plotted against their age at the time of the questionnaire (grey squares) and their age when they received the souvenir (light grey diamonds). The black triangles show the reminiscence bump (converted from Conway & Pleydell-Pearce, 2000), which is the number of memories recalled at that age.

Table 4.5. The functions people dedicate to their most valuable souvenirs.

Functions of the most valuable souvenirs	Participants choices	
	(%)	(n)
To watch the souvenir	47	14
To use the souvenir	43	13
To make me think of specific things	13	4
To talk about related things with other people	13	4
To make me remember related things	10	3
Their monetary value	7	2
To change my mood	3	1
To make me relax	3	1
No purpose	7	2

The previous questions dealt with the functions of souvenirs, while the remaining questions of the first part of the questionnaire ask for associated media with the participants' most valuable souvenir. From the 30 participants only eight (27%) did report they had no media (SQ 12) related to their most valuable souvenirs. The rest reported printed photos (60%), physical objects (27%), music/sounds (10%), odors/smells (7%), digital photos (7%), video (3%) and other types, such as books, presentations and travel reports (10%). On average each souvenir has 24.3 media items related to it. Table 4.6a and 4.6b give an overview of the media items related to the most valuable souvenir (SQ 13). One should note that five participants gave incompatible answers in SQ 12 compared to SQ 13, meaning that, e.g., they did not mention in SQ 12 that they had digital photos with this specific souvenir, but they did fill out "I have 1-10 digital photos related to my most valuable souvenir" in SQ 13. Since in four out of five cases these participants mentioned numbers of media in SQ 13 which they did not select in SQ 12, it appears as if they forgot to select those categories in SQ 12. This might indicate that in reality the percentages of the media types in SQ 12 should be higher than the values mentioned above and in Table 4.6a and 4.6b.

The numbers used for calculating the averages in the two tables below are based on the average of each option, e.g., the average of 1-10 is 5.5 and the ">"-category would then be 55.5.

Table 4.6a. The number of participants that selected a particular number of media instances (e.g., 1-10) which are related to their most valuable souvenir. The average stands for the average number of photos or objects per participant.

	Digital photos (#)	Printed photos (#)		Objects (#)
0	28	8	0	17
1-10	1	11	1-5	10
11-20	0	1	6-10	0
21-30	0	1	11-15	3
31-40	0	1	16-20	0
41-50	0	0	21-25	0
> 50	1	8	> 25	0
Average	2.0	19.2	Average	2.3

The second part of the questionnaire (SQ 14) investigated how the various souvenirs are distributed over different room types in the home. The living room

contained most souvenirs, on average 16 per participant (see Figure 4.5 for the distribution over the participants), followed by the study with 13 souvenirs on average (see Figure 4.6 for the average percentages over all rooms). The average number of souvenirs in each of the participants' houses was 52.1. (For the category "> 50" the value 53 was used in calculations.)

Table 4.6b. The number of participants that selected this particular number of media instances (e.g., 1-10) which are related to their most valuable souvenir. The average stands for the average number of photos or objects per participant.

	Music (hour)	Video (hour)	Smells (#)	Other media types (#)
0	28	29	27	27
1	0	0	2	2
2	0	0	1	0
3	1	0	0	1
4	0	1	0	0
5	0	0	0	0
>5	1	0	0	0
Average	0.28	0.13	0.13	0.17

Part three of the questionnaires (SQ 15 till 23) asked general questions about souvenirs, starting with the question whether people had fixed locations for "new" souvenirs (SQ 15) or for "less interesting" souvenirs (SQ 16). Both questions were answered predominantly negative (83% and 70%, respectively), although some people mention the stove/fireplace for the new and the attic as the location for the less interesting souvenirs.

23% of the participants never brought souvenirs from their holidays (SQ 21), the other 77% did. From the latter category two people did not bring any souvenirs from their most recent holiday this time (7%), but most people brought 1-5 souvenirs (60%), 7% brought 6-10 and only 3% (1 person) brought 11-15 souvenirs. The reasons for bringing these souvenirs from their holiday destination (SQ 22, a multiple-choice question, allowed for multiple answers) were diverse (see Table 4.7).

Despite the fact that most people brought souvenirs from their most recent holiday they did not throw away any in the past year (63% of the people) (SQ 17). 17% of

the participants threw away one to three souvenirs and another 10% four to 6. Only 10% of the people said to have done so over 15 times the past year.

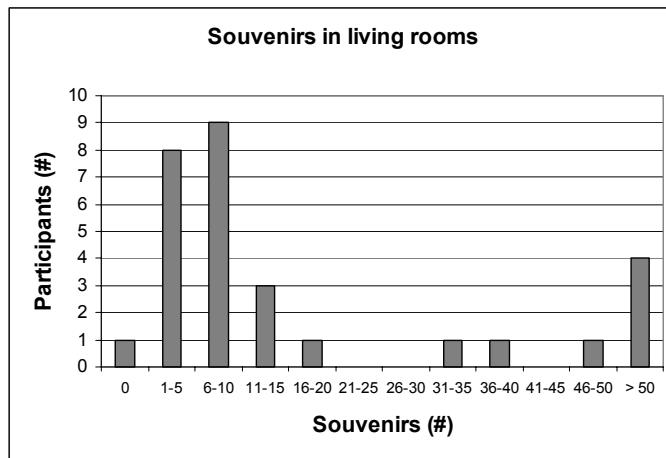


Fig. 4.5. The number of souvenirs the participants have in their living room.

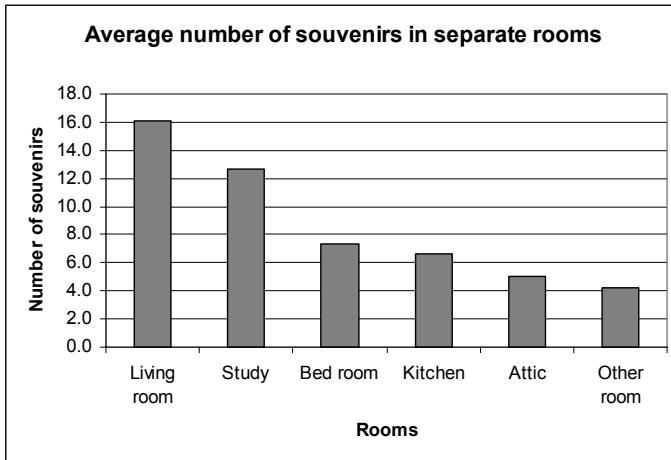


Fig. 4.6. The average number of souvenirs in each room of the homes of the participants.

The question about whether self-made objects can be souvenirs (SQ 18) was accepted by 80% of the participants, only 10% thought that they could only be souvenirs to other people than the creators and 7% did not believe self-made objects could be souvenirs to anyone.

Another topic asked for in the souvenir questionnaires was whether owners of souvenirs talk about their own and other people's souvenirs (SQ 19 and 20). The answer was that the majority did (57%), but that roughly one-third never talked about souvenirs (see Table 4.8).

Table 4.7. Reasons why people bring souvenirs from a holiday.

Reason	Participants agreeing	
	(%)	(n)
As a memory of the holiday	45	13
The souvenirs are beautiful	34	10
I want to use the souvenirs as gifts	17	5
The souvenirs are of great value	3	1
By accident	0	0
Without reason	0	0
Different reasons	10 (7% were gifts, 3% was for a collection)	3

Table 4.8. Talking about personal and other people's souvenirs.

Do you talk about souvenirs	Personal souvenirs		Other people's souvenirs	
	(%)	(n)	(%)	(n)
Yes, with anyone	57	17	57	17
Yes, but only with close friends and family	13	4	13	4
Yes, but only with my housemates	0	0	3	1
No, I never talk about souvenirs	30	9	27	8

The last question (SQ 23), which was posed in an open format, was about naming the three most important characteristics of a "good" souvenir. Table 4.9 shows an overview of the answers. The answers were categorized by the author and a colleague separately and later combined.

Table 4.9. The most important characteristics of souvenirs according to the participants, which are categorized later by two people separately.

Category	Examples of characteristics	Number of characteristics
Objective characteristics	It is functional/useful; it is unique; it should last long	30
Subjective characteristics – Aesthetics	It is beautiful; it is funny (“grappig” in Dutch); it is of good quality	27
Memory function	A (nice/fun) memory is attached	21
Subjective characteristics - General	It has emotional value; it has personal value	11
Total number of characteristics		89

4.3.3 Conclusions from the Souvenir Questionnaires

4.3.3.1 Souvenirs in General

On average each participant had over 50 souvenirs in his/her home. Most of them could be found in the living room and the study. The majority of the people did not have fixed locations for new or less interesting souvenirs. About a quarter of the participants never brought souvenirs from their holidays, but the majority did. Most people bringing souvenirs brought 1-5 and nobody brought more than 15 souvenirs. Despite the fact that most people brought souvenirs most of them did not throw away any during the last year.

From the most recent holiday about half of the souvenirs was brought primarily as a memory of the holiday, some because they were beautiful and a minority as gifts for others.

Eighty percent of the participants thought self-made objects could be souvenirs.

Participants were asked to name their most valuable souvenirs and only half of them were from a holiday, other categories were heirlooms and presents. 40% of these souvenirs are in possession of the participants for longer than 10 years and 75% of the souvenirs have always stayed in the same room, 43% even stayed exactly in the same location. Those most valuable souvenirs are mainly used for watching them and using them but some people use them for thinking about, talking about or recalling related things (multiple answers were permitted). But when they are asked to watch their most valuable souvenirs the first things that

they experience are memories popping up in almost half of the cases, some people realized how much they liked the souvenir and others answered they relived memories.

4.3.3.2 Are Souvenirs Available for a Recollection-Supporting Device (RSD)?

Assuming that an RSD will mainly be used in the living room means that an average of 16 souvenirs is nearby. In the majority of cases one of those souvenirs is the most valuable souvenir (two-thirds of the people keep it in the living room), with which three-quarters of the participants have other media-type associations, on average 24.3 per souvenir. It does not matter where those media items are stored, because the souvenir, which could be used as a shortcut together with an RSD, is in close proximity.

Since 45% of the most recent holiday souvenirs are brought as a memory of the holiday, there is a relatively large collection of objects that could be used in combination with an RSD.

4.3.3.3 General Conclusions

Since many people appeared to have a collection of souvenirs at home, they are available for use together with a Recollection-Supporting Device. This collection consists of three categories: holiday souvenirs, heirlooms and gifts. All three categories made the participants recollect memories when they looked at their most valuable souvenirs, meaning they serve as external memory for those people. Neisser (1982) describes a study on external memory aids used by students. They were asked what aids they used to remember future or past events and one of the results was that students do not know which types of external memory they use, unless they are explicitly mentioned, such as "do you use *diaries* for remembering". This result is consistent with results found in the investigation presented in this chapter, because the souvenir-questionnaire participants did not mention remembering as a function of their souvenirs. But apparently they did use their souvenirs as external memory, because when they were asked what happened when they looked at their most-cherished souvenirs half of the participants mentioned that memories popped up or were relived.

SECTION III – GRASPABLE USER INTERFACES: IMPLEMENTATION AND THEORY

Section II showed that souvenirs can serve as external memory to their owners. Section III describes the design and evaluation of a Digital-Photo-Browser user interface, which includes souvenirs as part of a Graspable User Interface (Chapter 5). Chapter 6 discusses Graspable User Interfaces and describes a proposal for an extension to a popular Graspable-User-Interface categorization that can be found in literature.

5 Digital Photo Browser Design⁴

5.1 Abstract

Several groups of users participated in the concept design of a Recollection-Supporting Device. This concept is implemented as a portable Digital Photo Browser using souvenirs as a Graspable User Interface. When brought into an intelligent room, the Digital Photo Browser is able to recognize the presence of people, graspable objects, and available output devices. Since souvenirs are suitable for use in a Graspable User Interface and they have the ability to cue recollections (see Chapter 4), souvenirs are used in this chapter as shortcuts to sets of digital photos.

⁴ This chapter is based on the following publications: van den Hoven et al. (2000), van den Hoven and Eggen (2001, 2003a), van Loenen and van den Hoven (2003).

5.2 Introduction

Taking the definition of souvenirs that was formulated and investigated in Chapter 4, printed photos can be considered a special class of souvenirs. For a long time, people have been looking at, talking about or touching printed photos to recollect memories. In a recent study by Eggen et al. (2003) on the home experience it was found that many people consider photos “the undisputed number ones in ranks of important objects” (p. 48). As was illustrated by the examples taken from everyday life and from the available literature on digital photos currently printed photos are being quickly replaced by their digital counterparts. At the time the research presented in this chapter started, no devices other than PCs were available to support the browsing of digital photos in manners that could match individually and socially accepted ways of watching and sharing printed photos within the home environment.

The aim of the study presented in this chapter was to analyze, design, implement and evaluate a device which would support digital photo browsing in the home. In addition, souvenirs were used to access subsets of digital photos, since they are cues to memories and, as was found in Chapter 4) souvenirs often have photos associated with them.

5.3 Digital Photo-Browsing Devices

This section gives an overview of studies that describe designs of devices that support the browsing of digital photos. This overview is a continuation of Section 3.1, which discusses digital-photo-related *research and applications*. Most of these applications, called “photoware” by Frohlich et al. (2002), are PC based and not particularly convenient for the social and physical settings of a living-room environment. The examples mentioned in Section 3.1 do not focus on other media types than photos. In this section, a literature overview of non PC-based applications is given subdivided according to the media types they use. It should be noted that in some cases the applications described are mere concepts which are not implemented as working demonstrators.

5.3.1 Photos combined with Text

The Personal Digital Historian (Shen et al., 2003) makes use of projection on a round tabletop. The photos can be browsed by the categories *who*, *what*, *when* and *where* that are presented as text and based on metadata input. The interaction uses touch, which can be a virtual keyboard when text needs to be entered. This

Personal Digital Historian is especially suitable for multi-user interaction, since people can sit around the table and turn the GUI in their direction with their styluses. This system is fixed to one location, because of the need for a projector and a projection surface.

Other devices with the functionality of PCs which could show photos and text are electronic books, or e-books, such as SoftBook Reader by Softbook Press and Rocket eBook by Nuovo Media (Harrison, 2000). Unfortunately they have one major disadvantage for photo viewing, namely that they are currently only available with monochrome displays.

5.3.2 Photos combined with Audio

The Personal Digital Historian combined digital photos with text, but other media types like sound can also be added. The PenPal (Piernot et al., 1995) is a communication device for children created for a design competition. With the PenPal children can take *photos* and add *sounds* or voice annotations, they can create and send images across the internet. The prototype consisted of an LCD touch screen device with slots for memory cards, a camera and a microphone. A docking station was used for getting internet access.

The StoryTrack (Balabanović et al., 2000) is a portable touch-screen device which is meant for enhancing storytelling. The user can browse and display digital *photos* and add and play *voice annotations* on the prototype. The touch screen was not used, instead the authors mounted new input controls on the edges of the device. The user interface contained a display area, a scrollable thumbnail-overview and a section showing information and controls for possible annotations associated with the digital photo currently displayed.

5.3.3 Photos combined with Video

The Family Tree concept description of the Philips Vision of the Future (Family Tree, 1996) is based on the idea of an interactive photo frame, that combines *photos*, *videos*, *letters*, *names*, *dates* and *family information*. Because of the family information it can be used as a reminder for birthdays and other special occasions.

5.3.4 Photos combined with Audio and Video

The Storytable is an art installation that combines *digital photos*, *videos* and *songs* (De Verhalentafel, n.d.). This table contains three hidden PCs and three visible PC-screens. Because the project aimed at the elderly user each screen has two large buttons in its vicinity. With one of these buttons the user can stop the videos and

songs from floating over the screen. The other button starts playing the currently selected media item. Typed stories can also be added to the system, but this requires help from a person with know-how of the system.

5.3.5 Photos combined with Audio and Odor

The only study which mentions *odor*, next to *photos* and *audio*, is based on an idea coming from a workshop with elderly (Ouderensworkshop 1997, n.d.). The participants had to come up with future applications they would like to have. Two out of the four application concepts dealt with memories. One concept was called the “Big Memorybook of the Netherlands”, a national database full of thoughts, feelings and anecdotes. These data are entered by individuals all over the country with small memorybooks they could borrow from the library and after returning them the data is added to the national database. The second concept was called the “Cuddly Pillow” (also known as the “nice memory machine”). It stores memories digitally and by lightly touching specific spots of the pillow those memories can be seen, heard or smelled. According to this study, memories seem particularly important to elderly, because they often have to move to old people’s homes to which they can not bring many of their possessions.

5.3.6 Photos combined with Physical Objects

Recollection-supporting devices which couple physical objects to digital media form the most relevant category of projects for this chapter.

The PhotoShare application (de Greef and IJsselsteijn, 2001) makes use of projection on a table for displaying digital photos. The user interacts via a Graspable User Interface with this application, instantiated by a wooden block that can be put on top of a projected thumbnail in order to enlarge it in an appointed location, both local and remote. This demonstrator was built to investigate the effect of video communication on social presence.

A project called memoryBox (Mingo and Dahiya, 2002), developed a concept of a box with buttons (for clothing). These buttons are each linked to one digital photo, just like the wooden blocks in the PhotoShare application. When the user runs her hand through the buttons the photos appear on the inside of the box cover, which is a display. The photos fade after the hand is removed from the box. This memoryBox is suitable for random browsing and creating an interactive experience for the user.

The Rosebud project (Glos, 1995, Glos and Cassell, 1997a,b) links children’s stories to keepsake objects. The children can type stories on their PC, which they “tell” to one of their stuffed animals. When the animal is held near the PC, the PC

recognizes it and a communication channel is established. The PC shows on-screen text and the animal can react to the content of the stories by asking questions or moving, e.g., by nodding its head or clapping its paws. Rosebud wants to teach children to treat their stuffed animals as listeners of their stories. In this way, a learning environment is created to improve children's verbal skills.

Objects can also be attached to souvenirs which is shown by MiMe (Multiple Intimate Media Environments, 2001). This project focuses on "the relationship between computer technology and people's experience of their intimate media⁵ collections around the home". The project came up with four concepts, of which one idea describes a picture ball that can be used to browse through photos by spinning it (Multiple Intimate Media Environments, 2001). A prototype was built based on their GlowTags-concept, which concerns small objects that can be linked to intimate media, e.g., a photo. Two people could have the same photo where each one is tagged. One tag can start glowing when the other person touches her photo, reminding the owner of the intimate media the tag is attached to. But the tag could also glow when, for example, the person in the photo has his/her birthday that day.

5.3.7 Photos combined with Physical Objects and Audio

HP's Memory Box (Frohlich and Murphy, 2000) "was built to illustrate the possibility of recording and attaching stories to memorabilia kept in a box". The project focused on recording and playing spoken stories which were associated with a limited number of objects. The difference between this project and the one described in this chapter is that the Memory Box explicitly wants the user to record a story with each object and this story, or memory, cannot be changed afterwards. This could be beneficial if those objects were gifts to other people, but if those objects were for the storyteller's own use the story might interfere with the user's memories in the near future since memories can change over time and according to context. Demonstrations of this prototype generated some interesting results. For example, it was suggested to add the voice recordings to gifts. The users responded positively to the idea of tagging souvenirs as long as attaching the stories and sounds and later playing them back was simple. Another conclusion was that the size of souvenirs varied a lot, from pianos to teeth, and a possibility should be

⁵ The term "Intimate Media" "describes the stuff that people create and collect to store and share their personal memories, interests and loves" (Multiple Intimate Media Environments, 2001).

created which enables large objects, such as furniture, to be used as a souvenir with stories and sounds attached to it.

5.3.8 Photos combined with Physical Objects, Audio and Video

POEMs (Ullmer, 1997), which stands for Physical Objects with Embedded Memories, is a concept in which physical objects are linked to digital “memories”, such as digital photos, audio and video. Two scenarios were developed, with a seashell and a book, and a vision video was created.

British Telecom, to be precise BTexact, created a prototype of a scanner that can scan objects, such as souvenirs (BBCNews, 2003). When an object is scanned a PC plays the attached media, like e-mail, text messages and websites and the TV shows photos, videos and audio.

Recent work from Stevens et al. (2003) focuses on parents who want to preserve memories of and for their children. Based on a series of ethnographic interviews with parents, design activities and focus groups they designed the so-called Living Memory Box, which makes it possible to link virtual information to physical objects. This linking is done by putting an object in a dedicated box and by selecting media-files on an attached display. The box is made of plexi-glass, has a touch screen attached to it and can record video and audio and makes photos of the object in the box. Whenever a user puts an object in the box she can record and attach a story to the object by interacting with the touch screen. Later the object is removed from the box, since it is not intended to be a storage container.

5.3.9 Conclusions on Digital Photo-Browsing Devices

Section 5.3 reviewed non-PC-based photo browsing applications that try to break away from the “lean-forward” interaction style so characteristic for PC-based applications. Most of the applications mentioned in Section 5.3 were published at the time the Digital Photo Browser was being designed. As a consequence the impact of these studies on the present study was limited.

The choice for keepsake objects as cues to memories was inspired by POEMs, which remained a concept (Ullmer, 1997), the Rosebud study, which focused on stuffed animals (Glos and Cassell, 1997a,b) and the MemoryBox project, which consisted of a box containing objects with recorded stories associated (Frohlich and Murphy, 2000). For the Digital Photo Browser the link between *souvenir* and *photo* seems useful since often souvenirs are bought on a holiday (see Chapter 4) and the buyer also creates the digital photos there, which later are linked to the

souvenir. Therefore the buyer and photographer is also the user of the Digital Photo Browser, with mental links between the two types of media.

5.3.10 Why a Graspable User Interface?

One way in which souvenirs can be used with a direct link to photos is by means of a Graspable User Interface (Fitzmaurice, 1996). A Graspable UI is defined as “a physical handle to a virtual function where the physical handle serves as a dedicated functional manipulator”. To the author’s knowledge there are currently only two studies that quantitatively compared usability aspects of Graspable User Interfaces to those of Graphical User Interface (GUI). With respect to speed (Fitzmaurice and Buxton, 1997) and spatial organization (Patten and Ishii, 2000), the Graspable UI showed a better overall performance than the GUI. Fitzmaurice (1996) compared Graspable User Interfaces to the use of a mouse. He concluded that people prefer tangibles above the mouse, because they can use their motor skills better. Also people prefer graspable objects because each object has clear functions and affordances (Fitzmaurice, 1996). In addition to these arguments found in literature a Graspable UI was chosen for the Digital Photo Browser for other reasons. First of all, because handling physical objects is more natural than dealing with virtual objects on a screen and people are experienced with physical object manipulation. Physical objects might even be more fun to handle than virtual ones. Second, those physical objects could be combined with virtual objects such that they could facilitate the change from everything being physical to more and more being virtual, not only in the office environment but also at home (see Chapter 2 for some examples). In addition, combining physical and virtual objects can also create a better understanding of the virtual objects and it might create new possibilities (e.g., physical objects can get new meaning, when virtual media is associated with it). Third, Chapter 4 showed that souvenirs can serve as external memory to the owners of the souvenirs. Fourth, with respect to personal memories most people already have personal objects which are suitable for a Graspable UI, like souvenirs, photo albums or other physical objects of choice. In addition to the Graspable UI described in this chapter, Living Memory Box (Stevens et al., 2003), Memory Box (Frohlich and Murphy, 2000), POEMs (Ullmer, 1997), Passage (Streitz et al., 1999), Rosebud (Glos, 1995, Glos and Cassell, 1997a,b) and the object scanner by BTexact (BBCNews, 2003) are the only studies that use personal objects instead of objects that are created for the task. The last reason for choosing a Graspable User Interface with the Digital Photo Browser is that people always look at “attractive” objects first before they see what they are looking for. Even if these objects are totally irrelevant, and people are unaware of

this behavior (Theeuwes et al., 1998). Perhaps objects used as part of the Graspable User Interface act as reminders for using the Digital Photo Browser.

5.4 Memory Focus Group

Most studies mentioned in Section 5.3 put emphasis on the application development. Much less is reported on people's everyday experience of memories. Therefore, it was decided to organize a memory focus group which was conducted to see whether it was possible to use other media types than souvenirs as cues for remembering. This focus group (van den Hoven and Eggen, 2000) was also used to gain a better insight into what objects or contexts people use to recollect memories and to look at possible cues of autobiographical memories which could be used in an application like a Digital Photo-Browsing Device.

Seven people (four men, three women, with ages ranging from approx. 20 to 40 years) participated and spent one afternoon thinking, talking and writing about memories. A trusted atmosphere was created in which the participants discussed and wrote about personal experiences. The focus group consisted of several exercises, two of which are described below.

5.4.1 Personal Media as Memory Containers

For the first session of the focus group all participants had to bring media from home that were associated with personal memories. The motivation for giving this task was the expectation that in a future memory container all kinds of media might be stored, not only photos as it is now, but also physical objects (e.g., souvenirs), sounds or odors.

The things that were brought by the participants (see Figure 5.1) confirmed our expectation that cues for memories can be diverse. The physical objects were linked to people, events, emotions or combinations of these. Cues consisted of odors, sounds, images, touch or combinations of those media types. For example, one of the participants brought a branch of lavender and explained that he would smell it whenever he wanted to think about a specific location, and in particular about the great time he had and the people he met there.

5.4.2 Non-Personal Media as Memory Cues

During this exercise the participants had to look at ten images, listen to six sounds, smell eight filled containers and touch one cuddly toy, all in a random order (see Appendix 5 for an overview). After each (possible) cue they had to write down all

the memories that popped up on Post-it notes. The stimuli were chosen on the basis of availability and diversity. For example, one olfactory stimulus was “cough syrup”, one image showed a beach and one sound was a dentist’s drill. Photos showing people were avoided since it was assumed that this might influence the recall. The same selection strategy was applied to voices in sounds.



Fig. 5.1. Objects that cue memories, brought by the participants of the focus group.

Despite the intrinsic non-personal nature of the stimuli and the relatively short exposure times (approx. 10 seconds) some stimuli used in the memory-cuing exercise generated several recollections. For some participants odors worked as well as other media types, while for others odors did not elicit memories at all. A reason for this could be the particular collection of odors used.

An expectation of the author was that photos would not do as well as sounds. People are much more visually oriented and can easily recognize that they never saw the context of a photo before, whereas this seems much more difficult for sounds and odors. This expectation turned out to be wrong, as more memories were generated for photos and sounds than for odors (respectively 7.9 and 8.2 per stimulus versus 6.0 for odor).

5.4.3 Conclusions of the Memory Focus Group

Participants showed a genuine involvement in the topic, since they enjoyed sharing personal experiences with others. The media that were brought showed that memories are most often associated with keepsake objects and in some cases photos.

Recollecting is successful after being presented with a random stimulus; but the categorization of these memories is difficult. In the discussion the focus group participants made clear that memories can serve different functions: one is to establish and maintain relationships, another is to process negative experiences. These findings are in agreement with Cohen (1996), who lists additional functions of Autobiographical Memory such as, a) the construction and maintenance of the self-concept and self-history, b) to regulate moods, c) for problem-solving, d) to build up likes, dislikes, beliefs and prejudices and e) to help predict what will happen in the future (for more information see Section 3.2.4.1).

5.5 Design & Implementation

5.5.1 The User-Interface Design

The design of the Digital Photo Browser started with the writing of scenarios of use, which were used to come up with user requirements. Two scenarios were worked out, one focusing on efficient photo browsing and the other on the fun aspect of digital photo browsing (Dijk et al., 2001). Because the device and its user interface is intended primarily to be used in the home and in a family setting, the author chose the second scenario to be elaborated. This selected scenario describes a situation where a family, that just returned from a holiday, wants to share their memories with grandma and grandpa. They do this by choosing a memory cue on a portable touch screen, which makes the room change into their holiday destination.

The following requirements were derived from this scenario (van den Hoven and Eggen, 2001) and from the focus group, which was mentioned before:

- R1 The device should contain personal, digital photos that can be viewed and shown in an easy manner;
- R2 The device should be suitable for putting it on your lap on the couch, which means it should be portable and wireless;
- R3 It should be possible for one or more users to view photos together;
- R4 The device should not look like a desktop PC but preferably more like the old-fashioned photo album;
- R5 The interaction with the portable device while sitting on a couch, should resemble the interaction with the old-fashioned photo album, therefore excluding typing or using a mouse;

- R6 The device should be able to contain photos of more people while taking care of privacy issues, e.g., family members should be able to store their photos in the same device;
- R7 It is more important for the interaction to be fun and entertaining than it is to be efficient.

Based on these requirements a user-interface concept was designed, that reminds people of their photos by continuously scrolling them along the display (see R7).

The user interface of the Digital Photo Browser (see Figure 5.2) consists of three areas: 1 - an area on the left which shows a moving photo roll, 2 - a central area which allows enlarging individual photos, both in landscape and portrait format, 3 - an area on the right where icons of the current user (3a), of other display devices (3b) or of detected graspable objects (3c) can be shown. The roll (1), which shows on average eight thumbnails on-screen, consists of two layers: the first layer shows an overview of all the albums owned by the current user and the second layer shows the contents of each album. This second layer is accessible by clicking on an album-icon, one can return to the first layer by clicking the "back"-button.

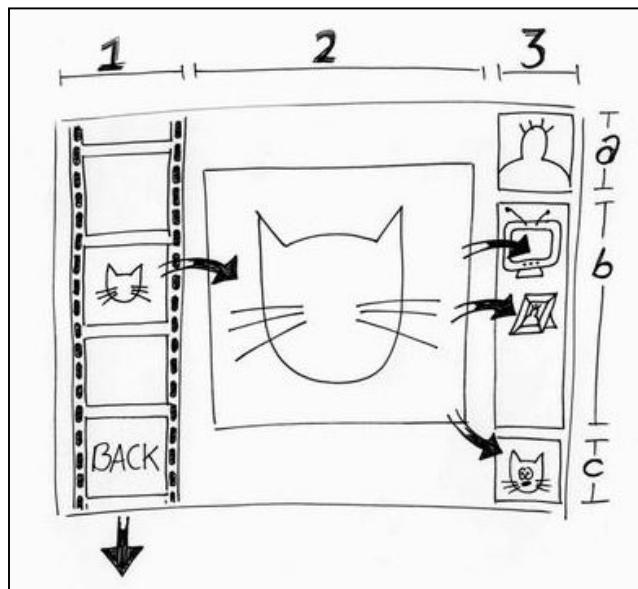


Fig. 5.2. A sketch of the Digital Photo-Browser user interface (for an explanation see text).

All photos and album-icons are stored in the PC, which usually is located in the attic or study. When using the Digital Photo Browser, with its limited memory

capacity, the photos and icons that are displayed on-screen are downloaded to the portable touch-screen device.

5.5.2 The User-System Interaction

The main input-modality of the device described in this chapter is touch (based on R5). It was chosen, since it resembles the manner in which people at home handle their physical objects and photographs, but also because touch screens “are easy to learn, require no extra workspace, have no moving parts and are durable” (Preece et al., 1994, p. 218). Other advantages of touch-screen devices are their portability (current products weigh around one to two kilograms), that they can be used wireless (R2) and that they do not resemble desktop PCs (R4). There are also disadvantages to touch screens, such as the screen getting dirty or greasy from the fingers touching it. Another disadvantage of touch screens is occlusion: since users have to move their hands or pens over the screen they cannot see what is happening on the screen. For this reason the photo roll, from which drag-and-drop movements have to be made, was placed near the right border of the screen for right-handed people and vice versa for the left-handed. The main problem with touch screens is that they are not very accurate, therefore the on-screen icons were made big (minimum of 2 x 2 cm).

5.5.2.1 Drag-and-Drop

The user can interact with the user interface on the touch screen device by making drag-movements on-screen with a finger(nail) or a pen (see the arrows in Figure 5.2). Making a downward movement with a finger over the (downward-moving) roll will increase the speed of the roll. In a similar manner the speed can be decreased. It is also possible to change the movement of the roll from downward to still, to upward, e.g., in case someone wants to enlarge a photo in the roll that just moved off the screen. In addition, the small photos (or thumbnails) can be dragged from the roll to the central area where they will be copied and enlarged for better viewing. Those photos can also be shown on displays of other devices, because the touch screen display is only optimal for one or two viewers, due to the limited viewing angle. Showing photos on other screens is possible by dragging photos to an icon of any detected and available device, like for example, a digital photo frame or a television screen (R1). The latter situation is especially convenient when a group of people wants to look at photos together (R3). Dragging towards the display-device icons or graspable-object icon is possible from the enlargement area, directly from the moving roll and even from another display-icon (R1). According to the user’s preferences the moving-roll can be

shown either on the right-hand or left-hand side of the screen, attainable via a set-up menu.

All the photo interactions on the touch screen can be divided into two groups, namely “showing a photo” which is a copy action and “removing a photo” which is a move action. For example, one wants to show a photo from the moving roll on the enlargement area and then decides to show it on the TV. First a copy is made by dragging the photo from the photo roll to the enlargement area, after that the photo is dragged either from the photo roll again or from the enlargement area to the TV-icon, in both cases this is a copy as well. In this way the user keeps all the photos in the moving roll at all times and in the enlargement area when showing it to others via the TV.

It was decided to add “removing” in addition to “showing”, because of privacy issues. When an unexpected visitor enters the room, a photo can be removed from the TV by dragging the photo from the TV-icon to the enlarged area. The photo will be removed from the television and enlarged on the portable device. There is no history kept on the screens, meaning that if a photo is removed the screen will be empty. This holds for the touch screen and the other display devices. Removing photos makes it impossible to secretly make a copy of a photo on a public screen such as the TV. Therefore, if people want copies, they should ask the owner of the photo to send one to their personal photo browsing devices.

All the arrows in Figure 5.2 represent copy-actions. The reversed or remove actions, which are move-actions, are all possible except for the object-icon arrow (arrow towards 3c in Figure 5.2). Since the graspable object visualized by this object-icon can contain many photos it would be unclear which photo to remove if someone would drag from the object-icon. Therefore, the current implementation is such that photos can be added to a graspable object, but they cannot be deleted from the digital association list.

Browsing or moving through the content of the roll on the portable device can be done by selecting the color-coded frames or the content of these frames, the thumbnails. The colors of the frames represent categories of photos: blue – photos attached to the graspable object that is currently detected, orange – an album-icon or the individual photos in one of the albums, white - back up in hierarchy, from individual photos to the album layer, or green – favorite photos, which have been displayed most often.

Feedback sounds were not implemented for any of the touch interactions, because it was assumed that they would not give additional information to the visual interface and might get annoying after frequent use. For all other interactions,

which are more indirectly connected to the touch screen device, sounds were added (see below).

5.5.2.2 Graspable Objects

A second way of interacting with the touch screen is through graspable objects (see Chapter 6), which can cue memories and act as strong-specific input devices (Fitzmaurice, 1996). An object can be placed near the Digital Photo Browser in order to change the content of the moving roll to the photos that are associated with the object. The object-photos have a blue frame in the moving roll in order to make the distinction between the new roll and what was viewed previously (mainly orange-album or green-favorites frames). With a white “back”-thumbnail, in-between the blue frames, the user can go back to the previous situation (which might be both at the album-level or inside an album, showing individual photos, see Figure 5.3). Returning to the blue frames is only possible by removing the object and placing it again in the neighborhood of the portable display.

Examples of souvenirs used as Graspable Objects can be seen in Figure 5.7.



Fig. 5.3. The implemented Digital Photo-Browser user interface using an object (down-left corner) and viewing its associated photos in the photo-roll.

As soon as the Digital Photo Browser recognizes the object it gives auditory feedback and displays an icon on-screen. Now, new photos can be associated with the object by dragging thumbnails or enlarged photos to the icon of the object.

The only effort needed to be done by the user is to make a photo of the object and enter into the system. This process is similar to entering regular digital photos (which is described below).

Each graspable object can be used by different people, each user has his own private photos attached to the object and cannot watch other users' photos (R6). The reason for this option is that often more people from the same household have memories related to a specific graspable object or souvenir, but those memories (currently represented by photos) are not necessarily the same.

5.5.3 The Graphical and Graspable UI Implementation

The first version of the prototype (see Figure 5.4) was operational in an intelligent living-room-like space, which recognizes users, devices, the status of devices and graspable objects. This room contained a couch, a TV, an audio system, a table with chairs and two bookcases. The second prototype version was implemented in a real house (called HomeLab, see Eggen and Aarts, 2002) and living room, after the formative evaluation (see Section 5.6).

Both versions of the Photo-Browser application were implemented consisting of various components, running on a PC somewhere else (for detailed specifications of the last version, see de Jong, 2003). These components comprise services, agents and general applications, which communicate with each other using a service-discovery architecture. The graphical user interface (described above) runs on a portable touch screen PC (Fujitsu Stylistic LT), which is connected via a 11 Mb/s wireless LAN link to a "fixed" PC on which all other services run. In a real-life situation this fixed PC is in the attic or study but to the user all functionality appears to be in the portable device. In general this Digital Photo Browser can be used for storing, browsing and viewing (digital) photos. Adding new photos to the database is possible by means of an attached camera, by scanning or by uploading from other storage media.

Adding photos can also be done via the home PC (R1), just like several other activities, such as: deleting photos, editing photos, changing the hierarchy in the moving roll and changing links to graspable objects. Those activities require a different type of interaction from dragging, e.g., typing folder names or using photo-editing software.

After attaching a wireless, battery-free RFID-tag (Radio-Frequency-Identification tag, see Philips Identification, n.d.) to a graspable object it can be detected when it moves near a coil-shaped antenna. In our set-up the users were seated at a table,

and the coil was stuck underneath this table. Therefore, the coil was invisible to the user and the device pretended to react to the objects placed near it. For this prototype only one object could be detected at the same time. This choice was not caused by technical limitations but made because otherwise it would require an object language. This language would have to explain what would happen if two objects were detected simultaneously, would all associations of each object presented or only the associations that were linked to both objects, which logical operators are used. This language would make the object-device interaction less straightforward, it would have to be explained in the user interface.

The graspable objects were placed in a bookcase near the table, resembling the home-situation where souvenirs in the living room are often on display (see Chapter 4).



Fig. 5.4. The first version of the implemented Digital Photo-Browser user interface and device.

The measurements of the touch screen are 21.2 x 16.0 cm, where 15.7 x 15.2 cm is used to display the enlarged photos. The individual photo thumbnails in the rolling film measure 2.5 x 1.8 cm and the icons in the right area are approximately 2.5 x 2.8 cm. The weight of the device is about 1,2 kilograms.

Another part of the first version of the prototype is a personal badge containing a transponder. This transponder can be recognized by a coil-shaped antenna and each transponder belongs to a user. Whenever a user enters or leaves the room while carrying the transponder he is recognized by the system and a personal feedback sound is played. Because several people can add their personal photos to one Digital Photo Browser (R6) placing the badge on the table near the device

determines who is the current user of the device and thus whose photos are shown on the touch screen device. The use of a badge is not optimal in real-life, but it was decided to choose badges because of practical reasons, e.g., their availability. The portable device can also be taken outside the room. In this case the user interface changes its appearance and functionality since e.g., the user identification with badges is no longer possible. When walking in or out of the room a feedback sound is played.

5.6 Formative Evaluation

5.6.1 Informal Heuristic Evaluation

An informal heuristic evaluation was conducted with eight Dutch people (three women, five men, ranging in age from approx. 20 to 50 years) who had no relation to the project, but who worked in a research environment. The stand-alone device was used with a mock-up of the user interface, requiring from the participant's imagination on how a mock-up would look and behave when it would be finished. The goal was to identify major problems or improvements of the current user interface and the type of interaction device.

The problems identified and suggestions made during this evaluation were incorporated in the prototype before the expert review took place. For example, participants thought the movement of the photo roll was too slow. The chosen solution for this was to add algorithms that adapt the speed of the roll according to the behavior of the user. The direction of the roll-motion was independent of this feature. Another conclusion was that people did not recognize the touch screen and mistakenly thought the buttons on the device were part of the interface. Since those buttons were not suitable for interaction (they contained a numerical keypad and some control keys) these were covered with black tape before the start of the expert review.

5.6.2 Expert Review

The second, more extensive, evaluation was an expert review because a rough first version of the graphical user interface was used. The prototype was implemented in an intelligent living room like space (see Section 1.1.2 and Requirement 2, Section 5.4.1), instead of a living room, because the HomeLab, was still under construction. Unfortunately, a portable touch-screen PC had to be used, since a more suitable webpad was not available at that time (1999-2000). Therefore it was decided not to test it with "real users", yet. Each of seven Dutch user-interface

experts (one woman, six men) went through a short introduction, a thirty-minute walkthrough, a thirty-minute structured interview and an informal discussion afterwards.

In the short introduction it was explained that the expert review consisted of two parts, a walkthrough and an interview, that the system to be tested was a prototype and that it was incomplete.

5.6.3 Walkthrough

The reason for a walkthrough was that this would make clear whether these experts could understand, learn and perform all basic tasks needed to have control over the prototype within five minutes. The interview was necessary to get more detailed information on specific parts of the interface.

The most important task of the walkthrough was to browse through the available photos using the speed-adapting photo roll. This roll contains two layers. Browsing through the photos in the roll proved no problem, eventually everybody found out what to do. There was only a difference between the group that started at the highest level in the hierarchy (which shows the album-thumbnails) compared to the other half that started one level deeper, which showed the content of a selected album. The first group did not see photos to start with so they needed time to find out that those names were albums and that these thumbnails could be pressed. On the other hand, the second group immediately understood what to do, since they were already at the level of the contents of an album (the individual photos). In the interview it appeared that the second group understood the hierarchy or structure of the interface better than the first group.

5.6.4 Interview

The interview consisted of 11 open questions on the user interface and one question on the device and the user interface together. When the experts had to rate whether the device was more a computer or a photo album to them, they were neutral (on a scale from 1 – 5: $m = 2.9$, $SD = 1.2$).

All seven experts said the interface structure and possibilities were clear and proved this in their explanations of this structure.

The experts unanimously agreed on whether extra media types would be beneficial. Five out of seven mentioned sound as the most important media type to add now. Some of them missed the audio feedback during the walkthrough, since they were completely occupied with their tasks. The ones that did hear the sounds still thought there should be more appropriate sounds added to the interface. In

addition to sound two people mentioned voice control and two others said not to add voice control.

Overall, the experts were positive about the interface; especially the interaction style was highly appreciated. Within five minutes the main interactions with the user interface were mastered.

5.6.5 Digital Photo Browser Discussion

In this session the issues that were raised during the formative evaluation are discussed in more detail.

The experts had different opinions on the appearance of the *graphical interface* and specifically on the use of colors. (The colors of the photo frames in the moving roll indicate different types of information, such as photos from an object, or icons from albums.) The experts understood the interface without understanding or noticing the meaning of the colors, which indicated no need for explaining the colors in the interface. For an experienced user it might give additional information, while other users will not notice it.

The size and number of *thumbnails* on-screen for the prototype was based on trial and error, since there should be a balance between the enlarged-photo space (which should support both portrait and landscape photos), the roll and the user and device photos. Because of different preferences for the various users (e.g., right-handed people versus left-handed people) it was decided to make this personalizable to a certain extent. Before the summative evaluation this was implemented.

Audio feedback is necessary when the eyes are turned away from the screen. This is the case when using objects (badges as well as graspable objects) and when entering a room (with or without the device). In all other situations it was decided not to add sounds, since this might interfere with storytelling or disturb other people in the room.

How to enter *photos* into the device was a frequently asked question. Although this is currently not a focus in the project, there are several possibilities depending on where the photos are stored. Digital cameras can be plugged in to the Digital Photo Browser directly, and since this device is wirelessly connected to an in-home network, the digital camera can copy its photos to the home PC. But people can also directly copy the photos to the PC.

A similar problem for the project team (see Section 1.1.1) was the filling of the prototype database with real-life digital photos. This appeared to be a time-consuming task; therefore a digital camera was purchased for the whole team to be used. The prototype used for the focus group and expert review contained 150

photos, which was clearly not enough. The final demonstrator used for the summative evaluation contained around 800 photos, which is still not comparable to a photo database of a person's lifetime but sufficient to show the concept.

5.7 Summative Evaluation & General Discussion

The previous part of this chapter described how potential end-users of a device aiming to support the experience of remembering were systematically involved throughout the design process that eventually led to the Digital Photo Browser functioning in a context-aware environment. These encounters with users were formative in nature as they helped to "shape" the Digital Photo Browser device. After those evaluations several aspects were changed, namely the graphical user interface was reprogrammed to look more professional, e.g., the album thumbnails in the roll showed not only the name of the album but also a photo characteristic for this album. In addition to the improvements in the user interface a new touch screen was used (Fujitsu Stylistic 3500) which looks more like a webpad without a numerical keyboard at the side, has a larger screen, a higher screen resolution and weighs less (around one kg). The back of the previous touch-screen device got hot after about 30 minutes of use and it was assumed the new touch screen would not have this problem, but this was not the case. Numerous discussions were unsuccessful in determining whether privacy issues had to be solved by the device or by the user, since it could not be predicted how such a device would be used, primarily indoors or also outdoors, or whether everyone would have a private device or one shared with family members. Therefore it was decided to create a possibility to change users on-screen and to keep the badge-based user identification intact (R6).

The improved Digital Photo Browser became part of an aware environment (see Figure 5.5). This living room, including the Digital Photo Browser, has been demonstrated to and used by many visitors (roughly 2000 over the last couple of years). These visitors, both men and women, ranged in age from about 20 to 70 years, and had diverse professions, such as journalists, managers, secretaries and researchers. In the following sections of this chapter some of the general recurring themes that emerged from these interactions "in vivo" are discussed.

The demonstrations of the Digital Photo Browser were one of the applications supported by the intelligent environment and the possibility for people to interact with the application themselves cued lively discussions about current practice and future possibilities for recollecting experiences from the past. In general, people

discriminated between two different contexts of use: a single-user, or individual, setting in which the experience of remembering seems to be linked to *mood* and a multi-user, or social, setting in which the activity of recollecting memories is related to *telling* personal and shared *stories* about the past. For both situations people mainly talk about the experiences and less about the actual media that are involved in creating these experiences. This seems to indicate that the problem of how to support recollecting memories should not be formulated as a pure content retrieval problem but that the focus should be on how the media stored in the system can optimally *cue* and set the right conditions for the experience of remembering. People repeatedly argued that they should always be in control of the application. However, in view of the expected large amount of media present in the system and because of the prospect of having available different media like sounds, video clips, souvenirs and web information complementing the digital photos, they could imagine the *system* taking *initiative* when appropriate. Over the period in which the Digital Photo Browser was “on display” many other issues were discussed but this chapter concentrates on the ones that were mentioned above and that seemed most relevant for this chapter.



Fig. 5.5. The demonstrator and graspable objects shown in the Ambient-Intelligent room.

5.7.1 In the Mood for Recollections

The use of the portable Digital Photo Browser was often compared to the “traditional” photo album, since it can also be put on one’s lap (it has roughly the

same size and weight) or it can be taken on a visit to friends. Visitors tell that at times when they are on their own a need to reminisce experiences from the past might crop up. This need was also formulated by the participants of the memory focus group that was conducted at the beginning of this project. Three situations to get into the mood for reminiscence were identified by the participants: 1 - when with friends, 2 - when physically or mentally on your own, or, 3 – when daydreaming and as a result open to all kinds of thoughts and memories (this is called Implicit Memory, see Section 3.2.2). Cues for this state of mind that were mentioned are very diverse ranging from a simple sound, a typical odor, to feelings such as missing a loved one badly. Once people are in such a mood, photo browsing is considered a fulfilling activity. The act of browsing a photo album might intensify a certain mood, or it might induce the opposite mood. Both directions of change are sometimes planned deliberately. Alternatives to photo browsing mentioned by people include music listening and the picking up of souvenirs. People anticipate and feel positive about future devices that would combine these alternatives in an integrated solution. They recognize the Digital Photo Browser as a first step in this direction.

As mentioned earlier, people focus on the experience of remembering. This positions the content stored in the system as cues for recollections rather than recollections as such. To fully explore this concept in the design of future devices that support recollecting more knowledge is needed on the effectiveness of various media to cue recollections. This question was the motivation for the study in Chapter 7.

5.7.2 Recollections: a Special Case of Story Telling

Photo browsing was often characterized as a social activity. People use photos, and more importantly, the stories they evoke for many purposes. For example, they are used to share information, exchange perspectives, consolidate and tighten bonds of friendship, or simply have fun. The possibility offered by the Digital Photo Browser to identify and use TV screens present in the environment for displaying photos as well as the option to easily access relevant “photo albums” by means of objects is valued as an enhancement of photo browsing in a social context. The story-evoking nature of objects has been investigated and applied in other studies (e.g., Glos and Cassell, 1997a,b and Glos and Umaschi, 1997) and these findings were supported by the results of the souvenir study described in Chapter 4.

While the application described by Liechti and Ichikawa (2000) was especially made to improve social relationships between geographically separated individuals, our prototype brings people closer together in natural settings and makes them communicate in a natural way and without the need for authoring tools. In our opinion one should not use PCs developed for office work for in-home situations since the office requires a lean-forward mode and the value of the device is based only on the functionality whereas for in-home situations the value is determined by the functionality in relation to the attention required, since there the laid-back mode prevails. This approach is also supported by the work of Balabanović et al. (2000), who built a comparable application to ours, but with a different purpose. They wanted to enhance storytelling by means of a touch-screen-like device with digital photo collections that can be shared locally or remotely, which is called the StoryTrack. They used almost the same type of device as the one mentioned in this chapter (Fujitsu Stylistic 2300) but mounted new input controls on the edges of the device to avoid using the touch screen. The assumption was that “people point at pictures when looking at them. Using the same gestures to control the device might be confusing and produce unexpected behavior.” During the evaluation of our system there was no evidence that this is the case.

5.7.3 Who is in Control?

Many people who interacted with the Digital Photo Browser had already made or were considering the shift from traditional photography to digital photo capturing. This was reflected in the awareness of most people facing the inevitable problem how to access large amounts of digital photos. People envisioned this problem to become even more serious when other media like music, sounds, video clips and possibly odors could be captured and stored in future systems. These considerations lead to some people's belief that future systems should take initiative in the user-system interaction not only to provide help in selecting the appropriate cues but also to play an active role in creating the experience of recollection by inspiring, challenging, exciting and affecting people. However, while people explicitly mention mixed-initiative interface solutions, they strongly emphasize the requirement to take over control whenever wanted.

Their strong views concerning this requirement come from the need to be able to control privacy aspects, particularly in social settings, and their conviction that the effects of spontaneous or desired mood changes are so delicate that they just do not believe a system can anticipate these effects on its own (R6).

One of the privacy issues concerns using souvenirs while other Digital Photo Browser devices are in the room. The table does not know which user wants to view the photos associated with the souvenirs on which device. Therefore a third and last version of the Digital Photo Browser was created, which supported multiple devices and sharing. The reason for choosing sharing as a topic for the third demonstrator was based on the fact that exchanging photos is one of the most widespread functions of photos (Edwards, 1999). The privacy issue was solved by designing a casing for the touch-screen devices that could emit light and change color by means of multi-colored Light-Emitting Diodes (see Figure 5.6).



Fig. 5.6. The third and final version of the Digital-Photo-Browser user interface and device, with LED's in the casing (white rim bordering the device). As can be seen in the left part of the UI, the cat-object is active (the third picture from the top) and the roll contains the photos associated with this object. (For the explanation of the back-pack picture in the top-left corner of the user interface, see Qian, 2004.)

Each user could select one personal color and brightness and the casing would change to this color every time the user identified herself to a Digital-Photo-Browser device. Together with this casing a small coffee table was designed, called a Chameleon Table since it can change color (see Figure 5.7). Whenever a user

wants to see photos attached to a souvenir she has to move the Digital Photo Browser close to the table. The Chameleon Table recognizes the RFID-tagged device and changes to the same color, indicating that this user is in control over the table. Every object placed on top of the Chameleon Table initiates its associated photos to be shown on the corresponding Digital Photo Browser. Light was chosen to indicate who is using which device and table, since, on the one hand, it can create specific ambiances and, on the other hand, it is visible from across the room. Furthermore, the LED-casing removes some of the PC look-and-feel of the touch-screen device, however it looks more like a digital photo frame than an old-fashioned photo album (R4).



Fig. 5.7. The Chameleon Table of which the top can emit light and the shelf can be used for storing souvenirs. The cat on top of the table is now active, as can be seen in the user interface in Figure 5.6.

5.7.4 Souvenir Appreciation

The first response of the visitors to the visual and sound effects the souvenir caused was one of surprise. Most people wondered how this souvenir was recognized and therefore they were looking around for (hidden) cameras. Once the RFID-technology was explained most visitors looked for the RFID-tags on the objects. Generally, the visitors appreciated the souvenirs and their role in the user interface of the Digital Photo Browser, but there were also some concerns. For example,

what happens when the digital photo collection starts to grow, are a lot of souvenirs necessary to get to the photos? And what happens when a souvenir gets lost? To answer both questions, all photos can be accessed without souvenirs at any time. When a souvenir is lost the photos attached to it are still in the Digital Photo Browser and a large collection of photos can be browsed without souvenirs, although this might take some time.

The visitors liked the natural and new interaction-method, which they immediately understood and which allowed them to focus on the screens and the photo collection.

5.8 Summary & Conclusions

The goal of the project described in this chapter was to build a device as part of an intelligent environment that supports recollecting. To improve our knowledge level from the user's perspective on "remembering" a focus group was organized. To get started and based on the information gathered it was decided to build a Photo-Browser demonstrator which uses graspable objects as shortcuts to (sub-)sets of digital photos.

A conclusion on the final design of the prototype is that its simplicity was valued highly by most of the users. Although some technology-oriented people would like to add lots of functionalities to the device, the majority thought the device to be useful and orderly because of the limited functionality and liked the interaction with the souvenirs.

6 Graspable User Interfaces

6.1 Abstract

This chapter describes an extension to Ullmer and Ishii's (2000) Tangible User Interface (TUI) categorization. The reason for adding new categories is based on the work of Chapter 5. The benefit of using *personal objects*, such as the souvenirs of Chapter 5, as opposed to generic objects is that in the first instance users already have mental models related to these personal objects. Another advantage of using personal objects as a Graspable or Tangible User Interface comes from the possibility for this UI to support existing media systems (such as a digital photo collection), instead of designing new physical objects that have to be learned by users. In addition, one of the added categories in this chapter was presented earlier by Ullmer and Ishii (2000), but later this so-called associative TUI category was omitted (Ullmer and Ishii, 2001), because of lack of confidence on the utility of this category.

6.2 Introduction

Imagine you are on holiday and you visit this local market where you find a piece of art you like. You take it home and put it in your living room and each time you walk by you reminisce about that great time you had there. It is as if your memories come to life whenever you see this souvenir. And not only the souvenir creates this effect but also your grandfather's chair you inherited and the vase you got as a birthday present. It seems that objects make it possible to re-experience past events.

In the case of the example described above, objects or souvenirs are automatically linked to memories or recollections and it is the owner's imagination that can relive the experience. Another option is to facilitate this experience by making a digital association with memory-cues, like for example digital photos. Lots of people use self-made photos to re-experience their holidays, alone or with relatives and friends. Recently, digital cameras were introduced and they are now quickly replacing the traditional ones. Since a digital photo is virtual and difficult to grasp for some people, it might help if they are associated with a physical object, such as the art-souvenir example mentioned above or the souvenirs mentioned throughout Chapter 5. Those souvenirs are RFID-tagged and can be recognized by the Chameleon Table. The Digital Photo Browser then shows the digital photos associated with the souvenir. In this situation, the personal souvenir becomes part of the Graspable User Interface (Graspable UI).

6.3 Definitions

According to Fitzmaurice et al. (1995) "Graspable User Interfaces [...] allow direct control of electronic or virtual objects through physical handles for control". In 1997, Ishii and Ullmer introduced a similar concept called the Tangible User Interface (TUI). According to Ishii and Ullmer "TUIs couple physical representations (e.g., spatially manipulable physical objects) with digital representations (e.g., graphics and audio), yielding user interfaces that are computationally mediated but not generally identifiable as 'computers' per se" (Ullmer and Ishii, 2000, p. 916). Since this definition still does not differentiate between the terms Graspable UI and Tangible UI, both will be used as synonyms in this chapter.

6.4 Graspable User Interface Categories

Ullmer and Ishii (2000) published their “emerging frameworks for tangible user interfaces”, giving a complete overview of different aspects of TUIs, amongst others describing an interaction model, application domains and an overview of four categories of TUI-instances. Those four categories can be divided into two groups, namely one group in which physical objects are used independent of each other and the second group consisting of groups of physical objects which together create an object language. The independent object-group is called “associatives”, representing physical objects which are individually associated with digital information (e.g., each sticker represents a URL such as in Ljungstrand et al., 2000), such as the souvenirs described in Chapter 5. The second group contains physical objects that rely upon other physical objects to create added value or meaning, such as *spatial* interpretations (e.g., a 2D layout such as in BuildIt, Fjeld et al., 1999), *constructive* (e.g., for building 3D physical models, such as LEGO-like Blocks, Anderson et al., 1999) or *relational* ones (e.g., creating temporary relations between different physical objects, such as annotating videos with blocks, by Cohen et al., 1999).

The physical objects which form the graspable part of the user-interface are termed “iconic” by Ullmer and Ishii (2000), when they share representational characteristics with their digital associations, or “symbolic” when those physical objects do not physically represent some property of the digital information.

Other relevant definitions related to Graspable/Tangible UIs come from Holmquist et al. (1999). They came up with the names “containers”, “tools”, “tokens” and “faucets” for four types of physical objects. Containers are generic physical objects that can be associated with any type of digital information and the physical shape gives no clues on the associations made with the digital information. Beside this they are primarily used to move information between devices or platforms. Tools also do not show a relationship between the physical information and the digital information; they are physical objects that can manipulate digital information, which means they often represent computational functions. Tokens, on the other hand, do reflect with their physical appearance the digital information associated with them and they are used for accessing stored information. Faucets are devices that can present the digital information associated with tokens. Apparently, the authors see “reading the information from the tokens” and “presenting the information from the tokens” as something done in the same device, whereas the work in Chapter 5 shows it can be two different devices as well (respectively a

table and a display). Holmquist et al. (1999) also came up with the term “overloading”, meaning that one token might be associated with more than one piece of information. This overload of information might require the token to be location or context sensitive, showing particular pieces at particular locations or in particular contexts, or a user might be able to access several pieces of information at the same time by means of a faucet.

According to Ullmer and Ishii (2000) their term iconic is similar to Holmquist et al.’s (1999) token and symbolic is similar to container. Only the meaning of the terms iconic and symbolic are limited to the physical representation of the associated digital information, whereas the terms token and container also are defined as giving information on the function of the objects as well (respectively: accessing stored information and moving information between devices and platforms).

Dourish (2001) describes a categorization on the “meaning-carrying” aspects of Tangible User Interfaces. He starts by subdividing the objects into iconic and symbolic and the meaning of the objects is identified as either related to other physical objects or to actions. This can get complicated. Imagine, for example, the souvenirs of Chapter 5. These souvenirs are objects, which mentally link to memories (perhaps those memories contain both objects and actions), but virtually those souvenirs link to digital photos that can be displayed by performing an action with the object. Dourish calls this “a blend of properties” (p. 168), which has potential but he already indicates this should be worked out in more detail.

A recent paper by Ullmer et al. (accepted for publication) mentions token+constraint interfaces, where the constraints are regions that map tokens to digital information. An example of such a token+constraint system is the Chameleon Table together with souvenirs (see Section 5.7.3), although it is different from Ullmer et al.’s description since a token is used to associate and manipulate the constraints. In this example a token associates, the constraints are manipulated by another physical object (the Digital Photo Browser) and the table sets the constraints by its color instead of movement or physical location of the tokens.

6.5 Graspable User Interface Category Extension

Although the division into “object-language” categories is extremely useful (Ullmer and Ishii, 2000), it misses out some of the other dimensions of Graspable UIs that are particularly important for the associative-TUIs group. And since Ullmer and Ishii left out this category in a later publication (Ullmer and Ishii, 2001) because they were “less confident of the utility of this category” (Ullmer and Ishii, 2000), an extension to the categorization is proposed in this chapter which both involves the spatial, constructive and relational TUIs as well as the associative-TUI category invented by Ullmer and Ishii (2000).

The extension of the TUI-instances or Graspable UI categories is based on the idea that users of personal Graspable UI objects have an existing mental model of the links between their personal physical objects and the associated digital information. One definition of a mental model is given by Norman (Preece et al., 2002, p. 130): “the model which people have of themselves, others, the environment, and the things with which they interact”. A mental model in this chapter is similar, since it stands for a link between objects and media that is not determined by the object’s physical properties, but by past events known to the user in which these objects played a role, such as buying a souvenir in a far-away country or leaving usage traces on a piece of furniture during that party you also have photos of. Later those physical properties might remind the user of the links. This definition, for example, would exclude a physical object that looks like a book which is assumed by a user to have stories attached to it. After some experience with this book the user does have a mental model of the object and its associated media, but these relationships were not present from the beginning, they were learned.

Examples of studies in this area include the souvenirs mentioned in Chapter 5, but also Rosebud (Glos and Cassell, 1997a,b) POEMs (Ullmer, 1997) and Passage (Streitz et al., 1999). The use of these Graspable UIs is more suitable for novice instead of expert users, because of the negligible learning time needed to create an internal association with an external object or a mental model. Therefore, the category extension starts with a subdivision of physical objects in “physical objects which have personal meaning to the user” (where the user is probably also the owner) and “physical objects that do not have personal meaning to the user” (where the user is “only” a user). This distinction immediately shows that the first group in particular seems very suitable for the home environment, since this is the place where most people keep their personal belongings. The second group is more suitable for expert users, since they are more willing to learn the

relationships between physical objects and their digital associations. Therefore this group seems more useful in the office environment. Physical objects in the first group are mostly used by one person whereas objects in the second group can be used by a group of people.

The second subdivision is made based on the concept of "dynamic binding" (Ullmer and Ishii, 2000), which means that digital associations can be created and thus changed or deleted by the user. One group of Tangible UIs does not support dynamic binding; they are termed "fixed" associations, while the other group can have "flexible" associations. It turns out that the examples of the Tangible UIs with fixed associations always have only one association, but that the flexible group often supports overloading (see Table 6.1 for examples). Both of these groups can be subdivided into symbolic associations, which means that the physical properties of the object do not represent the digital properties in any way, and iconic associations, for which there is a meaningful relationship between the physical and the digital information.

All physical objects with a fixed association appear to fall under the tool category as defined by Holmquist et al. (1999). Therefore, this group can be subdivided into symbolic tools (e.g., music coming out of a bottle when open in musicBottles, Ishii et al., 2001) and iconic tools (e.g., a glass lens-shaped object, which functions as a lens for beams of light in Illuminating Light, Underkoffler and Ishii, 1998).

Fitzmaurice (1996) came up with defining properties of Graspable User Interfaces, of which the following property seems to be most relevant for this chapter:

Both input and output of such an interface should be space-multiplexed instead of time-multiplexed. Space-multiplexed indicates that every function (on-screen) has a physical device associated with it. On the other hand, the time-multiplexed PC-mouse is constantly reassigned to a new function (strong-specific versus weak-general devices).

According to Fitzmaurice (1996) physical objects that support more than one function are time-multiplexed, which makes them fall outside the definition of a Graspable UI, which should be space-multiplexed. Perhaps it is interesting to note that space-multiplexed means that each physical object can only have one function, but it can contain more media files at the same time. Take, for example, the Rosebud system (Glos and Cassell, 1997a,b), where each stuffed toy can contain one or more stories told by the owner, but it still has this one function: retelling stories.

Table 6.1. An extension to the TUI-categorization by Ullmer and Ishii (2000), with two dimensions: the type of physical object and the type of digital association with the physical object. The numbers between brackets are the numbers of associations possible with each physical object at the same time. For the references to the individual systems see the Sections 6.5.1 and 6.5.2.

Digital associations	Fixed (1)		Flexible (n)	
	Symbolic (tool)	Iconic (tool)	Symbolic (token)	Iconic (token)
Physical object type				
Generic object No existing mental model, mostly multiple users =	Bricks (1)	ActiveCube (1)	BuildIt (0/1)	
	DataTiles (1)	BuildIt (1)	InfoStick (n)	
	FRIDGE (1)	Illuminating	MediaBlocks (n)	
	Logjam (1)	Light (1)	“memory objects” (n)	
	MetaDESK (1)	Lego-like Blocks (1)	MusiCocktail (n)	
	musicBottles (1)	metaDESK (1)	Rosebud (n)	
	MusiCocktail (1)	Robotic toys (1)	Senseboard (0/1)	
	Navigational Blocks (1)	SenseTable (1)	TellTale (0/1)	
	PingPongPlus (1)	SiteView (1)	Triangles (0/1)	
	Senseboard (1)	Urp (1)	WebStickers (n)	
	SiteView (1)		WWICE (0/1)	
	Soundgarten (1)			
	Task Blocks (1)			
	Triangles (1)			
	Urp (1)			
Personal object With existing mental model, mostly single user =			Passage (0/1)	POEMs (n) Phenom (n) Living Memory Box (n)

Although Holmquist et al.'s (1999) token was meant to be "iconic", based on its function, which is accessing stored information, a new subdivision can be made, namely symbolic versus iconic tokens, because examples of both types of tokens exist. For example, in the *metaDESK* system blocks are designed to look like miniature buildings because they represent them (Ullmer and Ishii, 1997), and because these objects show their link between physical appearance and digital information they are iconic tokens. Symbolic tokens only reflect to their current users the associated digital information, e.g., attaching a TV-show to a pen (Sluis et al., 2001). Holmquist et al. (1999) used the term container for both "symbolic associations" and for supporting overloading, which does not fit in the distinction made in this chapter that flexible associations can support one or more associations and thus do not always support overloading, therefore the term container is not taken forward in this categorization.

In Table 6.1 all this information can be found, together with some examples of Graspable/Tangible UIs. In this table the different categories by Ullmer and Ishii (2000) can also be placed, namely: constructive and relational TUIs belong in the box generic symbolic tools. The spatial TUIs belong in the box generic iconic tools and generic symbolic tokens, and the associative TUIs belong in the four boxes with flexible digital associations.

One Graspable UI can contain physical objects from more than one category, although the majority only consists of one category. Exceptions appear in the spatial and relational categories by Ullmer and Ishii (2000). Three examples will follow with three different combinations of tangibles. The first example is SiteView (Beckman and Dey, 2003) which uses *generic symbolic tools* (e.g., the "rain interactors" is a generic object showing text) and *generic iconic tools* (e.g., the "lights on interactor" is an object shaped as a light). The Senseboard by Jacob et al. (2002) contains both *generic symbolic tools* and *generic symbolic tokens*. The tokens on the Senseboard look like fridge magnets and each can be linked to one conference paper. The tools can be used to execute commands on the tokens, such as "copy" or "link". And the third example, BuildIt (Fjeld et al., 1999) contains both *generic iconic tools* (a camera-shaped brick is used for determining a camera view onscreen) as well as *generic symbolic tokens* (rectangular bricks represent handles to pieces of furniture).

6.5.1 Generic Graspable User Interfaces

This section gives an overview of the Graspable User Interfaces that fall in the generic category and which are mentioned in Table 6.1. Generic Graspable User-Interface objects are mostly designed for office environments. For example, blocks can be used as tools to control specific PC-functions, such as Lego-like Blocks (Anderson et al., 1999), Navigational Blocks (Camarata et al., 2002), Bricks (Fitzmaurice et al., 1995), BuildIt (Fjeld et al., 1999), Senseboard (Jacob et al., 2002), ActiveCube (Kitamura et al., 2001), SenseTable (Patten et al., 2001), DataTiles (Rekimoto et al., 2001), Task Blocks (Terry, 2001), metaDESK (Ullmer and Ishii, 1997), Urp (Underkoffler and Ishii, 1999) and FRIDGE (Vroubel et al., 2001). In addition to tools generic Graspable-UI blocks can also be used as tokens that contain information or files, such as infoStick (Kohtake et al., 1999), MediaBlocks (Ullmer et al., 1998), WWICE-tokens (Sluis et al., 2001) and WebStickers (Ljungstrand et al., 2000). Examples outside offices include toys, such as TellTale (Ananny, 2002), Triangles (Gorbet et al., 1998), PingPongPlus (Ishii et al., 1999), robotic toys (Patten et al., 2000), Rosebud (Glos and Cassell, 1997a,b) and a game in which someone has to find out a story through the memories of a collection of objects (Holmquist et al., 2000). In addition to toys a number of papers focused on audio or video applications in the home, such as Logjam (Cohen et al., 1999), musicBottles (Ishii et al., 2001), MusiCocktail (Mazalek and Jehan, 2000) and soundgarten (Wolf, 2002).

6.5.2 Personal Graspable User Interfaces

Most personal Graspable UI objects, which are all tokens, can be found in home environments, with the exception of the personal symbolic tokens of Passage (Streitz et al., 1999). Since Graspable User Interfaces in the home can be used by any type of user, e.g., people who do not have any PC-experience, the system and in particular the graspable objects should make clear, in one way or another, how they should be used. This function will be clearest to the user if the user herself can create the digital associations with these graspable objects, such as in POEMs (Ullmer, 1997), the Living Memory Box (Stevens et al., 2003) and the souvenirs of Chapter 5.

Although Ullmer and Ishii (2000) do not address “overloading” in their “emerging frameworks”-paper, this concept might explain partly the usefulness of their so-called “associative” category (in addition to the statement already made about the in-home use). Ullmer and Ishii state that they “are less confident of the utility of this category than those we have considered thus far. Nonetheless, the instances we have identified do seem to exhibit some consistency, suggesting the category

may have merit". (The categories considered thus far stand for the spatial, constructive and relational systems.)

To the author's knowledge all personal iconic tokens of the "associative" systems support "overloading", including the Graspable UI described in Chapter 5, which incorporates souvenirs that link to related media-items. This might explain why the iconic tokens of "associative systems" are not used for complex tasks involving other tokens: the digital interface is already complex enough with multiple pieces of information associated with each token.

6.6 Discussion

The strength of the extension proposed in this chapter is that it includes Graspable UIs that make use of existing everyday graspable objects like personal souvenirs people have in their homes. The need for this category of Graspable User Interfaces is supported by recent views on the future of computing, such as Ambient Intelligence (Aarts et al., 2001, Aarts and Marzano, 2003). These visions state that in the future many networked devices will be integrated in the environment. The numerous examples of personal tools and tokens that are featured in these scenarios, that describe the future, show that this partly can be done with personal objects people already have.

Therefore, an interesting area of future research would be the personal object-group. Currently most of these case studies start with personal objects and later "upgrade" them with a link to digital information. Is it possible to do this the other way around, or will this inhibit the personalization of the object? And why are the personal-fixed toolboxes empty: because the field is not yet mature, does not exist long enough? One can imagine a personal tool such as a bowl, which represents the user. Each object, e.g. a souvenir like the ones described in Chapter 5, that is placed in this bowl links to the digital associations created by the "bowl owner", since one souvenir can have different associations for different users. If the bowl represents its filtering function in one way or another, e.g., by text, icons or perhaps shape, it would be a personal iconic tool, and if it does not it would be a personal symbolic tool.

An interesting finding is that all the Graspable UIs mentioned in the personal iconic token box (Table 6.1) appear to make use of external memory (a subset of Distributed Cognition, see e.g., Perry, 2003), although none of the papers mentions this explicitly. This is not possible with generic objects, since they are all

alike (and would all remind the user of the same thing), but it is convenient for personal objects, because the mental model is created by the user herself and not imposed by the system. Therefore this group of objects seems very suitable as reminders.

The Generic Iconic Token box in Table 6.1 shows no examples, perhaps because an object that is flexible in its associations can contain several links but also several types of media and it is hard to represent an ever changing media type in a generic object.

Another remark concerns Dourish (2001) who talked about dividing Tangible UIs according to the meaning they carried, on a scale from objects to actions. This scale might be most useful for the generic objects presented in this chapter, since they have a unified meaning to users. The personal objects with predefined mental models might be difficult to fit in this subdivision.

6.7 Conclusions

This chapter explains a possible extension to the TUI-categorization by Ullmer and Ishii (2000). The extension is based on the idea that users of personal objects have an existing mental model of the links between their personal physical object and the accompanying digital information. To the author's opinion this extension is valuable, since the associative TUIs fit in, which Ullmer and Ishii (2000) found hard to categorize. Furthermore, the benefit of using personal objects instead of generic objects is that in the first instance users already have mental models, and the Graspable or Tangible User Interface can support existing object systems, instead of designing new ones that have to be learned by users.

SECTION IV – MEMORIES

From the discussion in Section II it was concluded that souvenirs can serve as external memory to people. In addition they appear to be useful as a Graspable User Interface for digital photo browsing devices (see Section III). In line with the overall aim of this thesis, to design a Recollection-Supporting Device, a shift will now be made from photos, one instantiation of personal memories, to more general information on memories or recollections. Based on insights gained from the literature on Autobiographical Memory (AM) in Section 3.2 a study was carried out about cuing memories (see Chapter 7). For this study a dedicated method was developed to be able to analyze the results of the memory-cuing study in a quantitative way. This method can be found in Chapter 8. The third and last chapter (Chapter 9) of this section describes a short study which verifies whether specific object cues that have been used in the cuing study of Chapter 7, can be treated as examples of the class of souvenirs defined in Chapter 4.

7 Cuing Autobiographical Memories⁶

7.1 Abstract

The beneficial effect on memory of reinstating the learning context has been well established, at least in laboratory settings. The role of context dependency in Autobiographical Memory (AM), however, has been studied less extensively. The purpose of the present study was to examine whether various cue types differ in their contribution to AM-performance, more specific to the number of memory details recalled. Sixty-eight adults participated in a real-life event (i.e., visiting a history theme park). One month later, recall was tested in a laboratory living-room setting using one of five cue types and a no-cue baseline. This resulted in a 5 (media type: photos, videos, sounds, odors, artefacts) x 2 (condition: no cue vs. cue) design with repeated measurements on the last factor. Results showed that the cue media type groups did not differ with respect to the number of ESKs recalled. However, cuing rendered a significantly *lower* number of ESKs than providing no cues, indicating a negative effect of context dependency on the number of ESKs recalled.

⁶ This chapter is based on the following publications: van den Hoven and Eggen (2003b), van den Hoven, Eggen and Wessel (2003).

7.2 Introduction

"When entering the hallway of the house my grandmother used to live in, when she was still alive, I recognize this specific smell which I cannot explain. Suddenly I get the feeling I've gone back in time several years and my grandma is waiting for me in the kitchen. But as soon as I reach the living room and look into the kitchen, I notice it was just a memory... she's not there."

Although this example is a personal childhood memory of the author, many people might recognize this cuing effect of specific odors in bringing back memories. This phenomenon is usually described in terms of the encoding-specificity principle (see also Section 3.5.2.1), which states that environmental cues that match information encoded in a stored event or memory trace (Tulving, 1983) cue recollection of the complete memory (see Smith and Vela, 2001, for an overview on context-dependent memory). Such a memory-enhancing cue may contain "item, associative, and/or contextual information that is encoded in the memory trace" (Smith and Vela, 2001, p. 206) and the process of recollection cued by such cues is typically experienced as relatively involuntary and automatic (i.e., associative retrieval: Moscovitch, 1995, Schacter, 1996, or direct retrieval: Conway and Pleydell-Pearce, 2000).

7.2.1 Autobiographical Memory Cuing

As can be seen from the overview in Section 3.2.6, autobiographical-memory-cuing studies focused mostly on odors, and some on physical objects or photos. For the study presented in this chapter, the following types of cues were selected: odors, physical objects, photos, audio and video, in order to compare different cue types quantitatively. Based on the real-life studies reviewed in Section 3.2.6.1 it is expected that object and photo-cues will generate more memories than a no-cue (or text) situation and odor-cues will generate more detailed memories. There are no studies known to the author that cued Autobiographical Memory with audio or video. The reason for including audio and video cues in addition to odor, photo and object cue types originates from the industrial context in which this research took place. The overall research aim is to design a future device for in-home use with which a user can support his or her personal recollection process. The cues mentioned in this paper are thought to be available to users for recording and playing from such a device in the near future. The main research question for the study presented in this chapter is based on the previous Digital-Photo-Browser interaction design (see Chapter 5) and is necessary for the following design step: is

there an optimal cuing media type for recollections of a real-life event? In order to test this, 70 participants joined in a standardized real-life event and one month later they were cued, when filling out questionnaires, either without a cue or with a photo, object, odor, audio or video cue.

In order to compare the different cuing media types a method was needed to quantify the number of generated memories. This method (which can be found in Chapter 8) was based on the model of Autobiographical Memory proposed by Conway and Pleydell-Pearce (2000). They specified three basic levels of autobiographical knowledge, namely a) Life-Time Periods usually spanning years, b) General Events, taking place over several days up to months and, c) Event-Specific Knowledge (ESK), where the event lasts seconds, minutes or at most hours. Since the study presented in this chapter asks the participants to recall a unique one-day event, the written-account analysis looks at ESKs only.

7.3 Method

7.3.1 Participants

Participants were 34 employees or students at the Philips Research Laboratories Eindhoven or the Eindhoven University of Technology. They were recruited through e-mail and company newsletter announcements inviting people to take part in a company outing to a historical theme park (Archeon; see below). They were instructed to bring someone of the other gender (not necessarily their spouse), resulting in a total of 70 participants. Two participants dropped out prior to a final testing session (due to illness or insufficient knowledge of the Dutch language) resulting in a total of 68 participants (33 men, 35 women). None of the participants had visited the Archeon theme park before.

7.3.2 Procedure

The experiment consisted of two phases. The first phase (*Archeon visit*) consisted of a journey to Archeon (<http://www.archeon.nl>), a history theme park in the Netherlands. The architectural styles of the areas in this park reflect various periods from the past (i.e. Prehistory, Roman Period and Middle Ages), thus creating a unique setting. The Archeon visit took place while the park was closed for other visitors. In order to approach a true day out, participants were asked to bring somebody else. During this day all participants took part in five handcraft activities each lasting 20 minutes, at five different locations and explained by Archeon-employees in historical costumes. The activities were a) making a fibula - using a

hammer, a pair of nippers and a piece of wood, while the room was smelling of vanilla incense; b) making felt - turning washed sheep's wool into felt while using olive soap, and knotting a felt bracelet; c) making a candle – heating up a wax plate with both hands, rolling it up with a taper in the center and finishing the edges; d) making a rope - with a special tool three thin ropes were twisted into one stronger rope, and e) writing in calligraphy - using a feather and ink while writing in a special ancient typeface, excess ink was removed with sand.

The 68 participants were divided into five subgroups. Each subgroup participated in the activities in the fixed order described above, but each had a different activity to start with. Two experimenters accompanied each group. At the end of the day the experiment leader collected the handcrafted objects. During the first phase no mention of the memory-oriented character of the author's research objectives was made to the participants.

The second phase of the experiment (*test session*) concerned completing two questionnaires. Each questionnaire asked for recall of one of two standardized activities ("making a fibula" and "making felt"), selected after extensive pilot testing. Each participant completed a questionnaire for one of these activities in the presence of one of five recall cues (Object; Picture; Odor; Sound; Video) of the corresponding situation (Cue Condition). The five cue types are shown in Figure 7.1. The questionnaire for the other activity was completed in the absence of any recall cues (No Cue Condition). Order of activities and order of Cue and No-Cue Conditions were counterbalanced. The number of memories recalled of the two questionnaires per participant are later subtracted for the exclusion of individual differences in recollecting and therefore filtering out the effect of the cue on recall. Nine participants were in a control group that had to fill out two No-Cue questionnaires in order to test for order effects.

To approach a real-life situation the participants were tested in the living room of HomeLab, a controlled laboratory environment closely resembling a three-bedroom house, located at the premises of the Philips Research Laboratories Eindhoven. The participants were tested in small groups (max. five participants), from the same Cue Condition. Participants sat at a large living room table, adapted such that they could not see each other or perceive any cues from the others. In the conditions involving audio the participants were told to wear the headphones at all times and keep the volume level fixed, in order to prevent them from hearing other participants' cues. At the end of the session, participants were debriefed and received the objects that they had handcrafted during their Archeon visit.



Fig. 7.1. The five types of cues used in the test session, from left to right: photos, videotapes, objects (felt bracelet and fibula), CDs and jars filled with odors. Each cue type consisted of two instances, one with cues related to the felt-activity and the other one to the fibula-activity.

7.3.3 Materials

7.3.3.1 Recall questionnaires

Free recall was tested by means of questionnaires. Each questionnaire contained a question asking for a complete and detailed description of the event “making felt” or “making a fibula”, using only words. Because the labels of the events fixed the recollections to the Archeon-experience (see below), the “repeated measurements paradigm” from Herz and Schooler (2002) was not applicable. Participants were encouraged to write down anything that came to mind related to the event and to use as much paper as required, without a time limitation. The second question asked for other memories, that were not directly related to the initial event, that came up while answering the previous question (associations). A control group of participants were in the No Cue-No Cue situation.

7.3.3.2 Recall Cues

Five types of cues were used to aid recall, each referring to one of two standardized events (“making felt”; “making a fibula”; see below) that participants engaged in during their earlier visit to the Archeon. Two variants of each cue type were used. Cues were a) the *felt bracelet* and the ancient-design copper-wire safety pin (*fibula*), handcrafted by the participants themselves during the event (Object

Cues); b) a 10- x 15-cm color photo of one of the two activities, showing the activity, the location and the participants (Photo Cues); c) vanilla-incense or olive-soap water in small jars with punctured lids (Odor Cues); d) 20-second audio clips from both events, containing voices, activity-related sounds and background noise, presented through a CD-player and headphones (Sound Cues), and e) 20-second color video clips from both activities (also showing the activity, the location and the participants), presented through a TV, VCR and headphones (Video Cues).

7.3.3.3 Apparatus

The specifications for the devices mentioned above are: a) Sennheiser HD 500 "fusion" headphones, b) - Philips AX 1001 portable CD-players, and c) - Philips NO. 21PV715/39, 21 inch BlackLine color TV-VCR combinations. The devices were provided for each participant individually in the appropriate Cue Conditions (Sound and Video Cues). The viewing distance for the TV was about 1 to 1.5 meter.

7.3.4 Data coding and analysis

The goal of the data analysis was to quantify memory units, which was done by counting the units of Event Specific Knowledge (ESKs). The coding, as described in Chapter 8, involves identifying each ESK by the finite verb, the accompanying subject and object, meaning that in most cases one ESK was represented by one sentence. Since one sentence could contain more details than another it was decided to score each ESK on the number of details or information providing words. Two independent raters scored all questionnaires. Interrater reliability was calculated with Cronbach's Alpha for the number of ESKs to be .97, and for the number of ESK-details .99. More information on this coding method is provided in Chapter 8.

7.4 Results

In order to check for effects of questionnaire order, several 6 (Media type: No Cue; Object; Picture; Odor; Sound; Video) x 2 (Order: Questionnaire 1 vs. Questionnaire 2) Analyses of Variance (ANOVAs) with repeated measures on the last factor were carried out. As for number of ESKs, both the main effect of order and the media type-by-order interaction remained non-significant, $F(1, 62) = 1.4$, $p = .24$ and $F(5, 62) = 0.33$, $p = .90$, respectively. Likewise, the analysis of the number of ESK details did not reveal a significant main effect of order, $F(1, 62) = 0.29$, $p = .59$, nor a significant media type-by-order interaction, $F(5, 62) = 0.43$, $p = .83$. However, analysis of the number of related associations revealed a

significant main effect of order, $F(1, 61) = 4.91, p < .05$, indicating that the second questionnaire contained a lower number of associations than the first one ($m_2 = 3.5, SD_2 = 3.0$ and $m_1 = 4.6, SD_1 = 3.5$, respectively). For associations, the media type by order interaction was non-significant $F(1, 61) = 1.22, p = .31$.

For addressing the question of what cue media type was most effective, the *number of ESKs* and the *number of ESK details* were analyzed by means of 5 (Media type: Object; Picture; Odor; Sound; Video) \times 2 (Condition: Cue vs. No-Cue) ANOVAs with repeated measures on the last factor. These analyses rendered rather similar results: a significant main effect for cuing emerged for both number of ESKs, $F(1, 54) = 4.62, p < .05$, and for number of ESK details, $F(1, 54) = 4.69, p < .05$. Since the number of ESKs and ESK details per ESK were highly correlated ($m = 6.8, SD = 1.0$), independent of the condition, these similar results were to be expected. Contrary to expectation, however, cuing elicited *lower* numbers of ESKs and ESK details than the No-Cue Condition. For both analyses, the media type by cuing interaction remained non-significant, $F(4, 54) = 1.22, p = .31$ and $F(4, 54) = 1.78, p = .15$ for numbers of ESKs and ESK details, respectively. Table 7.1 summarizes the results for the number of ESKs. Per Cue group 11 or 12 participants filled out a Cue and a No-Cue questionnaire.

Table 7.1. Average number of ESKs for the five Cue groups (Object; Photo; Odor; Sound; Video) under No-Cue and Cue Conditions (No Cue; Cue). Standard deviations are in parentheses.

	Object	Photo	Odor	Sound	Video	Average
No Cue	19.88 (7.35)	19.54 (9.36)	21.54 (9.93)	16.82 (8.26)	16.33 (12.94)	18.86 (9.64)
Cue	15.33 (4.56)	17.54 (10.54)	19.67 (11.02)	15.55 (9.01)	17.33 (14.45)	17.11 (10.2)
Average	17.60 (6.56)	18.54 (9.93)	20.60 (10.47)	16.18 (8.63)	16.83 (13.69)	17.98 (9.92)

Because the number of associations differed as a function of questionnaire, the question of cuing effectiveness was addressed by means of a 5 (Media type: Object; Picture; Odor; Sound; Video) \times 2 (Condition: Cue vs. No Cue) \times 2 (Order: Questionnaire 1 vs. Questionnaire 2) ANOVA with repeated measures on the last two factors. No significant effects involving cuing emerged, all F 's < 1.1 .

The participants filled out the questionnaires over a period of 29 to 43 days after their Archeon visit, therefore the correlations between time and the total number of ESKs and time and association-ESKs were calculated, both correlations were negative but not significantly different (ESK: $r = -0.13$, $p = 0.28$; Association-ESKs: $r = -0.07$, $p = 0.58$).

7.5 Discussion

Although the presented study is presumably the first to investigate a real-life event, which compares quantitatively recollections across different media types, it is perhaps also the first to find a negative effect of cues on the number of memories produced compared to a no-cue situation, which was contrary to expectation. Below, possible explanations of this result are discussed.

7.5.1 Cuing Memory Recall

The recall cues which were used in this study were chosen on the basis of unicity, since this appeared to be important, at least for photos (Burt et al., 1995) and for odors (Aggleton and Waskett, 1999). And one cue type, the objects or artefacts which were created during the activity by the participants themselves, where even encoded explicitly, since all the attention was focused on them during the activities (Vaidya and Gabrieli, 2000), which could help cuing later. But since the results showed that there was no significant difference in influence of the different cue types, the specific cues might not be as important as they were expected to be. Of course, one might argue that it is never known which cues correspond to the cues people have in their memories, and they might vary greatly over different people. Although this is a problem for all cuing-experiments, this could only explain the results if all cues were "wrong", which is rather unlikely. It might explain some of the variance among participants or individual differences, though.

For this experiment external memory cues can be divided into two types: experimental and environmental external memory cues. The first type includes the several Cue Conditions that were imposed on the participants. The second memory-cue type stands for the cues which might have been in the environment during the test session, such as the furniture in HomeLab or the presence of other people, including the author. But, although HomeLab was a unique and, for most participants, a new entourage for completing their questionnaires and the author could have been an additional cue, significant differences were found in the Cue and No-Cue Condition of the within-subject design. Therefore, it can be concluded

that the effect of the experimental memory cues at least surpassed the effect of environmental cues, if the latter were present at all.

If the participants did not pay attention during the test session to the first type of external cues, one would expect to find no difference in memory recall between the Cue and the No-Cue Condition. This was not the case. Therefore, one can conclude that external cues do have an effect on the number of recollections retrieved, namely an inhibiting one. This means that the recall process was influenced by external memory, where the external memory consisted solely of the cues offered to the participants. It might be concluded that internal memory results in a higher number of ESKs recalled than external memory or a combination of internal and external memory.

Contrary to results from other studies (see Section 3.2.6.1) no increase in recall was found for photo or object cues and no increase in the number of details for the odor cues. A general effect of cues (no matter which instantiation or media type) was found that appeared to be a filtering one. Since cues restrict the number of memories recalled compared to the No-Cue Condition, it is hypothesized that more information presented (in the form of cues) leads to more constraints on the internal memory search of the iterative retrieval process as suggested by Conway and Pleydell-Pearce (2000). Another way of explaining this is to state that cues make people focus on their perception of the cues. Only one other study known to the author mentions a selective search strategy, namely Chu and Downes (2002). They used this statement to explain why their participants produced fewer sentences in the visual-cue condition compared to the text-cue condition. Perhaps an interesting future direction would be to check whether text imageability (Williams et al., 1999) has an influence on these results. Williams et al. show that for word-cues their imageability predicts the memory specificity, which means the easier it is to imagine a picture in your head of the presented word cue, the more specific the memory will be that pops up. So the research question would then be: how does word-cue imageability relate to the experiments mentioned above where photos retrieve less memories than text?

Earlier studies with real-life events concerned cuing children with photos or artefacts (Hudson and Fivush, 1991, Pipe and Wilson, 1994, and Gee and Pipe, 1995). Contrary to our results these three studies found a positive effect of cuing on memory recall, compared to the No-Cue Condition in which the children were asked to recall this specific event. The participants in these experiments were all engaged in a unique activity like in the study presented in this chapter.

(Engelkamp, 1998, showed that memory for performed tasks is better than for observed tasks and Gee and Pipe, 1995, showed that a participatory role is more beneficial for cuing memories with objects than an observer role). A difference that could be responsible for the inconsistent results is the much higher age of the participants in the present study (the average age in this study is approximately 40 years, ranging from 17 to 71). Perhaps children are less susceptible to free recall without cues, since it requires a more active memory search, which might benefit from experience, and they might rehearse less than adults. This less-susceptible-to-free-recall explanation might also hold for old participants, because evidence indicates that aging is often associated with inefficient conceptual processing and not with inefficient perceptual processing (Sauzeon et al., 2000). In addition, although the cue-experiment of Sauzeon et al. was different from the one presented in this thesis (in their study, word cues were used in order to remember a list of words, compared to photos, objects, odors, audio or video in order to remember an event) it was found that middle-old (50-69 years) and old (70-89 years) participants benefited more from cues than young (20-39 years) adults (Sauzeon et al., 2000). Young adults (their mean age was 19) also participated in a recent study by Chu et al. (2003), who found no effect of odor or visual cuing on the recall of three real-life activities. Thus children and older people might benefit more from memory cues than adults, which could explain why other studies have found positive effects of cuing with physical objects and photos.

It should be noted that the participants only recalled 18 ESKs per free-recall question, which was a lower number than expected. The author could easily come up with at least a ten-fold of ESKs when answering the same free-recall question as the participants had done. Simon Chu (personal communication) also found that his participants produced less information than he had expected. But of course, in both cases the participants were unaware of the research topic, which might have played a role.

7.5.2 Theoretical Implication

The main result from this study: the No-Cue Condition generates significantly more ESKs than the Cue Condition, might give some more information on the encoding specificity principle. This principle states that environmental cues that match information encoded in a stored event can cue recollection of the complete memory. This still holds but perhaps the completeness of the memories can vary over the different types of cues. For example this chapter showed that textual cues

(the No-Cue Condition) generate more complete memories than photographs, odors, sounds, videos or physical objects.

7.5.3 Experimental Procedure

The choice to let the participants write down their memories, instead of telling them to the experimenter, was based on our assumption that it is hard to interview people without giving (conscious or unconscious) cues to them. It is known that speakers continuously receive feedback from listeners (Eysenck and Keane, 2000), e.g., the expression of a face or other body language of the experimenter might encourage or discourage the speaker to add information or to change the topic. In addition, literature shows that writing is more deliberate and spoken messages are more redundant, the latter meaning that more repetitions and unfinished sentences occur (Horowitz and Newman, 1964).

A consequence of writing down memories is that people can make drawings, therefore the questionnaire instruction was “only to use words” while answering the questions. Still 17.6% of all questionnaires contained mostly one drawing or sometimes more. Most of the drawings were found in the condition “making a fibula” (14.7%) and only a few in the condition “making felt” (2.9%). Presumably, the reason is that “making a fibula” included more distinct steps and complex actions compared to “making felt”.

Since this study focused on the everyday use of autobiographical memories and encouraged people to share their life stories or to process past events, the author was not interested in the validity of the recollections, in contrast to most of the example studies mentioned in Section 3.2.6.1. However, since a real-life event was organized for the present study where the organizers were present, the participants were aware of the possibility to check for validity, which presumably suppressed potential inclinations for confabulations. In addition, the author, who was present during the event, read all the accounts afterwards and did not come across clear confabulations. Therefore it might be concluded that the results of this study are based on the actual memories of this real-life event.

7.6 Conclusions

The encoding specificity principle and several other studies (see Section 3.2.6 and 7.2) predict and show a positive cuing effect on memory recall. However, the main result from this study shows that the No-Cue Condition for the recall of a real-life event generated significantly more Event-Specific Knowledge compared to any of the Cue Conditions (Object, Picture, Odor, Sound and Video). In order to

explain this result, it is hypothesized that cues might have a filtering effect on the internal memory search resulting in fewer memories recalled with a cue compared to the No-Cue Condition.

8 A Quantitative Method for Counting Recollections in Written Accounts

8.1 Abstract

A method was developed in order to analyze the number of recollections in written free accounts. This method focuses on Event-Specific Knowledge (Conway and Pleydell-Pearce, 2000). Because currently no clear workable definition of ESK exists it was tried to identify them based on grammar, thereby avoiding interpretation of the accounts. And although the method is based on Dutch grammar, it is believed that the main structure and background of the method will also hold for other languages. In addition to identifying individual ESKs, the number of details contained in each ESK was counted and a general ESK-type was identified (either describing perception, reflection, state, action or object). This method does not judge the validity of the recollections.

The validity of the method was evaluated by letting two independent persons each score 114 written accounts from the cuing study of Chapter 7. Since the interrater reliability of the two independent scorers were high (.97 for ESKs and .99 for ESK-details), it is concluded that this method is an objective and reliable measure for a quantitative analysis of written accounts.

8.2 Introduction

Comparing written accounts from different people describing their memories is not an easy task. Because even if these people participated in the same event, they can write about completely different topics or issues, depending on what they remember at that point in time. Comparing accounts quantitatively over different events is even more complicated. Still, developing a quantitative method for the analysis of written accounts is important for research on Autobiographical Memory, since it makes it possible to compare recollections from different people in different experimental conditions.

This chapter describes the development and the result of such a method which was developed in order to analyze free recall accounts resulting from the study, described in detail in Chapter 7. The aim of this study was to test the effects of different types of recall cues (photos, objects, smells, sounds and videos) on the recollections of a unique event.

Most studies performed to compare recollections from different people or different conditions focus on the validity of the memories, e.g., by asking questions about facts and checking whether the answers are “right” or “wrong” (e.g., Wagenaar, 1986, Gee and Pipe, 1995, Aggleton and Waskett, 1999). Other studies focus on other aspects than the content of the memories, e.g., the vividness or emotionality of the recollection (e.g., Rubin et al., 1984, Herz and Schooler, 2002).

For this chapter the focus is on six existing methods for the analysis of free recall accounts. They will be described in order of increasing complexity. The first coding procedure for Autobiographical Memory cued recall is described by Chu and Downes (2002). They transcribed spoken responses and used *single sentences* as the unit of analysis. If sentences were long they were split up in more units when it seemed appropriate. For this study a double-cuing methodology was used, which means that twice the participant was asked for free recall of a specific event, where the first time no cue was present and the second time a cue was present, in this case an odor. Later, the first free-recall accounts were used as a measure for verbosity and for the second accounts the sentences were scored on the content being either old, meaning it was mentioned before, or new. The focus of this method was on a quantitative measure of the number of new sentences produced in three minutes of free-recall speech after the second cue, while checking the validity of the utterances. This procedure is not explained in detail in the paper.

The second method categorizes remarks. Pipe and Wilson (1994) asked children to freely recall a specific activity in which they had participated. After transcribing the interviews the statements were first checked for validity and later content-wise coded for the following “valid” categories: people, actions, objects, the context of

the event, the accident (part of the activity the children took part in) and the “error” categories: distortions (based on actions that did occur but were changed), intrusions (based on actions that did not occur) and object errors. The same method was used by Murachver et al. (1996) but with two additions: 1- they added the category “generalizations”, which was used when one utterance contained several actions or objects, and 2 – they checked whether the order of the utterances corresponded to the original order of the activity’s events. The children were not specifically asked to recall in the “correct” order.

The next and more precise method, by Hudson and Fivush (1991), contained one additional coding rule compared to the previous two examples. That is, it started with the basic coding unit, which they called a “proposition”. A proposition was defined as a statement containing an argument and a predicate. After the propositions were identified in the transcribed speech accounts, they were analyzed based on the content. The “valid” propositions were coded as either an act (action), description (of the environment) or elaboration (repetitions including supplementary information) and the “error” propositions as intrusions (based on actions that did not occur). The following free-recall account method was the only method that involved written free-recall accounts and that did not involve checking for validity. Brown and Kulik (1977) studied Flashbulb Memories and personal shocks and asked their participants to write down their free-recall accounts. They analyzed the stories by counting the total number of words as an objective measure on elaboration and by coding the content into the following categories: place, ongoing event, informant, affect in others, own affect, and aftermath. Event and person were added for the personal shock stories, they were both used as cues for the Flashbulb Memories.

Poole and White (1993) used Syntactic Units (SU) in their method analyzing narrative responses. They defined an SU as the words that describe either an actor (*he*), an action (*took*), a direct object (*a pen*), physical traits (*he is tall*), qualifiers (*he is not very tall*), prepositional phrases (*in the chair*), temporal information (*then*) or quotes from the encoding event, where each of those categories is counted as one single unit. In addition to the category, the words were also marked as accurate, inaccurate or uncertain. The interrater agreements for these three judgment categories were, respectively, 84%, 81% and 87%.

The method described in this chapter was developed in order to compare different free-recall accounts quantitatively and did not check any of the recall accounts for validity, making the error and generalization categories by Pipe and Wilson, Murachver et al. and Hudson and Fivush superfluous. The content of the accounts

was checked for the following categories: actions, objects and context, and, in addition, perceptions and reflections. The latter two types were added, since together those five categories were assumed to cover the majority of utterances. Location was not used as a coding category because in the cuing-study this was the primary recall cue ("making felt at Archeon" or "making a fibula at Archeon"). The objective measure from Brown and Kulik (1977) was used which is counting the total number of words per free recall, but since this is rather straightforward it will not be elaborated in this chapter.

Another method, using so-called Syntactic Units (Poole and White, 1993), was also based on content and therefore not useful for analyzing free-recall accounts. The method developed in this chapter is rather similar to these Syntactic Units (on the detail-level) however it is not based on content but on grammar, which makes it possible to quantitatively compare free-recall accounts of different events.

The intention for the coding method was to be able to quantify memories objectively in free-recall accounts. Therefore the specificity theory of Conway and Pleydell-Pearce (2000) was applied. This theory describes three hierarchical levels in Autobiographical Memory, namely: 1 - lifetime periods, spanning years of one's life, 2 – general events, which recur over a time span of days or months, and 3 – Event-Specific Knowledge (ESK), lasting seconds or at most hours. ESKs are the details in recollections, the lowest level of specificity and suitable for counting free-recall accounts of a one-day unique event. Therefore it was decided to make ESKs the starting point of the method.

8.3 Method

8.3.1 Test study

The method was developed in order to analyze the free-recall accounts resulting from the study described in more detail in Chapter 7. The aim of the study was to find out which modality (Object; Picture; Smell; Sound; Video) was most efficient in cuing one-month old recollections of a real-life event. The results are used for the design of a digital device which can support reminiscing in the home environment (see Chapter 10).

For the first phase of the experiment 68 participants joined in a company outing. During this event the participants had to take part in five unique activities of 20 minutes each. Two of these activities ("making felt" and "making a fibula") were used to test free recall in the second phase of the experiment, which concerned completing two questionnaires. Each participant completed one questionnaire for

one of these two activities in the presence of one of five recall cues (Object; Picture; Smell; Sound; Video) (Cue Condition). The questionnaire for the other activity was completed in the absence of any recall cues (No-Cue Condition). The first question of all questionnaires asked for a complete and detailed description, using only words, of the events "making felt" or "making a fibula" (*free-recall account*). Participants were encouraged to write down anything that came to mind, to use as much paper as required, and to take as much time as needed.

8.3.2 Data Coding

The objective of the test-study was to find out the influence of cues on recall of personal recollections in a social setting, therefore the validity of the recollections were not of interest. It is possible that a person recalling memories consciously or unconsciously alters the truth but that is his/her responsibility. Because the method should be an objective and quantitative one, it was decided not to interpret the contents of the written accounts in detail and therefore the method was based on grammar. In this specific situation the texts were in Dutch and thus the method was based on Dutch grammar, but it is believed that the main structure and background of the method would also hold for other languages.

For comparing free recall accounts one should identify a grammar-based unit which serves as the starting point of the analysis. This countable unit originated from the theoretical concept of Event-Specific Knowledge (ESKs), and on this ESK-concept the method is based, which consists of three phases. The *first phase* concerns identifying an ESK, the *second phase* involves counting the details within the identified ESK and in the *third phase* the general content of the ESK is categorized.

Because it should be possible afterwards to check the analyzed texts a special notation was chosen for each of the phases. The raters had to use red or green ink for that because it can easily be distinguished from blue (original accounts) or black text (photocopies).

Each sentence of the written accounts is analyzed according to the three phases that will be described in detail below. The *first phase* of the method starts with reading the sentence and checking whether it contains a description of a memory. If a sentence is clearly describing something else than a memory, it was not counted as an ESK. For example, the words "I am not so sure about that" refer to the previous sentence, but is no actual recollection of the activity "making felt" or "making a fibula". If in doubt the sentence was counted. The same holds for repetitions, if two sentences were exactly the same and following each other, one of them was not counted. In the material evaluated, repetitions did not occur, and

non-memory remarks were made only in a small number of cases. When it is decided that the sentence contains a description of a memory one starts identifying the ESK by the finite verb ("persoonsvorm" in Dutch), the accompanying subject ("onderwerp") and (direct or indirect) object ("lijdend / oorzakelijk of belanghebbend voorwerp") in the sentence. This means that in most cases one ESK is represented by one sentence, although sometimes two sentences form one ESK or one sentence forms two ESKs, depending on the number of finite verbs. Often a sentence with more than one ESK is easily recognized by conjunctions ("voegwoord"). The chosen notation for identified ESKs uses green square brackets at the beginning "[" and at the end "]" of the ESK.

Since one ESK can contain many more details than another, while both are counted as one memory unit, it was decided to score each ESK on the number of ESK-details. This was implemented in the *second phase* by counting the number of information-providing words with the help of a custom-made document containing a list of counting instructions and examples for diverse words and sentence structures. This document was given to the raters as a work of reference for the ESK-detail counting rules. The author does not claim that this list is exhaustive or according to linguistics standards, nevertheless it is useful and complete enough for the method described in this chapter.

In short, counting ESK-details in the *second phase* starts as follows: The finite verb (even if it is forgotten, which rarely occurs) and subject are always counted as one detail each. Articles ("lidwoord") are never counted and most other words are counted as one detail. There are some exceptions for the remaining words, though. In Dutch compound ("samengesteld"), reflexive ("wederkerend"), progressive ("duratief") and perfective verbs ("perfectief werkwoord") can consist of two words but are counted as one detail. Inchoative verbs ("inchoatief werkwoord", e.g., "de soldaten sloegen aan het muijen") can contain four words and are counted as two. Modal verbs ("modaal hulpwerkwoord") are counted, whereas auxiliary verbs ("hulpwerkwoord") are not. Since diminutives ("verkleinwoord"), which means adding a few letters to the end of a noun, are often used in Dutch spoken language, and therefore also in the accounts, they were not counted as extra details. In order for the method to be clear and not too complicated it was decided that both coordinating and subordinating conjunctions ("nevenschikkend en onderschikkend voegwoord") were not counted. Relative pronouns ("betrekkelijk voornaamwoord") were not counted when they referred to words in the same sentence (without adding information). On the other hand, when they referred to the previous sentence (which does add information) they were counted as one detail. Demonstrative adjectives and demonstrative pronouns ("aanwijzend

voornaamwoord, respectievelijk bijvoeglijk en zelfstandig gebruikt") are counted. Adverbs ("bijwoord") are counted as one detail and prenominal adverbs ("voornaamwoordelijk bijwoord") (junctions of several adverbs in Dutch) are counted as two details. Adjectives ("bijvoeglijk naamwoord") and nouns ("zelfstandig naamwoord") are mostly counted as one detail unless the word was a junction of two information adding words that could also be used as two separate words, then it was counted as two details. The final category contained a number of expressions, which could be replaced by one word and therefore had to be counted as one. The notation for the ESK-details concerned numbers between angle brackets behind the word counted, in red. E.g., "[I <1> used <2> an old <3> hammer <4>.]

In the *third phase* of the method each ESK had to be categorized. The rationale for this was to check for effects of cues on the general content of recollections, without interpreting the accounts or the validity. Based on suggestions by Martin Conway (personal communication) the following types were made up that could be useful descriptors of ESK-information: a) perceptual information, describing the senses, e.g., "there was a strange smell in the room" (Perception-Specific Knowledge, PSK); b) reflection, opinion, or emotion-related information, e.g., "I was thinking to myself..." (RSK); c) status information on the situation or the environment, e.g., "the room looked ancient" (SSK); d) action information, e.g., "he bent the copper wire" (ASK), and e) object information, e.g., "the fibula consists of two parts" (OSK). Since some ESKs could contain more than one ESK-type, a hierarchical order was determined based on assumed occurrences (e.g., the PSK was anticipated to be mentioned less often than the RSK, based on the pilot accounts). The OSK is in any case an exception compared to the other types, since the test study contained activities ("making felt" and "making a fibula") during which the participants had to create physical objects, therefore biasing this type of SK. To prevent this bias from influencing the results for the other specific-knowledge types a hierarchy was made, based on assumed increasing frequency, in which first one checked for a PSK, presumably the type with the lowest probability. If the ESK-type was not a PSK one continued to check for an RSK, then an SSK, followed by an ASK and finally for an OSK. For the notation during the free-recall analysis, the identified knowledge types were written in red on the accounts above the corresponding ESK. In Table 8.1 a part of one of the coded accounts is shown as an example.

All accounts were made anonymous and scored by two independent raters, who were trained for about 10 hours each on pilot experiment accounts. The raters had

to return all totals (ESKs, ESK-details and ESK-types per account) and the annotated accounts to the author. The latter counted the number of words for each free-recall account as an objective measure (similar to Brown and Kulik, 1977), this measure also includes the remarks which were not counted as ESKs.

Table 8.1. An example of coded text according to the method described in this chapter (column 1). In column 2 the Dutch text is translated into English and in the last column the total number of ESKs, ESK-details ESK-types and words counted in the text are given.

Original Dutch account	Translated text into English	Notation in Dutch account by rater	Scores
In het gebouwtje liepen we door naar achteren, waar we in een nogal rokerige en warme ruimte kwamen met een open haard.	We walked to the back of the building, where we came in quite a smoky and warm room with a fireplace.	[In <1> het gebouwtje <2> liepen <3> we <4> door <5> naar <6> achteren <7>], [waar we <1> in <2> een nogal <3> rokerige <4> en warme <5> ruimte <6> kwamen <7> met <8> een open <9> haard <10>].	ESK = 2 ESK-details = (7 + 10) 17 ESK-types = 2 ASKs words = 22

8.4 Results

The evaluation of the method described in this chapter was based on the study that is explained in detail in Chapter 7. Two raters rated 114 free-recall accounts from this study, in order to calculate the interrater reliability for each of the three phases of the method. For an overview on the descriptive statistics of an average account, see Table 8.2. This table shows that an average account contained 164 words, 18.5 ESKs and 127.1 ESK-details. These 18.5 ESKs can be subdivided into 0.5 PSKs, 1.6 RSKs, 3.9 SSKs, 11.3 ASKs and 1.2 OSKs.

The interrater reliability for the number of ESKs was .97 and for the number of ESK-details .99. The ESK-types identified per free-recall account were mostly ASKs.

8.5 Discussion

The main conclusion from evaluating the new method presented in this chapter is that raters can objectively quantify the number of ESKs and ESK-details in free-recall written accounts. This means that a workable definition of Event-Specific Knowledge has been found. In addition to the first two phases of the method, the ESKs and ESK-details, there was a third phase, subdividing the ESKs into different categories, namely: perception, reflection, state, action and object specific knowledge. The value of this third phase could not really be evaluated, since the test-study's accounts focused on one ESK-type only, leading to 61% of ASKs. It has to be shown in different experimental settings whether these distinctions are useful for psychological research, especially the State Specific Knowledge (SSK), since Pipe and Wilson (1994) found that very few statements in free recall related to context.

Table 8.2. The average numbers per account (column 2) and interrater reliability (column 3) of ESKs (row 2), the number of ESK-details (row 3), the numbers for each SK-type (row 4-8), and the number of words (row 1). The numbers between parentheses (in column 2) show the minimum and maximum number counted.

	Average number N (min, max)	Interrater reliability
words	164 (22, 455)	N.A.
ESKs	18.5 (3, 50)	0.97
ESK-details	127.1 (18, 340)	0.99
PSK	0.5 (0, 4)	0.78
RSK	1.6 (0, 9.5)	0.84
SSK	3.9 (0, 14.5)	0.76
ASK	11.3 (0, 28.5)	0.90
OSK	1.2 (0, 5.5)	0.49

Comparing the results recapitulated above with results from former studies is difficult, since only one study can be more or less compared with this method, namely Brown and Kulik's (1977). The other studies either did not have specific rules which can be compared or they focused too much on validity which made their categories incomparable with the ones used in this chapter, such as the categories errors and generalizations. Brown and Kulik's method, on the other hand, did not check for ESKs or ESK-details, but it did organize written accounts

into useful content categories for their topic of Flashbulb Memories, such as place and informant. Their interrater agreements were high, namely 90%, but not as high as the ones for this method. This lower value might be due to the fact that they did not work out in detail which unit would be used for the categorization, such as our ESK. In general, one can say that the method described in this chapter is the most precise and detailed one known to the author for quantitatively counting ESKs in written free-recall accounts, which also yields high interrater reliability scores. The raters had a maximum of ten hours of training before starting evaluating the test study accounts, which includes an explanation, reading of the accompanying documents and trying out the method on pilot accounts. After this training the method is rather straightforward and quick to use, because it took the raters an average of five to ten minutes per account.

8.6 Conclusions

In this chapter a method is presented for objectively quantifying recollections, instantiated by Event-Specific Knowledge (Conway and Pleydell-Pearce, 2000), in written free-recall accounts, without checking the validity. The high interrater reliability (.97 and .99) shows that after about 10 hours of training individual raters can objectively count ESKs (phase 1) and the number of details in each ESK (phase 2).

9 Are the Archeon Artefacts Souvenirs?

9.1 Introduction

The results of the Chapter 7 showed that the physical objects created by the participants during two distinct events, “making a fibula” and “making felt” in the Archeon, did not cue more memories than other types of cues, and more importantly the No-Cue Condition did significantly better than all Cue Conditions, including the object-condition. From Chapter 4, it was concluded that souvenirs, defined as: “physical objects to which memories are attached”, can be used as external memory. Therefore the question arises: are the physical objects or artefacts created in the Archeon seen as souvenirs by the participants who created them? If the answer is negative, then it could be argued that ordinary artefacts from a specific event do not recall more memories than any other type of cue. On the other hand, if the answer is positive, the results from Chapter 7 are convincingly showing that even external memory cues, such as souvenirs, cannot generate as many memories as the No-Cue Condition. Such an outcome would make it probable that internal memory has more influence on the number of ESKs recalled than external memory.

9.2 Methodology

In order to answer the question mentioned above, all participants of the cuing study in Chapter 7 received a questionnaire via e-mail. There were two reasons for choosing a questionnaire as the most appropriate format to gather the information,

first because the questions were straightforward and mostly multiple-choice (see below for the actual questions), signifying that there was no need for additional explanations or other human support. The second reason was that an anonymous questionnaire allowed for more truthful answers compared to e.g., interview situations in which people might be reserved if they suspected their answers were not what the interviewer wanted to hear.

9.2.1 Participants

About one year and three months after the Archeon-visit e-mails were sent to 66 people, who joined in the cuing-study, asking them to fill out these questionnaires. Thirty participants (15 men, 15 women) returned their questionnaires. The dates on which those questionnaires were completed ranged over a period of one month, on average one year and five months since the Archeon event. The average age of the participants was 40 years at the time of completing the questionnaires.

9.2.2 Archeon Souvenir Questionnaires

The questionnaires started with a short instruction defining a souvenir as “a physical object to which memories are attached”. In addition to the instruction, the questionnaire contained seven questions (see Appendix 6), one open question asking for “the souvenir of the Archeon visit” (Archeon Souvenir Question 1, ASQ 1) and six multiple-choice questions on whether the fibula (ASQ 2) and felt bracelet (ASQ 5) were still in the participants’ possession (yes, no, or I don’t know), if yes, where it was located (living room, bed room, study, attic, somewhere else in the home, somewhere else outside the home, or I don’t know, ASQ 3 and 6) and whether they saw those artefacts as souvenirs (yes or no, ASQ 4 and 7). The answers to those questions are reported below.

9.3 Results

The first question (ASQ 1) concerned what the participant thought was “the souvenir of the Archeon visit”. Table 9.1 shows the choices of the 24 people that answered this open question. In the first column five objects are mentioned which were all created during that Archeon visit, namely the fibula, felt, candle, calligraphy and rope. In addition, two people mentioned they did not have one specific souvenir of the Archeon visit and five people mentioned other things than the artefacts created during that day, namely photos they took or the memories they had. Strikingly, only female participants mentioned the felt objects and the

candles were mentioned exclusively by male participants. But still the majority of the participants chose the fibula as their souvenir of that day (46%).

When asked whether the participant still possessed his or her personal self-made fibula (ASQ 2) and if yes, where it was located (ASQ 3), 47% of the participants agreed to the first question, 20% did not keep their fibulas and 33% did not know where they currently were. Of the 47% who still possessed their fibulas, most people kept them in their living rooms (57%), and their studies (21%).

Table 9.1. The artefacts created at the Archeon which are chosen to be the souvenir of the day.

Objects	Participants' choice	
	(%)	(n)
Fibula	46	11
Candle	17	4
Felt	8	2
Calligraphy	0	0
Rope	0	0
No souvenir	8	2
Other	21 (13 = photos, 8 = memories)	5 (3 = photos, 2 = memories)

The same questions but then concerning the felt bracelet generated quite different numbers since only seven people (23%) still possessed it, 57% did not and 20% did not know (ASQ 5). Of those seven people three kept it in the living room (43%) and one in the study (14%) (ASQ 6).

The last two questions asked the participants whether they thought their fibula (ASQ 4) or felt bracelet (ASQ 7) was a souvenir to them. 69% (n = 18) agreed for the fibula and 54% (n = 14) for the felt bracelet. 50% of the participants saw both the artefacts used as cues with the questionnaires in HomeLab (see Chapter 7) as souvenirs, and 27% thought neither the fibula nor the felt bracelet were souvenirs to them.

Four of the 30 participants gave inconsistent answers because they chose in the open question either the fibula or felt as “the souvenir of Archeon” and when asked specifically they answered neither the fibula nor the felt was a souvenir to

them. Because of this unclarity those four people were excluded from this part of the results.

It should be remarked that the status of these objects might have changed over time. It is possible that they were not seen as souvenirs at the time of completing the cuing-study questionnaires (see Chapter 7), but once they regained their artefacts (after completing those questionnaires) they might have become souvenirs after all. Despite the uncertainty on this process of physical objects becoming souvenirs it is clear that taking away the objects from the participants for five weeks did not prevent them from becoming souvenirs in the end.

9.4 Conclusions

The main question of the questionnaires described in this chapter was “are the fibula and felt bracelet souvenirs to the participants”, where a souvenir was defined as “a physical object to which memories are attached”. That the fibula and felt objects were self-made by the participants was clearly no problem for these objects to become souvenirs to their owners (also supported by SQ 18 in Chapter 4), since 71% of the participants that returned the questionnaire chose one of the objects created at Archeon as *the* souvenir of the visit. This is in agreement with Csikszentmihalyi and Rochberg-Halton (1981), since they mention the self-made souvenir category in their different types of souvenirs. The answer to the above-mentioned question was that for 69% of the participants that returned the questionnaire the fibula was a souvenir of the Archeon visit, and the felt bracelet for 54%, approximately one year and five months after the Archeon visit. Because of the anonymity of the Archeon souvenir-questionnaire participants it is not known which of those participants, who completed the cuing-study questionnaires, were in the object condition during the cuing study. But there appeared to be no difference in the number of memories recalled in the cuing questionnaires about the making-felt activity compared to the making-a-fibula activity (Felt: $m = 18.15$, $SD = 1.20$, Fibula: $m = 18.94$, $SD = 1.14$). This means that the two artefacts in the experiment had the same memory-recall capacity, despite the slight favor of the participants for the fibula as a souvenir (69%), compared to the felt bracelet (54%).

In conclusion, the question “are the fibula and felt bracelet souvenirs to the participants” is answered slightly positive, indicating that for at least half of the participants both artefacts used as cues in the recollection-cuing study are seen as

souvenirs. This means that the results from Chapter 7 show that even souvenirs, as external memory cues, cannot generate as many memories as the No-Cue Condition.

SECTION V – DESIGN GUIDE

The last section of this thesis is a guide for designers of a future Recollection-Supporting Device. Chapter 10 gives an overview of the guidelines found in literature and the design-relevant knowledge acquired during this project as described in the previous sections of this thesis, namely the souvenir study (Section II), the design of a Digital Photo Browser (Section III) and recollection research (Section IV). In addition to these requirements Chapter 10 concludes with a discussion of possible future directions inspired by insights gained from the research described in this thesis.

10 Design Recommendations for a future Recollection- Supporting Device

10.1 Introduction

This chapter aims to serve as a guide for designers of a future Recollection-Supporting Device (RSD). Initially the project plan was to create and evaluate a prototype of an RSD and describe the process and outcome in this thesis. But during the course of this project it became clear that a choice had to be made between gathering more of the missing information or start building an RSD without it. It was decided to acquire more information that could guide the work of a future RSD designer. This chapter first reviews a number of studies that have investigated devices for recollection support. On the one hand, these studies serve as a source of inspiration for future work on recollection-supporting devices. On the other hand, they sometimes give concrete design recommendation towards the development of such devices.

The second part of this chapter summarizes the main lessons learned from the work described in this thesis. These lessons learned are presented as design recommendations. This chapter ends with a discussion of directions for future research in the area of recollecting memories in everyday life.

10.2 Literature

In Chapter 2, examples taken from everyday life were presented. Chapter 3 reviewed literature on digital photos, mainly focusing on PC-based systems. Chapter 5 extended this literature review with a discussion of studies that tried to move away from the “lean-forward” mode of a desktop computing. In this section, the literature overview is completed by reviewing studies that extended the investigated problem space from photo browsing to memory browsing.

The relevant literature on devices or ways to help people recollect memories can be divided into four groups: 1 – recording life, 2 – reminding tasks, 3 – creating cues, and 4 – recollection-supporting devices (which can also include recording life and creating cues). The studies discussed within these categories can inspire future work on recollection-supporting devices. As will be shown some even formulate recommendations for designing such devices.

10.2.1 Recording Life

Recording a person’s life can be the start of recollecting memories, because when the recordings are later re-experienced they can cue the viewer. The projects mentioned below do not focus on cuing memories, but more on other aspects of having a database of facts, such as looking up appointments. The process of recording life is made possible with an automatic and, in these cases, electronic “diary”, such as the Shadow project proposal (Atkeson, 1995) and the Familiar (Clarkson et al., 2001). Both systems contain sensors, cameras and microphones, that try to record everything the user perceives or experiences. The aim of these two projects is dissimilar. The Shadow aims at reminding and giving advice to the user while the Familiar aims at learning to record the right event in the multimedia diary. A similar study was done for the workspace (Ikei et al., 2003), making use of cameras, sensors, displays and RFID-tags, where specific activities with objects are recorded and replayed in order to make the user learn the location of that object. This project aims at extending human memory by recording events that are later shown to the user. The Forget-me-not device (Lamming and Flynn, 1994) automatically records several types of office behavior, such as meeting people, using the PC and making telephone calls. The user decides to look through the stored events later on a portable device, when she tries to remember a name of a colleague or the location of a document.

The “Lifelog” project (Gage, n.d.) funded by DARPA (a research funding institute of the US Ministry of Defense) goes a step further, because the project owners are planning not only to use cameras, body sensors and microphones, but also credit card information, e-mail messages, phone conversations, internet activities,

newspaper subscriptions and so on. Eventually Lifelog wants to create software to analyze human behavior and habits. A project similar to Lifelog is called "Memories for life" (Fitzgibbon and Reiter, 2003), which is seen as a Grand Challenge in Computing in the UK. Currently, the Memories for life project proposal includes several subprojects addressing topics like analyzing stored memories and creating stories out of them, or "newpaper": smart, electronic paper for memory input or a prompting aid for elderly with Short-Term Memory problems. One group of people already implemented some of the above-mentioned ideas. Starner et al. (1997) created a Remembrance Agent which is a text-based augmented-reality system. This agent is fed by a database of information recorded by means of wearable computing that is partly integrated in special glasses and partly in special clothing. The wearable computing system contains video cameras that record audio and video continuously and that can perform face recognition. In addition, sensors detect location and body responses of the wearer. The Remembrance Agent can be addressed by typing in commands and the agent will search in the database for relevant items and display one line with a suggestion on the inside of the glasses. This agent will also make suggestions when the wearer is typing in an e-mail message or when working on a paper. Starner et al. would like communities to arise in which many Remembrance Agents are present that can share their knowledge to any community member. This means that there is no privacy, which is important for recollecting personal memories.

In addition to these projects, in which recordings of memories are made automatically without user control, there are also projects in which the user can decide what to record and what not. The very first ideas were already written down by Bush (1945) who proposed the "memex" (p. 14): "a memex is a device in which an individual stores all his books, records, and communications, and which is mechanized so that it may be consulted with exceeding speed and flexibility. It is an enlarged intimate supplement to his memory". In the context of the theoretical framework of this thesis, this memex concept can be seen as an early example of external memory. According to Bush this memex looks like an ordinary desk. A more recent description of such an idea is called "The Teddy" (2002). The Teddy is a small portable device that each individual carries around his whole life. This device can record anything and the interaction necessary for retrieval, of e.g., telephone numbers, ID-numbers, or bank accounts, goes via speech recognition. The previous two examples consisted of ideas, while the following projects were more or less implemented to record a part of a person's life. The Memory Box (Cole et al., n.d.) can record two specific physical experiences by means of a

playful interaction with either a tube filled with tilt sensors or a soft object with bend and pressure sensors. When these two objects are touched the interaction is “painted” with a brush that can move mechanically over a piece of canvas, which is visible to the user. Another project (Fleck et al., 2002a,b) is situated in a science museum and the benefit for the user is that she can decide which information offered in this museum she wants to have access to later. The user gets a portable PDA or an RFID card (both with the same functionality), that can be used to select interesting exhibits. When doing so four photos are shot from the user at the specific stand. When the user leaves the museum she receives a fridge magnet with a unique URL, that links to a website with all the personally requested information and the photos. The MyLifeBits Project (2003) by Microsoft is aimed at providing software for people who record their own life by collecting all personal documents and media online. In the near future such software could be the basis for a Recollection-Supporting Device.

10.2.2 Reminding Tasks

Reminding people of tasks concerns prospective memory (see Section 3.2.2), which helps people remember things they have to do. A well-known example is a knot tied in a handkerchief. Examples of investigations in this area include the MemoClip (Beigl, 2000): a pin worn by the user reminds of a location-based task when this user walks into a specific area. Another example is the CybreMinder (Dey and Abowd, 2000), a system using location sensors, cameras and speech recognition, which reminds users of specific conditions, e.g., to take an umbrella when going outside if it is both cloudy and the car is in use by someone else. Memory Glasses (DeVaul et al., n.d.) go along with a jacket full of computing, sensing and a speech recognition system. Reminders, depending on the context, are projected on the inside of the glasses.

The above-mentioned projects all ask from the users to insert their list of things they want to be reminded of and later the reminders are forced upon the users.

10.2.3 Creating Cues

People use memory cues to help them remember (see Section 3.2.5). Two projects focused on the creation of such cues, both implicit and explicit. The first study created a history-of-use of digital objects (Schütte, 1998), where the traces of usage could help people remember what happened to the object. The second study (Harman, 2001) used software to recreate a mnemonic device. The idea behind this Memory Palace is that it helps people recall if they imagine their to-be-learned

material in a mentally created house. Later when they recollect with this place in mind the mental images of the rooms are used as cues to help recall.

10.2.4 Recollection-Supporting Devices

Several studies worked on devices or objects to help people recollect their autobiographical memories. Some of them remain concepts, while others have been developed into working prototypes. An overview can be found in Section 5.3. Only the recommendations of Stevens et al. (2003) which were based on the design of their prototype for linking digital media to physical objects, will be mentioned here, since they are most important for the design of a future RSD:

1. *Develop the process of annotating or organizing memories into an activity of personal expression, for example some of the users experienced scrapbooking (see Section 2.1) as “therapeutic” because it helped them to cope with their emotions;*
2. *Make the inclusion of practically any object possible (which is similar to the findings of Chapter 4);*
3. *Bring the interaction away from the PC (which is what was done in Chapter 5);*
4. *Develop “natural” interactions (i.e. touch and voice);*
5. *Encourage storytelling at any point;*
6. *Assure the capability of multiple “voices” (creating multiple annotations to one object, such as done with the souvenirs in Chapter 5);*
7. *Create unique experiences, especially for creating and viewing annotations.*

10.3 Lessons Learned

The design recommendations given by Stevens et al. (2003) are a first set of guidelines that can be used for the design of a future RSD. In this section these recommendations will be expanded with guidelines that can be derived from the research presented in the previous chapters of this thesis. The recommendations are organized by topic, which are souvenirs, user-system interaction and autobiographical memory.

10.3.1 Souvenirs

Since many definitions of souvenirs exist it is important to repeat the definition which was used in this thesis, namely that souvenirs are physical objects to which memories are attached.

From the souvenir study of Section II it was learned that a souvenir can function as an external memory cue. Therefore, souvenirs are suitable for usage in combination with a future RSD, both as part of a Graspable User Interface and as external memory for the users of the device. Another lesson learned was that souvenirs can roughly be subdivided into three groups, namely holiday souvenirs, gifts and heirlooms. Because the latter group often contains furniture, it seems useful for the RSD to support furniture as souvenirs. Most of the souvenirs are in the living room, which is a reason to design a device for use in the living room. Other lessons learned from Chapter 4 are that the most favorite souvenir has over 20 media items associated with it and the majority of the participants immediately recollects or relives memories when they view their most favorite souvenir.

Expected data which the user might want to add to the RSD include memory-cues to loved ones and the positive highlights in her life, e.g., weddings, parties and holidays. These “memories” mostly consisted of photos and physical objects (personal communication with Molly Stevens).

Based on the findings in this thesis related to souvenirs recommendation 2 by Stevens is made more specific:

- *Include souvenirs in a Recollection-Supporting Device.*

10.3.2 User-System Interaction

As mentioned in Section III, more and more people create digital recollection-cues. Therefore the design of the RSD should be based on a digital device in order to be able to store and play those digital media, for example photos. On the other hand, there is still the opportunity to combine the digital cues with the physical ones, like the souvenirs in the Digital Photo Browser demonstrator. This combination has several benefits, such as using the physical objects people already have that are often valuable to them. Another benefit is that souvenirs are traditionally used to cue memories, therefore helping the recollection process in a natural way. The combination of physical and digital objects might also help people who are not experienced in working with digital devices in their interaction with those new technologies.

Physical objects representing shortcuts to subsets of digital photos, or the Graspable User Interface, were chosen for the following reasons: 1 - quick access to photos (Chapter 5), 2 – a self-chosen object is the link, so there is room for personalization (Chapter 5), 3 - people already know beforehand the mental link between the object or souvenir and the photos, since they created and bought both of them (Chapter 5), 4 - the interaction style makes it possible to link physical with virtual, making digital photos tangible (Chapter 5), 5 - at the same time the

souvenirs provide external memory cues to the user (Chapter 4), 6 – the affordances of touching and releasing a physical object serve as natural start and stop points of the interaction (Fitzmaurice, 1996) and 7 - souvenirs might facilitate storytelling, or sharing recollections (Glos, 1995, Glos and Umaschi, 1997). Because of these reasons

- *Souvenirs should be used as tangibles in a Graspable User Interface of a RSD.*

Three different interaction styles, coming from previous work, should be supported by the Recollection-Supporting Device:

1. Browse, search and share the different media types stored in the RSD-database (Chapter 5),
2. Automatically cue (see also Section 10.4.5.3) the user into recollecting or reminiscing, without him or her browsing and continue the cuing while the user is reminiscing (Chapter 3),
3. Physical objects, such as furniture, souvenirs, artefacts and printed photos (Chapters 4, 5, 7, 9), should be linked to the device and maintain their original function. The user can decide what she wants to associate to the RSD and the options should include all kinds of media, ranging from a piece of text to a complete bodily experience. In this chapter the focus is on media that are currently available for the regular user, namely: sounds / music, video, photos / pictures, physical objects / souvenirs / keepsakes / mementos / heirlooms / furniture, and text.

10.3.3 Autobiographical Memory

Section 3.2.4.1 mentioned the diverse functions of Autobiographical Memory, including problem solving, regulating moods and creating and maintaining relationships. A future Recollection-Supporting Device could in theory support all these functions. The question however is whether people will use such a device for all these functions, since the focus of the device predominantly is on supporting personal identity and communication to other people.

- *Support the development of the personal identity of the user and her communication to other people.*

Chapter 7 (Section IV) describes a study into what types of media most efficiently cue free recall of a real-life event. Against expectation text cues (the no-cue condition) worked better than photos, videos, odors, sounds and souvenirs. The explanation for this unexpected result could be that cues make people focus on what they perceive instead of trying to think of other memories that might be

related. Therefore, if the RSD should be used for remembering as much as possible, text should be added to the device.

- *For an RSD meant for remembering as much as possible text should be the main cue type.*

However, it might be dangerous to restrict to text (based on the experiment) since there are more dimensions to recollecting that were not tested in Section IV. Examples of these additional dimensions are pleasure while recollecting, the ability to change the user's mood, the intensity of the memory, the effect of cues a long time after the memory-creation, the speed of the memory-recall and perhaps personal preferences for certain cue types. Although those dimensions were not investigated in this thesis it is assumed that e.g., the pleasure of the recall process is bigger with photos than with only text, especially in a situation where someone is communicating her memories to somebody else. The pleasure aspect was often apparent during the summative evaluation of the Digital Photo Browser (Section 5.7) in both speaker and listener, shown by smiling faces, pointing fingers towards the photos and concentrated conversations. In addition, cues might have different effects for the different age groups (Section 7.5.1). Therefore, more research is needed and:

- *At least text should be used in an RSD.*

An interesting remark resulting from the Maypole project (Pemberton, 1999) was made about the truthfulness of physical versus digital photos. A lot of people do not know whether to believe the contents of a digital photo, since anybody nowadays can change or edit them with software on their own personal PCs. But, according to Maypole, printed photos do also not represent the *truth* in the sense that people go to great lengths to make a family look happy, successful and prosperous in a photograph, whether this is true or not.

From the literature in Chapter 3 it was learned that memories do not stay the same over time, they are, just as photos, not per se a carbon-copy of the truth, where in this case the truth stands for what really happened. People's beliefs and contexts change (as seen in Chapter 3) and therefore the reconstruction of memories can change as well. This is an important fact for the RSD, since it implies that this device is really only a *support* for the user. Ultimately, it is the user who has to recall the memories herself. Therefore:

- *An RSD should not pretend to know the truth, since this might interfere with the experience of remembering of the user.*

In addition to remembering recollection also comprises rehearsal. Every time a memory has been remembered this information will be stored more securely, or the information might change, because of a context change. This implies that adding, deleting or changing metadata to the RSD should be flexible. People might change their mind on the story behind a souvenir, which requires a metadata system that can easily be adapted. Perhaps it could be interesting to keep an interaction history, such as the one described in Qian (2004), which keeps certain changes made by the user, e.g. to digital photos, as metadata.

- *Create a metadata system that can be changed easily by the user.*

10.4 Future Directions

While doing the work described in this thesis a lot of research was found on related issues. But only few results could be found that directly addressed topics under investigation in this thesis, such as designing a device that supports people when recollecting, or what do souvenirs mean to people and what is the relationship people have with them. How can personal souvenirs be used in a graspable user interface or how can memories be quantified in a written account. Two explanations come to mind: 1 – these topics were often at the boundaries of different disciplines, such as user-system interaction, psychology, technology and anthropology, and 2 – these topics have a lower priority for research compared to, e.g., investigations on illnesses and legal systems on which human lives depend. The work presented in this thesis on recollecting memories in everyday life defines a new multidisciplinary area that leaves ample room for future research. Below some of these future directions will be discussed clustered around the following themes: theoretical framework, autobiographical memory, souvenirs, graspable user interfaces and user-system interaction.

10.4.1 Theoretical Framework

The theoretical framework was based on the Autotopography and the Distributed Cognition concepts. They both mention the use of physical objects in the environment as aids in recalling tasks. The framework extracted from these concepts showed a clear distinction between a cue and information, and between the internal and external situation. This distinction helped to clarify the work described in this thesis. Both Autotopography and DCog are closely related to each other content-wise and also to this thesis. In general, the two concepts can be studied in more detail, for example working on concept definitions and inventarizations of the areas, since little research is done so far. Future directions

concerning the theoretical framework could also be based on combining the methods used in the DCog-work with the topic of study described by the Autotopography concept. DCog is a user-system interaction approach studied by means of experimenting, while Autotopography comprises a more descriptive and observing research approach. The strength of Autotopography is that it shows how important objects are for recall and that the use of these objects in the home is often unconscious. Interesting extensions to this topic could be to investigate cultural-, gender- or age-related differences in this behavior, to see what objects are used in particular for the different ways of creating an Autotopography and how these arrangements evolve over time, different locations and different (groups of) people. This research would be beneficial for research on Ambient Intelligence in general. It could also help the design of a future Recollection-Supporting Device since this knowledge could make it possible to support the users better when they are creating or maintaining their Autotopography.

10.4.2 Autobiographical Memory

From Chapter 7 it was concluded that there might be other dimensions to recollecting that were not tested in Section IV, such as the examples mentioned in Section 10.3.3: pleasure while recollecting, the ability to change the user's mood, the intensity of the memory, the effect of cues a long time after the memory-creation, the speed of the memory-recall and perhaps personal preferences for certain cue types. Preferably these dimensions should be studied with real-life events, such as the one described in Chapter 7, since it is expected that "real-life" knowledge is needed to build applications that truly fit people's everyday experiences.

The external cognition concept as explained in the Distributed Cognition framework (Section 1.2) could benefit from additional studies, since at this moment the framework of this new field is not clearly defined and only a small number of studies exist in this area. Further development of the DCog-concept would, for example, help to clarify the relation between autobiographical memory cuing and external cognition and make clear what distinguishes one from the other and how they complement each other. From the introduction of both areas (Chapters 1 and 3) it can be concluded that both fields have much in common and at this point in time, the author thinks both fields show some overlap.

10.4.3 Souvenirs

From Chapter 4 it became clear that little is known about the physical and mental usage of souvenirs at home. This topic could be studied ethnographically. Most souvenir-oriented studies are performed by cultural anthropologists who focus on the land of origin and the local situation (e.g., Hitchcock and Teague, 2000), they study, e.g., how the increase of tourism in a certain country affects the local souvenir industry.

Another question concerns the relationship between physical external memory (such as souvenirs) and virtual external memory (such as digital photos). If a souvenir would link to digital photos and this souvenir is often used for this function, would this digital association become redundant? Just like the comment by Ben Shneiderman (personal communication) that photos become the memories after a while. It seems interesting to study the long-term use of physical and virtual external memory in relation to the original memory or event. How these relations change and what is it that causes the photos to become the memories, sheer laziness? Another interesting aspect to study is whether the memory-owners are aware of this possible shift.

10.4.4 Graspable User Interfaces

Chapter 6 proposed an extension to the current Graspable UI categorization, creating new categories some of which still need to be supported with examples at this moment. In general the categorization needs further investigations, but there are perhaps other useful ways in which the current state-of-the-art can be divided by looking at the examples from another viewpoint. More specifically the two categories that lack examples, personal symbolic tools and personal iconic tools, should be studied. Is there an explanation why most studies reported in literature focus on the non-personal categories? Are categories such as the generic objects more technical by nature and therefore more interesting or do these categories have additional benefits? It might be useful to implement examples that fit these new categories to get more insights on some of the questions posed here.

10.4.5 User-System Interaction

In Chapter 5 a Digital Photo Browser was designed, built and evaluated. A long-term ethnomethodological test would have made the design process complete, but this takes a long time and was outside the scope of this thesis.

10.4.5.1 Metadata

It is doubtful whether people will add metadata to a system, if they do not see any immediate benefit. This is for example the case when people are asked to add metadata to photos, because at the time of asking the people still know who is in the photo and where it was taken. Only later when they have forgotten these details they realize it is too late for adding metadata. Rodden and Wood (2003) show that people do not want to add metadata to a digital photo database, on the other hand, Ben Shneiderman says adding metadata depends on the ease with which metadata can be added (personal communication) and on the clear benefit of adding metadata. In Section 10.3.3 it was suggested that the user should be able to add data at any time and any level of interest. One can start with adding holiday photos without having to add names or other information, those photos just receive a unique ID and end up in a photo-folder called New. It should be possible to add metadata later (such as name, date, location, keywords, stories, sounds, accompanying texts or hierarchy in the photo structure) but it is not at all obliged, avoiding a threshold which is too high for adding photos or other media to the system. Some of the metadata types can be added automatically to digital photos and digital video, such as date, time, GPS-based location information, perhaps this will be an option too for other media later.

10.4.5.2 Context of Use

The context-of-use of the Recollection-Supporting Device concerns in-home reminiscing as an entertaining activity, either alone or in a social setting with friends or relatives. Reminiscing is the process of remembering, the popping up of memories. This can happen when someone is alone, consciously initiated for example to change the current mood or it can happen unexpectedly when someone bumps into something which makes her remember, for example an old stuffed animal received from grandmother a while ago. Reminiscing does not only happen when being alone, it also occurs when other people are around, for example when friends want to know how your holiday has been or you want to share some intimate memories with them to strengthen the relationship. Four situations can be distinguished which a Recollection-Supporting Device should be able to support or even cue in some situations (see Table 10.1 for an overview). The device can be an external cue once people have experienced its possibilities. In addition to the device itself being a cue, also the content displayed (like the moving photo roll in the Digital Photo Browser, Chapter 5) can act like one, by reminding people of certain types of media the RSD contains (in the case of the Digital Photo Browser photos were used to cue memories).

Table 10.1. Examples of the relevant contexts for the Recollection-Supporting Device when used in-home.

Social setting \ Cue	Internal cue	External cue
Alone - private	You want to change your mood by thinking of happy memories	Suddenly you see your stuffed animal again, which makes you remember grandmother
With other people - public	You want to show your appreciation to your listeners by telling them personal memories	Friends ask you about your recent holiday

Since this RSD is a new device (being digital and having extra possibilities) in a field with rather old traditions (e.g., gluing photos into photo albums, or having dia-positive slideshows in a darkened room at home), the RSD should not interfere with all kinds of interaction patterns of the “traditional” way of reminiscing. Preferable the device should be compliant with the media people already have, e.g., printed photos and physical objects used as memory cues.

The user of the RSD can be anyone wanting to reminisce about the past. This would mean, for example, that children and elderly should at least be able to use basic functionalities needed for cuing. Adults, or more experienced users in general, should be able to also use the more advanced functionalities, like editing media with the help of a PC.

In the context of the home the RSD can have multiple users, who share all kinds of social relationships and therefore might have overlap in memory-cuing media. It does not seem necessary to make privacy an issue that has to be solved by technology (see, e.g., Langheinrich, 2001). Currently people are most of the time very capable to solve privacy issues socially, with photo albums tucked away in cupboards. It is assumed people will apply the same social skills when dealing with multi-user conflicts concerning personal devices.

The environment of the Recollection-Supporting Device is the living room or any other home area where someone feels at ease. It is assumed that most devices will stay in the home. Since these devices are both unique and personal, the owner might prevent taking risks such as losing it. However, reminiscing has no

boundaries, in the sense that one might want to use the RSD anywhere and anytime. It should be possible to take it out of the house and carry it to friends, or play with it while being on the move.

10.4.5.3 AutoCue Function

When using a Recollection-Supporting Device the user should be able to indicate what types of cues she wants to experience, specific ones, if she knows what she is looking for or not specific if she wants to be surprised with “random” cues. A random selection can also be applied to a subset of cues. If, e.g., the user is having a conversation sound would not be convenient and could therefore be excluded from the choice of cues. The user should be able to start some sort of AutoCue-function, where the device takes initiative in choosing cues that might result in surprising memories popping up.

The AutoCue topic concludes this section mentioning numerous possibilities for future research.

11 Summary

The main purpose of the work described in this thesis is to acquire design recommendations for a digital device that helps people in recollecting their personal memories in the context of the home. The work was carried out as part of a project at Philips Research Laboratories Eindhoven and as a consequence both the project context as well as the industrial context influenced the content of this thesis. The project team at Philips Research decided to build a demonstrator of a "Memory Browser" and the Ambient Intelligence research program shaped the industrial context of this project.

To get to the design recommendations for this Recollection-Supporting Device several studies were performed. The first study tested with questionnaires how people use souvenirs in the home. It confirmed that souvenirs can be seen as external memory and that they are suitable as tangibles in a graspable user interface for the Recollection-Supporting Device. The second study focused the analysis, design, implementation and evaluation of a user interface for browsing and viewing digital photos on a touch screen device. This user interface consisted of a graphical and a graspable user interface, the latter using personal souvenirs as tangible user interface controls. The research into the use of tangibles led to an extension of the current Graspable UI-categorization. The Digital Photo Browser raised some issues on memory cuing. Therefore an experiment was conducted which compared the effect of cue-modality (odor, physical object, photo, sound and video) on the number of memories people had from a unique one-day event. During this event all above-mentioned modalities were present and they were later used to cue the participants when filling out questionnaires. Against expectation the no-cue condition (in effect only a question asking the participants to write down their memories) created on average significantly more memories than any of the cued conditions combined with the same question. The given explanation for

this effect is that “specific cues” can make people focus on the perceived information, whereas text leaves space for reflection. Because the definitions of the word “souvenir” mention that these objects support remembering the physical-object cue condition was expected to do better than they did in practice. Before concluding that this expectation was not confirmed it was tested whether the participants in that study viewed their personally handmade artefacts as souvenirs. It turned out that most of them did and therefore it was concluded that, indeed, souvenirs cued fewer memory details than text-only cues.

All the information from the above-mentioned studies served as input for the last chapter of this thesis, which formulates a set of design recommendations that can guide designers who want to realize a future Recollection-Supporting Device. This chapter comprises a literature overview, a lessons-learned section and some future directions.

12 Samenvatting

Het hoofddoel van het promotie onderzoek beschreven in dit proefschrift was het maken van ontwerprichtlijnen voor de bouw van een digitaal apparaat dat mensen helpt bij het ophalen van hun persoonlijke herinneringen in een huiselijke omgeving. Het werk dat de basis vormt voor de inhoud van dit proefschrift is uitgevoerd in een project van Philips Research Laboratories Eindhoven en is als gevolg daarvan beïnvloed door zowel de project context als de industriële context. De projectleden van het Philips Research project besloten namelijk in overleg een apparaat te bouwen waarmee herinneringen opgehaald konden worden. De industriële context van het project was dat het viel binnen het Ambient Intelligence onderzoeksprogramma.

Om tot ontwerp richtlijnen te komen voor het apparaat waarmee herinneringen opgehaald kunnen worden zijn verschillende onderzoeken uitgevoerd. De eerste studie onderzocht met behulp van vragenlijsten hoe mensen thuis souvenirs gebruiken. Deze studie bevestigde dat souvenirs gezien kunnen worden als extern geheugen omdat zij mensen helpen herinneren. Daarnaast bleek dat souvenirs geschikt zijn als tastbare objecten in een Graspable User Interface van een apparaat waarmee je herinneringen op kunt halen. De tweede studie concentreerde zich op de analyse, het ontwerp, de implementatie en de evaluatie van een user interface voor het bladeren door en bekijken van digitale foto's op een apparaat voorzien van een touch screen. Dit user interface bestond uit een grafisch en een tastbaar user interface, waarbij de laatste gebruik maakte van persoonlijke souvenirs als tastbare user-interface bediening. Het onderzoek naar het gebruik van deze souvenirs leidde tot een uitbreiding van een reeds bestaande Graspable User Interface categorisatie. Het geïmplementeerde fotoapparaat riep vragen op m.b.t. het oproepen van herinneringen. Daarom werd er een experiment gedaan dat bedoeld was om het cue-effect van modaliteit (foto, fysiek

object, geluid, geur en video) aan te tonen op het aantal herinneringen dat mensen hadden van een gezamenlijk en uniek dagje uit. Gedurende deze dag waren alle modaliteiten verwerkt in de activiteiten die de deelnemers moesten doen en later, tijdens het invullen van vragenlijsten, werden deze modaliteiten als cue gebruikt. Tegen de verwachtingen in riep de conditie zonder cue meer herinneringen op dan alle andere condities met cue. De gegeven uitleg voor dit effect is dat "specifieke cues" mensen doen focussen op de gegeven informatie, terwijl de vraag om herinneringen op te schrijven (die in beide condities aanwezig was) mensen vrijlaat om over alles na te denken. Omdat verschillende definities van het woord souvenir melden dat deze objecten het herinneren ondersteunen was de verwachting dat de fysieke object modaliteit het beter zou doen dan hij deed. Maar voordat geconcludeerd kon worden dat deze verwachting niet uit was gekomen moest onderzocht worden of de deelnemers hun zelfgemaakte fysieke objecten zagen als souvenirs. De meeste mensen bleken dat wel te vinden en dat betekende dat, ondanks eerdergenoemde verwachting, souvenirs minder herinneringen opriepen dan tekst alleen.

Alle informatie uit de bovengenoemde onderzoeken diende als basis voor het laatste inhoudelijke hoofdstuk van dit proefschrift. Dit hoofdstuk vormt de ontwerprichtlijnen voor ontwerpers die een toekomstig herinneringenoproep apparaat willen realiseren en bevat een literatuur overzicht, een gedeelte dat alle relevante resultaten uit dit proefschrift beschrijft en ideeën voor vervolg onderzoek.

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Berry Eggen, je begon als mijn industrieel adviseur, daarna werd je mijn dagelijks begeleider en na jouw “promotie” werd je op het laatste moment toch nog mijn tweede promotor. Jij hebt (na mijzelf) verreweg de meeste tijd en moeite gestopt in mijn promotie en ik durf dus ook wel te beweren dat het me zonder jou niet was gelukt om dit proefschrift te schrijven.

Naast je vakinhoudelijke kennis en inzet heb ik vooral genoten van je karakter: je bent namelijk perfectionistisch, nieuwsgierig, enthousiast en hebt veel humor. Een ander belangrijk aspect van jouw karakter heeft me altijd veel steun en energie gegeven: je niet-aflatende optimisme. Gelukkig stopt onze samenwerking niet, want je vroeg me of ik interesse had ook bij Industrial Design te komen werken en inmiddels heb ik het daar erg naar mijn zin als je collega. Bedankt voor alles.

Armin Kohlrausch, eerst was je de promotor van Jeroen, daarna mijn afstudeerbegeleider. Vervolgens vroeg ik je om mijn tweede promotor te zijn en tot slot werd je mijn copromotor, omdat Berry hoogleraar werd en jij hem het stapje omhoog gunde, wat ik heel erg waardeer. Jij hebt mij vanaf het begin bijgestaan, met name in het spelletje dat politiek heet, op welk gebied ik nog steeds veel van je leer, maar niet altijd alles in de praktijk breng ☺. Daarnaast heb

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Phenom colleagues: Yvonne Burgers, Esko Dijk, Nick de Jong, Evert van Loenen, Yuechen Qian, Doug Tedd, Dario Teixeira and Esa Tuulari. Thank you all for inviting me to join the team and for the great time we had together! Especially during the gezellige Monday-morning meetings. I vote for Phenom reunions once in a while ☺.

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Natuurlijk wil ik alle 120 deelnemers bedanken die hebben deelgenomen aan een of meerdere van de diverse studies beschreven in dit proefschrift (souvenir focus group / memory focus group / Digital Photo Browser informal heuristic evaluation /

Digital Photo Browser expert review / Autobiographical cuing experiment / souvenir questionnaires).

VOORNAMELIJK CONTEXTUELE INVLOEDEN

Voor de context waren uiteraard al mijn collega's van belang, zowel bij het **IPO** (Center for User System Interaction, TU/e), **(E)ESI** ([Eindhoven] Embedded Systems Institute, TU/e), **NatLab** (Philips Research Laboratories Eindhoven) en **ID** (Industrial Design, TU/e). Met name de ski-vakanties van het NatLab en IPO waren bijzonder geslaagd, daarnaast ook de sniek-bezoeken en andere uitjes met de NatLab-collega's.

De volgende mensen wil ik in het bijzonder nog even noemen:

Esko Dijk, Dario Teixeira and Yuechen Qian, thank you for being very pleasant and not too noisy roommates, the last four years!

Marcelle Stienstra, mijn proefschrift is nu klaar, dus ik kan eindelijk op vakantie naar Denemarken! Bedankt voor de gezellige uitjes samen en je vrouwelijke humor ☺.

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Gerard Bloemen en **Karsten van Lierop**, bedankt voor de mooie films die jullie gemaakt hebben, het was een geweldige ervaring om daaraan mee te mogen werken!

Uiteraard kwamen de meest belangrijke contextuele invloeden van het thuisfront. Onder andere van **Onyx & Ruby**, de "fotomodellen" op en in dit proefschrift die in diverse nationale dagbladen en verschillende keren op TV zijn geweest. Daarnaast kreeg ik steun van mijn **paronymfen Cindy en Jeroen**. De laatste was uiteraard mijn belangrijkste steun tijdens mijn gehele promotietraject, omdat jij er altijd voor me was en ook nog eens ervaring had met "promoveren". Dank je wel... voor alles.

Appendix 1. POEMS AND SONGS

ABOUT MEMORIES

Poems and songs about memories do also exist. Read for example the poem below, entitled Old Things Are More Beautiful, by Clay Harrison (Heartland, n.d.).

Old things are more beautiful
than many things brand new
Because they bring fond memories
of things we used to do.

Old photographs in albums,
love letters tied with lace
Recapture those old feelings
that new ones can't replace.

Baby shoes, a teddy bear,
a ring that grandma wore,
Are treasures waiting there behind
a door marked "Nevermore".

Old things are more beautiful,
more precious day-by-day.
Because they are the flowers
we planted yesterday.

The following lyric called Makin' Memories by the Sherman Brothers (Heartland, n.d.), is about photography and memories.

Long before the old Model T
Round about the turn of the century
Folks discovered a barrel of fun
Takin' pictures by the light of the sun

Smile, hug, look at the camera
Hold your breath and say cheese...
Little did they realize back then
They were makin' memories

(chorus)

Makin' Memories, makin' memories
Takin' pictures is makin' memories
Catching little pieces of time
Makin' them yours, makin' them mine

Birthday faces and happy places
We love to hold near and dear
When we're makin' memories
Happy days can reappear!

Then the flappers appeared on the scene
Rumble seats and 20 cent gasoline
Radios and Dixieland Jazz
Brownie cameras and razzamatazz

Snap shots, hug the whole family
Give that button a squeeze
Little did they realize back then
They were makin' memories

(chorus)

Realizations and celebrations
We can forget in a year
But when we're makin' memories
Happy days can reappear

Now we shoot whatever we see
Night or day in color photography
Candid shots of baby at play

Photo finishes and tigers at bay

Hey don't look into the camera

Let's be natural please...

And with every single shot we take

We are makin' memories

(chorus)

Great vacations and graduations

We love to hold near and dear

And when we're makin' memories

Happy days can reappear

One More Time...

(chorus)

Look at the Birdie!....

Another more recent song written by Pink and performed by Mya, is entitled "Take a Picture" (Mya, 2003) and the chorus goes as follows:

I wanna take a picture

So I'll remember this moment forever

I wanna take a picture

So I'll remember this moment together.

Appendix 2. SOUVENIR FOCUS GROUP QUESTIONNAIRE

All participants of the souvenir focus group (see Chapter 4) brought 5 souvenirs, and completed a questionnaire about them (see below), all the answers can be found below in Appendix 3.

Souvenir Focus Group Vragenlijst

Naam:

SFGQ 1: Beschrijf het uiterlijk van elk souvenir kort (en gebruik bij de volgende vragen voor hetzelfde souvenir steeds hetzelfde nummer)

1 =

2 =

3 =

4 =

5 =

SFGQ 2: Beschrijf voor ieder van deze souvenirs hoe je eraan komt en waarom je het hebt gekregen/gekocht/gehouden

1 =

2 =

3 =

4 =

5 =

SFGQ 3: Schrijf op welk van deze 5 souvenirs het meest waardevol is voor jou, en waarom

SFGQ 4: Was ieder object al een souvenir vanaf het moment dat je het kreeg of gebeurde dat pas later, en wanneer gebeurde dat dan

1 =

2 =

3 =

4 =

5 =

Appendix 3. SOUVENIRS FROM SOUVENIR FOCUS GROUP

All participants of the souvenir focus group (see Chapter 4) brought five souvenirs, and completed a questionnaire about them (see Appendix 2), all the answers can be found below in Table A3.1.

Table A3.1. Of each souvenir brought by the participants of the souvenir focus group a description is given, the source of the souvenir, the one which was most valuable and whether the object became a souvenir immediately after its receipt or later.

Partici-pant	Souvenir descrip-tion (SFGQ 1)	Souvenir source (SFGQ 2)	Most valuable souvenir (SFGQ 3)	Souvenir imme-diately or later (SFGQ4)
1	Medallion from Kadoma City, in a box	Got it during study trip to Japan; official nature will never be forgotten		Imme-diately
	Book Metamor-phoses, Ovidius, Latin/ English	Bought it in Cambridge when visiting book stores; nostalgia		After years
	Swedish flag	Bought it in Sweden as a keepsake; kept it as wall decoration		Imme-diately
	Purple pin from the NY-Metro-politan Museum	Got it as admission pin; visited many museums		Imme-diately

	Pebble stone	Found it in knee after fall from bike	Yes	Imme-diately
2	Bowl/dish	Bought it in Turkey, beautiful and cheap, liked negotiating		Imme-diately
	Doll	Got it from parents after holiday; remembers of holidays together		Imme-diately
	Small statue	Got it from former employer after finishing study		After I left my employer and moved to Noord-Brabant
	Pipe	Bought it in Tunisia, useful and fun, liked negotiating		Imme-diately
	Etching (Dutch = "ets")	Bought it in London, liked it	Yes, first holiday on my own, left deep impression	Imme-diately
3	Colorful embroidered bookmark	Bought it on holiday as a keepsake and for usage		Imme-diately
	Olive wood wine bottle stopper	Bought it on holiday as a keepsake and for usage		Imme-diately
	Medal half-marathon	Got it after finishing the half-marathon, as a keepsake to the event and the people I was with		Imme-diately
	Wooden lady bird	Found it and took it as a keepsake from good friends' wedding		Imme-diately

	Wooden key ring "elephant"	Got it from my best friend on my birthday, it remembers me of our holiday together, especially visit to woodcarve-store	Yes, it symbolizes a special friendship, I almost always carry it with me	Immediately
4	Puzzle ring	Got it for my birthday, from boyfriend, who bought it in Puzzle museum in New Zealand		Immediately
	T-shirt	Bought it, nice flag of Switzerland, hard to wear, people think you're a nurse		Immediately
	"Art"-card	Bought it, typical Indian art from Canada		Immediately
	Natural stone pendant	Bought it, symbolic for harmonious life, happiness, beautiful and typical of China		Immediately
5	Miniature Chinese lion	Bought it, beautiful and typical of China, very special	Yes, it is special, I find it very beautiful and never saw them anywhere else	Immediately
	White T-shirt with OJII-logo	Bought it in my "skateboard" period 18 years ago, memory of an "era"		Since around four years, when I found it again
	Cigarette box	Got it, inherited it two years ago from my grandfather		Immediately

	Piece of cord	Found it 8 years ago in surfhouse in Scheveningen, joined me on all my big trips		After my first trip to Australia
	(Digital) video	Recorded/created it 1,5 year ago in Australia, video report of trip with girlfriend		A month after it was recorded
	Musical item (John Frusciante, untitled 2)	Listened to ("wear out") it during holiday in France, 1998 (most beautiful and worst moments in my life)	Yes, it is symbolical for my reach of adulthood	When I came back to the Netherlands after four months
6	Mug from Finland (Oulu)	Got it in Oulu after three days project meetings, ugly thing with good memories		Later, after I decided not to throw it away
	Candlestick (~ candle holder?)	Bought it in Florence, great holiday, beautiful surroundings		Immediately
	CDs	Bought them in France and Vienna, remembers of countries and holidays	Yes, CD from France, content is appealing and reminds me of France, a great, relaxed holiday	Later after I had listened to them more often
	Bookmark	Bought it in San Francisco, great time, tram was cool, nice bookshops		Immediately
	Masks	Bought it in New Orleans, successful conference, cool music		Immediately

Appendix 4. SOUVENIR

QUESTIONNAIRE

In chapter 4 a souvenir questionnaire was used, and the original Dutch version can be found below.

Souvenir Vragenlijst

Instructies

Deze vragenlijst bestaat uit 3 onderdelen. Voordat u begint wil ik graag wat personalia van u weten, maar omdat de gegevens anoniem zullen worden verwerkt vraag ik alleen naar uw geboortedatum en geslacht. Vervolgens beginnen de inhoudelijke vragen over souvenirs.

De vragen in de secties zijn allemaal schuingedrukt (*zoals deze tekst*), de antwoorden en eventuele extra uitleg is standaard (*zoals deze tekst*) en de ruimte voor de antwoorden **grijs** en **omrand** gemaakt (als u het formulier print ziet u alleen de omranding). Past uw antwoord niet in het grijze vakje, schrijft of typt u dan gerust door op het wit van de bladzijde.

Als u bij een vraag moet kiezen uit een rijtje mogelijkheden wordt er slechts 1 antwoord verwacht tenzij anders vermeld.

Met de term souvenir bedoel ik in deze vragenlijst:

Souvenir = een fysiek voorwerp waar herinneringen aan gekoppeld zijn

Het is belangrijk dat u deze vragenlijst **thuis** invult, dus mocht u thuis geen PC hebben waarop dit kan, dan kunt u deze vragenlijst ook uitprinten, invullen en na afloop (intern) opsturen naar het volgende postadres:

Philips Research Eindhoven,
t.a.v. Elise van den Hoven,
Prof. Holstlaan 4 – WY21,
5656 AA Eindhoven.

Een tweede mogelijkheid is dat u mij uw huisadres doorgeeft, zodat ik deze vragenlijst voor u uitprint en opstuur samen met een voorgefrankeerde en reeds geadresseerde retour envelop.

Het doel van dit onderzoek is om een indruk te krijgen van hoeveel souvenirs mensen hebben en wat ze ermee doen.

Op de volgende bladzijden beginnen de vragen, het zijn er 23 in totaal en het invullen duurt ongeveer 30 minuten. Alvast veel dank voor het meewerken aan mijn onderzoek.

Met vriendelijke groet,
Elise van den Hoven

evdhoven@natlab.research.philips.com

Datum van invullen (dd-mm-jj):

--	--	--

Personalia

Geborendatum (dd-mm-jj):

--	--	--

Geslacht:

- man
- vrouw

Sectie 1 – uw meest waardevolle souvenir

SQ 1: Wat is uw meest waardevolle souvenir? (beschrijf het kort)

--

--

--

SQ 2: Waarom is dit souvenir zo waardevol?

--

--

--

SQ 3: Is dit souvenir ook nog een souvenir voor andere mensen dan alleen uzelf?

- ja, het is ook een souvenir voor anderen
- nee, het is alleen een souvenir voor mezelf

SQ 4: Waar bevindt het souvenir zich nu?

- woonkamer
- slaapkamer

- studeer- /werkkamer
- zolder
- ergens anders in huis, nl.:
- ergens anders, maar niet in huis, nl.:
- ik weet het niet (ga door naar SQ 7)

SQ 5: *Hoe is het souvenir neergezet/opgehangen/weggelegd?*

- zichtbaar - als je midden in de betreffende kamer staat kun je het zien
- onzichtbaar – als je midden in de betreffende kamer staat kun je het niet zien

SQ 6: *Heeft dit souvenir zich altijd op deze plaats bevonden?*

- ja, al zolang als ik het heb
- nee, ik heb het verplaatst, maar altijd binnen deze kamer
- nee, ik heb het verplaatst, ook buiten deze kamer

SQ 7: *Hoe komt u aan dit souvenir?*

- zelf gekocht
- gekregen
- gevonden
- zelf gemaakt
- geërfd
- anders, nl.:
- ik weet het niet

SQ 8: *Hoe lang is het souvenir in uw bezit?*

- korter dan een jaar
- 1-2 jaar
- 3-4 jaar
- 5-6 jaar
- 7-8 jaar
- 9-10 jaar
- langer dan 10 jaar

Indien mogelijk pak het betreffende souvenir erbij voor de volgende vraag.

SQ 9: *Als u naar het souvenir kijkt dan is het eerste dat bij u opkomt:*

- ik realiseer me dat ik het een mooi/bijzonder/waardevol souvenir vind (ga door naar SQ 11)

- ik ga als vanzelf over iets nadenken dat te maken heeft met het souvenir, maar wat geen herinnering is (ga door naar SQ 11)
- ik herinner me dingen die met het souvenir te maken hebben (ga door naar SQ 10)
- ik beleef opnieuw een situatie die te maken heeft met het souvenir, er speelt zich als het ware een soort film af in mijn hoofd (ga door naar SQ 10)
- ik denk nergens aan (ga door naar SQ 11)
- ik kan nu niet naar het souvenir kijken (ga door naar SQ 11)

SQ 10: *Waar herinnerde het souvenir u aan?* (als meerdere antwoorden van toepassing zijn kies dan degene die het grootste deel van uw herinnering beslaat, want u mag maar 1 antwoord geven)

- aan een persoon of meerdere personen
- aan een vakantie
- aan een plaats/lokatie
- aan een huisdier
- aan een speciale gebeurtenis, nl.:
- anders, nl.:

SQ 11: *Waar gebruikt u dit souvenir voor in het dagelijks leven?* (meerdere antwoorden mogelijk)

- ik gebruik het vanwege de functie die het object heeft (bijv. het is een flesopener en die gebruik ik om flessen mee te openen)
- ik gebruik het om naar te kijken
- ik gebruik het om aan andere mensen te kunnen vertellen over dingen die met het souvenir te maken hebben
- ik gebruik het om aan bepaalde dingen te denken
- ik gebruik het om mijn humeur te veranderen
- ik gebruik het om mezelf aan bepaalde dingen te herinneren
- ik bewaar het omdat het een geldelijke waarde heeft
- ik gebruik het souvenir nergens voor
- anders, nl.:

SQ 12: *Stelt u zich voor dat u aan mij een verhaal vertelt over het souvenir. Heeft u, om het verhaal te ondersteunen, andere dingen die te maken hebben met het souvenir, zoals foto's, muziek, videobeelden etc., voor het gemak "media" genoemd?* (meerdere antwoorden mogelijk)

- ja, ik heb digitale/electronische foto's

- ja, ik heb analoge/afgedrukte foto's
- ja, ik heb muziek/geluid
- ja, ik heb videobeelden
- ja, ik heb voorwerpen/objecten
- ja, ik heb iets met een geur
- ja, maar het staat hierboven niet genoemd, het is nl.:
- nee, ik heb niks anders dan het souvenir

SQ 13: Dezelfde vraag als SQ 12 maar nu wil ik hieronder graag een schatting hoeveel media u heeft, behorende bij uw meest waardevolle souvenir:

a) *ik heb ... digitale foto's*

- 0
- 1-10
- 11-20
- 21-30
- 31-40
- 41-50
- meer dan 50

b) *ik heb ... afgedrukte foto's*

- 0
- 1-10
- 11-20
- 21-30
- 31-40
- 41-50
- meer dan 50

c) *ik heb ... uur muziek*

- 0 uur
- 1 uur
- 2 uur
- 3 uur
- 4 uur
- 5 uur
- meer dan 5 uur

d) *ik heb ... uur video*

- 0 uur
- 1 uur
- 2 uur
- 3 uur
- 4 uur
- 5 uur
- meer dan 5 uur

e) ik heb ... voorwerpen

- 0
- 1-5
- 6-10
- 11-15
- 16-20
- 21-25
- meer dan 25

f) ik heb ... geuren

- 0
- 1
- 2
- 3
- 4
- 5
- meer dan 5

g) ik heb [] (aantal invullen) andere media, die ik bij SQ 11 ingevuld heb als "anders"

Sectie 2 – al uw souvenirs in huis

Voordat u ieder onderdeel van SQ 14 invult, wil ik u vragen even in de betreffende kamer te gaan kijken en daar souvenirs te tellen.

Ter herinnering de definitie van een souvenir in dit onderzoek: een fysiek voorwerp waar herinneringen aan gekoppeld zijn.

SQ 14: Hoeveel souvenirs heeft u per kamer in uw eigen huis?

a) In mijn woonkamer heb ik ... souvenirs:

- 0
- 1-5
- 6-10
- 11-15
- 16-20
- 21-25
- 26-30
- 31-35
- 36-40
- 41-45
- 46-50
- meer dan 50

b) *In mijn slaapkamer heb ik ... souvenirs:*

- 0
- 1-5
- 6-10
- 11-15
- 16-20
- 21-25
- 26-30
- 31-35
- 36-40
- 41-45
- 46-50
- meer dan 50

c) *Op mijn zolder heb ik ... souvenirs:*

- ik heb geen zolder
- 0
- 1-5
- 6-10
- 11-15
- 16-20
- 21-25
- 26-30
- 31-35
- 36-40

- 41-45
- 46-50
- meer dan 50

d) In mijn keuken heb ik ... souvenirs:

- 0
- 1-5
- 6-10
- 11-15
- 16-20
- 21-25
- 26-30
- 31-35
- 36-40
- 41-45
- 46-50
- meer dan 50

e) In mijn studeer- of werkkamer heb ik ... souvenirs:

- ik heb geen studeer- of werkkamer thuis
- 0
- 1-5
- 6-10
- 11-15
- 16-20
- 21-25
- 26-30
- 31-35
- 36-40
- 41-45
- 46-50
- meer dan 50

f) Ik heb een andere kamer waar ik veel souvenirs heb, maar die hierboven niet genoemd is, nl.:

en daar heb ik ... souvenirs:

- 0
- 1-5

- 6-10
- 11-15
- 16-20
- 21-25
- 26-30
- 31-35
- 36-40
- 41-45
- 46-50
- meer dan 50

Sectie 3 – algemene vragen over souvenirs

SQ 15: Heeft u een vaste plaats in huis voor het bewaren van nieuwe souvenirs, ofwel souvenirs die voor het eerst het “huis” inkomen?

- ja, nl.:
- nee

SQ 16: Heeft u een vaste plaats in huis waar minder interessante souvenirs bewaard worden?

- ja, nl.:
- nee

SQ 17: Heeft u het afgelopen jaar wel eens een souvenir van uzelf weggegooid?
(kado doen hoort er niet bij)

- nee, 0 keer
- 1 keer het afgelopen jaar
- 2-3 keer het afgelopen jaar
- 4-6 keer het afgelopen jaar
- 7-10 keer het afgelopen jaar
- 11-15 keer het afgelopen jaar
- meer dan 15 keer het afgelopen jaar

SQ 18: Kunnen, volgens u, door uzelf gemaakte voorwerpen souvenirs zijn voor uzelf?

- ja, dat kan voor mij een souvenir zijn

- nee, dat voorwerp kan voor mezelf geen souvenir zijn, maar datzelfde voorwerp kan wel een souvenir zijn voor iemand anders
- nee, zelfgemaakte voorwerpen kunnen geen souvenir zijn
- anders, nl.:

SQ 19: Praat u wel eens met iemand anders over uw eigen souvenirs?

- ja, met iedereen als dat zo uitkomt
- ja, maar alleen met mijn beste vrienden of naaste familie (incl. huisgeno(o)t(en))
- ja, maar alleen met mijn huisgeno(o)t(en)
- nee, dat doe ik nooit

SQ 20: Praat u wel eens met iemand anders over zijn/haar (andermans) souvenirs?

- ja, met iedereen als dat zo uitkomt
- ja, maar alleen met mijn beste vrienden of naaste familie (incl. huisgeno(o)t(en))
- ja, maar alleen met mijn huisgeno(o)t(en)
- nee, dat doe ik nooit

SQ 21: Hoeveel souvenirs heeft u meegebracht van uw meest recente vakantie?

- ik ga nooit op vakantie, dus ik heb nog nooit souvenirs meegebracht (ga door naar de instructie onder SQ 23)
- ik ga wel op vakantie, maar neem nooit souvenirs mee (ga door naar de instructie onder SQ 23)
- 1-5
- 6-10
- 11-15
- 16-20
- 21-25
- 26-30
- 31-35
- 36-40
- 41-45
- 46-50
- meer dan 50

SQ 22: Waarom heeft u deze souvenirs meegebracht van uw vakantie? (meerdere antwoorden zijn mogelijk)

- ik vond de souvenirs mooi
- ik vond de souvenirs waardevol
- om aan iemand anders kado te doen
- als herinnering aan de vakantie
- per ongeluk
- zonder reden
- anders, nl.:

SQ 23: Wat zijn volgens u de drie belangrijkste kenmerken van een "goed" souvenir?

1)

2)

3)

Klaar!

Alles ingevuld? Dan zit het souvenir onderzoek er voor u op. Heel hartelijk dank voor uw deelname! Mocht u nog vragen of opmerkingen hebben, of u wilt meer weten over het onderzoek, dan kunt u me bereiken op onderstaand adres. Hetzelfde adres waar ook deze vragenlijst naar toe moet:

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5656 AA Eindhoven

Wilt u weten wat er uit dit onderzoek is gekomen, kruis dan het volgende vakje aan:

- U ontvangt dan eenmalig een e-mail met daarin uitleg over de resultaten.

Bedankt voor uw tijd en de moeite die u genomen hebt!

Met vriendelijke groet,
Elise van den Hoven

Appendix 5. MEMORY CUES OF THE MEMORY FOCUS GROUP

Table A5.1. The following non-personal media were used as memory cues in the Memory Focus Group of Chapter 5 in the order as presented below. Note that the images used were full-color.

Order (#)	Modality	Description
1	Image	Sunset, Figure A5.1
2	Odor	Vanilla oil
3	Sound	City sounds
4	Image	Dentist, Figure A5.2
5	Odor	Cough mixture
6	Sound	Countryside sounds
7	Image	Text “past” (“vroeger” in Dutch)
8	Image	Art, Figure A5.3
9	Odor	Sweet spicy biscuit spices (“speculaaskruiden” in Dutch)
10	Sound	Market in Hong Kong
11	Odor	Chlorine
12	Image	Bubbles, Figure A5.4
13	Sound	Dentist’s drill
14	Odor	Incense (smoke)
15	Image	Beach, Figure A5.5
16	Touch (Odor, Image)	Cuddly toy backpack “Gizmo”
17	Sound	(Playing) Children
18	Image	Market place, Figure A5.6
19	Odor	Deodorant
20	Image	Wasp, Figure A5.7
21	Image	Thunderstorm, Figure A5.8
22	Sound	Thunderstorm and rain
23	Odor	Mouthwash

24	Image	Art, Figure A5.9
25	Odor	Babypowder



Fig. A5.1

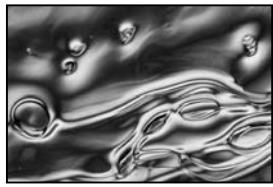


Fig. A5.4



Fig. A5.7



Fig. A5.2



Fig. A5.5



Fig. A5.8



Fig. A5.3



Fig. A5.6



Fig. A5.9

Appendix 6. ARCHEON SOUVENIR QUESTIONNAIRE

In Chapter 9 a souvenir questionnaire was used, the original Dutch version can be found below.

Archeon Souvenir Vragenlijst

Instructies

Deze vragenlijst bestaat uit 7 vragen. Voordat u begint wil ik graag wat personalia van u weten, maar omdat de gegevens anoniem zullen worden verwerkt vraag ik alleen naar uw geboortedatum en geslacht. Vervolgens beginnen de inhoudelijke vragen over souvenirs.

De vragen in de secties zijn allemaal schuingedrukt (*zoals deze tekst*), de antwoorden en eventuele extra uitleg is standaard (*zoals deze tekst*) en de ruimte voor de antwoorden **grijs** en **omrand** gemaakt (als u het formulier print ziet u alleen de omranding). Past uw antwoord niet in het grijze vakje, schrijft of typt u dan gerust door op het wit van de bladzijde.

Als u bij een vraag moet kiezen uit een rijtje mogelijkheden wordt er slechts 1 antwoord verwacht tenzij anders vermeld.

Met de term souvenir bedoel ik in deze vragenlijst:

Souvenir = een fysiek voorwerp waar herinneringen aan gekoppeld zijn

Alvast veel dank voor het meewerken aan mijn onderzoek.

Met vriendelijke groet,
Elise van den Hoven
Philips Research Eindhoven,
Prof. Holstlaan 4 – WY21,
5656 AA Eindhoven.
evdhoven@natlab.research.philips.com

Datum van invullen (dd-mm-jj):

--	--	--

Personalia

Geboortedatum (dd-mm-jj):

--	--	--

Geslacht:

- man
- vrouw

ASQ 1: Wat beschouwt u als het souvenir van het dagje uit naar het Archeon, vorig jaar januari? (slechts 1 antwoord mogelijk)

--

ASQ 2: Heeft u uw fibula nog in bezit? (de fibula was de Romeinse speld van koperdraad)

- ja
- nee (ga door naar vraag ASQ 5)
- ik weet het niet (ga door naar vraag ASQ 5)

ASQ 3: Waar heeft u uw fibula liggen?

- woonkamer
- slaapkamer
- studeer- /werkkamer
- zolder
- ergens anders in huis, nl.:

--
- ergens anders, maar niet in huis, nl.:

--
- ik weet het niet

ASQ 4: Beschouwt u uw fibula als souvenir?

- ja
- nee

ASQ 5: Heeft u uw vilten armbandje nog in uw bezit? (het vilten armbandje heeft u gemaakt van geverfd schapenwol)

- ja
- nee (ga door naar **Klaar!**)
- ik weet het niet (ga door naar **Klaar!**)

ASQ 6: Waar heeft u uw vilten armbandje liggen?

- woonkamer
- slaapkamer
- studeer- /werkamer
- zolder
- ergens anders in huis, nl.:
- ergens anders, maar niet in huis, nl.:
- ik weet het niet

ASQ 7: Beschouwt u uw vilten armbandje als souvenir?

- ja
- nee

Klaar!

Alles ingevuld? Dan zit het souvenir onderzoek er voor u op. Heel hartelijk dank voor uw deelname! Mocht u nog vragen of opmerkingen hebben, of u wilt meer weten over het onderzoek, dan kunt u me bereiken op onderstaand adres. Hetzelfde adres waar ook deze vragenlijst naar toe moet:

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