

Bringing up the past : interaction design for serendipitous reminiscing

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Bringing Up The Past

Interaction Design for Serendipitous Reminiscing

Doménique van Gennip



Bringing Up The Past

Interaction Design for Serendipitous Reminiscing

Doctoral Dissertation by Dominicus Antonius Petrus van Gennip

2018

Eindhoven University of Technology Department of Industrial Design

University of Technology Sydney School of Software

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Bringing Up The Past

Interaction Design for Serendipitous Reminiscing

PROEFSCHRIFT

ter verkrijging van de graad van doctor aan de Technische
Universiteit Eindhoven, op gezag van de rector magnificus
prof.dr.ir. F.P.T. Baaijens, voor een commissie aangewezen door
het College voor Promoties, in het openbaar te verdedigen op
donderdag 3 mei 2018 om 11:00 uur

door

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Het onderzoek of ontwerp dat in dit proefschrift wordt beschreven is uitgevoerd in overeenstemming met de TU/e Gedragscode Wetenschapsbeoefening.

Certificate of original authorship

This thesis is the result of a research candidature conducted jointly with the Eindhoven University of Technology and the University of Technology Sydney as part of a collaborative Doctoral degree. Supervision has been shared between two universities. Supervision at the University of Technology Sydney (where most time was spent) involved prof.dr. E.A.W.H. van den Hoven MTD as the principal supervisor, with prof.dr. P. Markopoulos acting as co-supervisor. Supervision and examination at the Eindhoven University of Technology was outlined on the previous page.

I, Dominicus Antonius Petrus van Gennip, declare that this thesis is submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the School of Software at the University of Technology Sydney and the Department of Industrial Design at the Eindhoven University of Technology.

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

Signature of Candidate:

A handwritten signature in black ink, appearing to be 'D.A.P. van Gennip', with a long horizontal flourish extending to the right.

Date: 12/04/2018

Acknowledgements

As I write this, a late afternoon thunderstorm rolls over Sydney and washes away the heat, leaving a clear sky as dusk sets in. In the distance, I can see a red beacon flash atop the city's famed Harbour Bridge. In some ways, this book is that red beacon: a clear mark that conceals the distance and time since I started this work over four years ago. I'm forever grateful to everyone who joined me on this adventure.

First, I would like to thank my supervisors. Elise, I feel lucky to have had you as a supervisor. I am happy you gave me the chance to get deeper into (design) research. You helped me expand my abilities and grow. This will go down in memory. I admire your continued optimism at whatever comes your way. Panos, I would like to thank you for your keen insights, advice, and encouragements. It has been a blessing to have you come on-board. I enjoyed our discussions, always a source of inspiration. At the same time, you never lost sight of the goal: producing a quality piece of work. Together, both you were great team, bundling your perspectives and a desire make the work the best it could be.

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Abstract

People reminisce to entertain themselves, to connect with others, and to increase self-awareness. Photographs have proven a great resource to support reminiscing. However, with a move towards digital capture and storage, people have more photos that end up undervalued and underused. This thesis explores how interaction design can support reminiscing in everyday life, in particular through the use of digital photos. We focus on serendipitous reminiscing: the casual recollection and reliving of past experiences, brought about by chance encounters with things that remind of one's past. These encounters are easily afforded to physical things but not to digital photos.

Based on a diary study on involuntary reminiscing, a repertory grid study on remembering as experience, and two research-through-design studies on interactive photo displays, this thesis explores how people relate to memory cues in everyday life. We confirm that encounters with personal media and other things that remind one of one's past are welcome, and that the value of photo displays stems from making photos present in everyday life (rather than their interactive features). The findings contribute to design research by furthering the understanding of remembering as experience and the development of several novel concepts that facilitate serendipitous reminiscing.

Please note a longer summary is available at the end of this thesis.

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Introduction

1

1.1 Introduction to this chapter

In the Summer of 2008, that year's edition of the Tour de France geared up for its showdown on the slopes of the famous Alpe d'Huez climb. For one rider that day proved to be one of his best days on a bike. Carlos Sastre of Spain was not the favourite but would go on to win that exciting, suspenseful stage and with that, the coveted yellow jersey in Paris. A true highlight of his career:

"I went back there again in 2012 for a charity event but I only rode up as far as bend seventeen, which is the one with my name on it... I didn't ride any further because I didn't want to [besmirch] the memories I have from 2008. It was such a beautiful day." – Carlos Sastre (quoted in Cossins, 2015).

His quote hints at how much the memories of that day mean to him. Unwilling to spoil them, he avoided 'overwriting' them with a renewed impression of riding up that road. On any given day the climb to the ski station of Alpe d'Huez is a bland road, engineered for easy access by coach. It is devoid of charm and the very positive emotions Sastre must have felt on that day. Part of the climb's near-mythical status for cyclists seems to be derived from its ordinary blandness, ever so often transformed into a magical place.

This is however not a thesis on the social memory of some winding road in France. Rather, this thesis concerns itself with how we choose to remember our past in everyday life. Within the frame of the above vignette, it is about how Sastre remembers that day and how someone would like to reminisce about their earlier experiences. It is understandable he deliberately attempted to steer the otherwise partially subconscious and involuntary process of remembering, perhaps to relive those moments in a way more suitable to his desires. Next to that, technological means can also expose the past for better or worse: a digital photo frame or Facebook's 'On this Day' function may show (un)welcome flashbacks to the past. While such chance encounters may bring joy, it remains open how this affects and inspires reminiscing. This thesis explores how interaction design can support this kind of reminiscing in everyday life.

1.2 Motivation for this research

Reminiscing is not only a leisure activity that people may engage in to entertain themselves or others, but it also provides an opportunity to connect with other people's experiences, find common ground, and increase their understanding of themselves. Reminiscing is a specific type of remembering, different from, for example, mere factual recollection of the past, recalling the meaning of a word, or reminding oneself of future intentions (Tulving, 2007). Westerhof and Bohlmeijer (2014) explain the functional benefits of reminiscing in three ways. First, it is social as sharing memories in everyday conversations fosters bonding. Second, reminiscing provides a way to reflect on the past,

which in turn helps to define one's identity. Finding a thread and narrative in one's life is also instrumental. By recalling past experiences, people learn to understand themselves and others. This helps to identify useful ways to deal with future situations.

By revisiting the past, we may change our perspective. Often, this is very welcome, as it allows people to reconsider and reframe particular events or relationships with others. This is why any memory of the past is malleable to remain relevant for our current and future self (Conway, 2005). Similarly, if a memory seems irrelevant, it is likely to be forgotten unless someone or something reminds us. That something may be a familiar sight, a collection of photos, an old email, a particular smell, someone else bringing it up, etcetera. For Carlos Sastre, the cyclist mentioned in the introduction, the winding road towards Alpe d'Huez was such a place with significance. As his quote makes clear, Sastre was not keen to readjust his memories just yet. His past experience is perhaps a sensation that is at odds with the road's bland reality, as it took exceptional circumstances to create the original experience. Trying to relive that experience, that same environment in its more mundane state may not help to rekindle the earlier sensations.

1.2.1 Things to represent the past

In general, however, people like to keep around and make use of things that represent their past and present-day identity. Doing this is what motivates many to store and put on display personal photos, souvenirs, and other memorabilia (Belk, 1990; Csikszentmihalyi & Rochberg-Halton, 1981; González, 1995). The interaction between personal identity, personal memories, and things is particularly interesting because of the changing ways people relate to things. We deliberately use the qualifier 'things' rather than just objects, as those can be real, virtual, or entirely imaginary and yet be able to affect someone in a meaningful way, according to Brown (2001). This relation between objects and things is more formally described by thing theory (B. Brown, 2001). Objects are physical artefacts that sit in a particular spot, have material properties, and in contrast to things, do not really 'live' in the mind of someone. Things are what people relate to and imbue with significance (Ingold, 2012). Objects, while normally mundane and rather uninteresting to the mind, may leap to significance and become things that people can emotionally connect with (Plotz, 2005) (see Figure 1.1).

More precisely, in a linguistic sense, the object relates to a subject as in the following example: 'the boy [subject] kicks [verb] the ball [object].' The ball has little if any agency in this example. However, if imbued with significance by the subject, an object can transcend that insignificant state and become a meaningful thing (B. Brown, 2001). In the movie *Cast Away* (2000), a volleyball of the Wilson brand is transformed into a character called Wilson based on what is projected onto it by the subject (a man stranded on a deserted island with only Wilson for company). Thingness thus depends on the subject-object

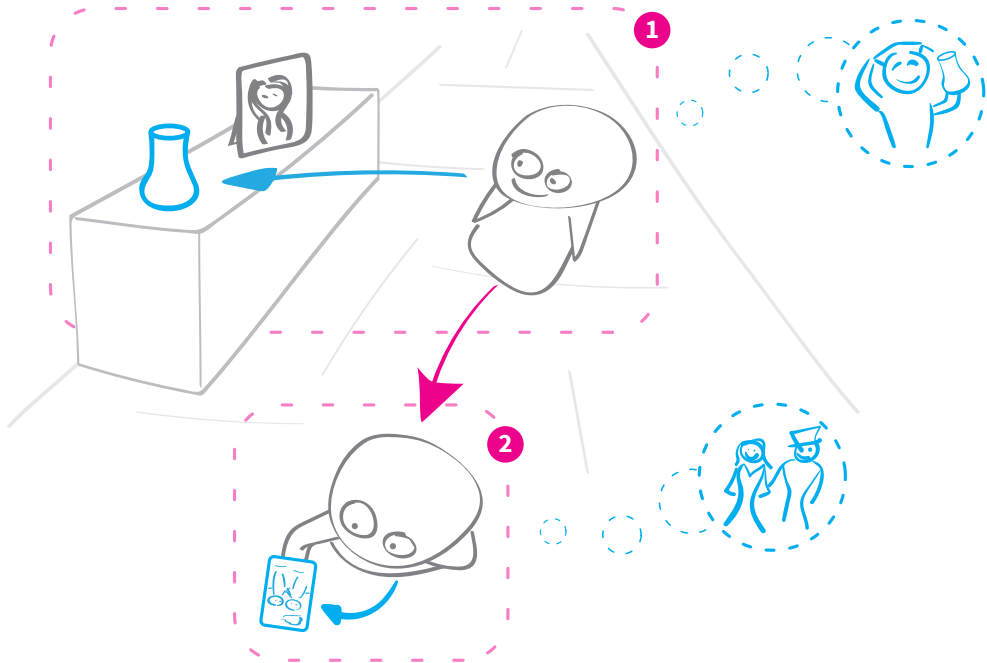


Figure 1.1. Things may help connect people with their past, through casual observation where such objects may attract sudden attention (instance 1) or when people actively seek them out, for example by browsing digital photos on their phone to reminisce about a wedding (instance 2).

relationship. Without such a relation, a thing is not a thing but merely an object.

Thing theory posits that things enable us to project our ideas; ideas that we use to think. It is through ‘asserting thingness’ that objects can influence thinking (B. Brown, 2001, p. 4). Thinking about the past, at least where it concerns present interests, may be equated to remembering. The past is an idea (or rather a collection of ideas) through which people think about themselves and about their relation to others and the world around them. To continue this analogy, if thinking can happen with the help of things, remembering can also happen with the help of things. The research presented in this thesis aims to study the relation between things and reminiscing, along with how digital things such as photos could acquire a similar significance to support reminiscing.

1.2.2 Things and serendipity

Brown (2001) refers to a “suddenness with which things seem to assert their presence and power” (p. 3) and gives examples of tripping over a toy or cutting one’s finger on paper. These moments, according to Brown, are occasions of contingency, chance interruptions from the mundane pattern of everyday life where an object becomes a thing and asserts

its 'thingness.' Such an encounter leads to a sudden change (or the establishment) of a subject-object relationship. This change allows a thing to bring to mind relevant connotations and memories. The encounter instigates a leap of thought that closely resembles the notion of serendipity.

Serendipity is "*the art of making an unsought finding*" (Ansel, 1994, p. 631). Historically, serendipity has been closely associated with the nature of scientific discoveries (Ansel, 1994; Merton & Barber, 2004). For such discoveries, this implies an intellectual leap towards a new understanding. Unexpected encounters prompt people to consider new connections between what they already know (e.g., their memories) and any ambiguity that they encounter (Leong, Harper, & Regan, 2011). This implies that out of chance encounters a more meaningful moment may emerge (Leong, Vetere, & Howard, 2008). Indeed, for everyday situations, it is more helpful to discuss such moments regarding their ability to deliver possible delight and a meaningful experience (Leong et al., 2008). It is namely in this process of making sense, through recollection, reminiscing and abduction that people arrive at new insight and personally relevant meaning.

Serendipity thus requires two steps: First, noting something odd or unexpected and second, making a realisation about that unusual thing or occurrence. Only when a chance encounter is synthesised into new insight would it be considered serendipitous (Ansel, 1994; André, Schraefel, Teevan, & Dumais, 2009). For this reason, it is as much about the (soon to be changed) relation of the subject to the object as it is about the encounter itself. Someone needs to encounter, relate to, and respond to a thing for a serendipitous moment to occur (Merton & Barber, 2004). Nonetheless, serendipity remains opaque in that having the requisite elements does not guarantee it is automatically forthcoming. There remains an almost necessary element of unexpectedness to make an encounter truly serendipitous. Similarly, Breitbach (Breitbach, 2011) referred to the chance contingencies inherent to things as 'everyday magic' (p. 38).

For someone to serendipitously reminisce about a past moment in their life, this idea of the past had to leap to their attention. To do so through an object (e.g., a birthday gift card placed on a table at home, similar to Figure 1.1) requires the object to 'assert its thingness' and hold influence over one's thoughts. Of course, it is possible to reminisce, even serendipitously, without reliance on external things but that lies beside the present focus. Reminiscing is more likely to occur through the former path, that is, through encounters with objects become things that may spontaneously bring aspects of the past to mind (i.e., involuntarily cued memories; Berntsen, 2009).

1.2.3 Things that inspire serendipity

The relation between things and memory has been studied well in sociology, social

psychology, and by those interested in digital and material culture. Later chapters provide a substantive background on this, but these words by Csikszentmihalyi (1990) outline it most succinctly:

“To keep the past registered can contribute to quality of life. It frees us from being enslaved by the present and makes it possible for our minds to visit the past. It makes it possible to choose and in our memory keep events that have been particularly pleasant and meaningful and thereby ‘create’ a past that helps us to deal with the future.”

In seeing personal things or interacting with them otherwise, the thoughts and ideas invested into them may once again be brought to the fore. The motivation to do this kind of collection and portrayal of identity is not new. Some of the oldest traces of human civilisation are such portrayals of everyday life and its most noteworthy aspects, such as cave paintings of animals (Donald, 2010). More elaborate displays of personal style and significance have however long been left to those with enough disposable wealth to get their portrait painted or a bust produced in stone. Doing this was either very laborious or expensive. As technology progressed and people acquired more living space and free time, it has become easier for a wider group of people to collect, display, and share things. The ease with which people can capture fragments of their life (and later look back at those) further accelerated with the widespread adoption of computers, photo cameras, and other digital means. It is no longer an effort to capture a formal portrait or notable event, rather, people can conveniently do so whenever and wherever they would like to (Sarvas & Frohlich, 2011).

The trends outlined above may be for the better, but also introduce difficulties. People may still have as many physical possessions today while having a magnitude more digital possessions. If we take photography as an example, the ease of taking photographs increases the size of collections people keep. The advent of personal digital technology has driven people to accumulate more virtual possessions, as creating and storing these comes at a low cost (e.g., K. Rodden & Wood, 2003; Whittaker, Bergman, & Clough, 2010). Higher costs are incurred at a later stage when people might have to sift, sort, and search amid a large collection. When visiting the past becomes less a stroll down memory lane and more of a trudge down a memory back alley (with all the unclear signage and mess that goes with that connotation), the collection of these digital things becomes less valuable as it hinders our ability to fluently create our own story (Marshall, Bly, & Brun-Cottan, 2006; Sellen & Whittaker, 2010).

Too many digital photos that are seldom revisited imply that there are under-utilised opportunities to reminisce with the help of these things. The physicality of things, or at least, the peripheral presence of objects is a prerequisite for such objects to invoke the

past serendipitously. For example, a photograph of family may be framed and situated in one's living room. Occasionally, the photo (or rather, the content it represents) catches one's attention and helps to reminisce about the depicted events. For this thingness of photos (that is, the ability to facilitate encounters with one's past), there is little inherent difference between printed photos and digital photos. Rather, it is the relation between the viewer and the depicted content that counts (Breitbach, 2011). However, this relation is modified by the means through which a thing is encountered (or, in the case of digital photos, mediated through technology), and by how we view and interact with it.

Viewing digital photos tends to evoke an experience that is of a very different quality compared to traditional keepsakes and selected physical photos. A more deliberate, slower process of viewing has been replaced with a very fast paced browsing of a much larger photo collection, losing some of the qualities associated with reviewing one's photos (e.g., Crabtree, Rodden, & Mariani, 2004; Petrelli & Whittaker, 2010; Whittaker et al., 2010). One of these qualities is serendipity, the unanticipated ability of a photo to foster a sudden change in thoughts to bring the past to mind. Digital photos are more likely to require voluntary effort before these can be seen. Someone may look on a hard drive and review individual photos, perhaps a specific photo for which a search was begun. However, the value of the collection as a whole in supporting the aforementioned functions (e.g., reflecting on one's past and fostering social relations) diminishes as such collections are often left to their rather remiss place in everyday life.

In response to these challenges, the present research seeks to explore how qualities of serendipity can be employed to use digital photos for the support of reminiscing in everyday life. As this section highlighted, digitally mediated objects such as photos rely on the design of the mediating technology to become things and gain meaning. The key to enabling serendipitous encounters rests in the way such technology manifests itself and lets people interact with it.

1.2.4 Serendipitous reminiscing with digital photos

The research presented in this thesis is built on the foundational idea that an increasing number of people have on the one hand a problem of abundance of digital materials that serve as potential memorabilia. On the other hand, this abundance is not expressed through an equivalent presence of one's digital media in the everyday environment. In general, people would rather not throw out such digital things but are otherwise not sure how to deal with them properly (e.g., Frohlich, Wall, & Kiddle, 2012; Whittaker et al., 2010). In lieu of a clear way forward, photos are captured still, perhaps shared with others shortly after, and then make their way into the purgatory of digital storage (Figure 1.2). This implies digital photos may be under-utilised for the purposes of reminiscing and reflection on one's past. The question of interest is how people could make the most of

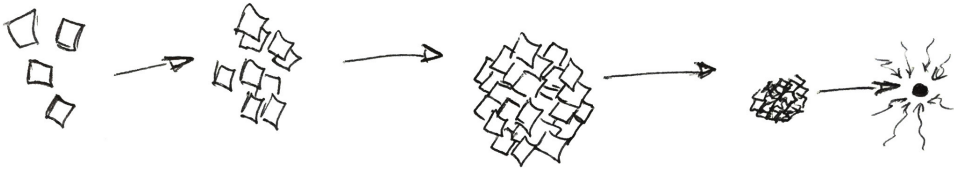


Figure 1.2. Illustration of the problem caused by increasingly large collections of, for example, digital photos. As the number of things increases, the ability to distinguish any particular thing decreases, until the collection becomes an indistinguishable blob.

what they already have, namely the various sets of digital things that in some way reflect their past and present selves.

We can identify several ways to approach this issue, the third of which this thesis adopts. One such approach orients towards improvements in the ability to manage and organise collections. This process is often regarded as a chore; monotonous work that often does not get easier with more deliberation and time spent (e.g., Jones & Ackerman, 2016; Whittaker et al., 2010). It is complicated by the hard to answer question of which materials will deliver personal value some time into the future. Getting rid of things now comes at an unknown future cost. Another avenue would suggest to be more deliberate and selective towards the capturing of new things, such as when taking photos, to reduce quantity but not quality. Why do we capture and save certain moments? What phenomena drive the desire to snap and share our food, social gatherings, weird things we encounter in everyday life, or other mundane happenings? Could people be motivated to consider the long-term consequences of snapping away and be made to act on it? Any effective solution here may reduce the flow of new material into our collections.

A third strategy is to explore some means of casual enjoyment of the past, such that a lack of organisation may not hinder as much or perhaps provide occasional moments of joy. Here, we opt to investigate this direction. Therefore, the premise of this work is that it may be advantageous to bring out digital photos and other digital things and attempt to give these a place in everyday life. This is not to equate these things with the same level of permanence as souvenirs or other objects that were deliberately sought out for display purposes. Nonetheless, the idea is to use them in such a way as to bring value towards the kind of casual reminiscence that takes place in our everyday life. When and how such value may arise provides the impetus for the exploration we put forth.

1.2.5 Memory, experience, and design

The thesis brings together three topics: memory, experience, and interaction design. Memory provides the faculty by which people can remember their past and relations with

others. In remembering these things, people are able to think about themselves, how they relate to others, and reassess their perspectives on the past. When remembering past experiences, it is not just the perceived order of events that is reconnected with; any emotional qualities may also be remembered (Middleton & Brown, 2005). In turn, someone's current experience may be affected as a result of remembering. Often, this is precisely why someone opens up photos from past events, plays songs that bring back memories, or recollects a story with friends; reminiscing can lift someone's state of mind. Interacting with the past is thus a veritable way to find joy or make sense of conflicting situations and feelings (e.g., Harris, Rasmussen, & Berntsen, 2014; Webster, Bohlmeijer, & Westerhof, 2010). Where it gets particularly interesting is when this kind of reminiscing happens through (or least with the help of) things. These things may represent or invoke memories (e.g., souvenirs, memorabilia, digital photos), or these things may be means through which remembering is supported (e.g., photo browsing devices such as phones and laptops). The particular ways in which such an artefact works and influences remembering drives the design angle here. Design as a field of research is concerned with how these interactions between things and people work out and how such interactions may be influenced to move similar occasions in the future towards a more desirable state (Simon, 1996, p. 111).

1.3 Research objectives

The previous section laid out the challenges in adopting digital things as integral to people's reminiscing practices in everyday life. The present research seeks to explore how qualities of serendipity can be employed to use digital photos for the support of such reminiscing. By situating the study of reminiscing in everyday life, we explore practices, preferences, and (desired) experiencing for reminiscing through the use of interactive systems. This focus on serendipitous reminiscing intends to explore casual encounters with digital memorabilia as a meaningful way of interacting with the past. The aim is to further the understanding of how personal memories interrelate to designed (digital) artefacts. Hereby the thesis contributes to defining and understanding the everyday situations in which remembering takes place. Additionally, the research presented here evaluates end-user experiences via (partial) examples of novel interactive designs. Thus, the work co-develops its understanding of the topic alongside the evaluation of particular solutions. Specifically, this thesis addresses the following research questions:

1. When and how do people relate to external memory cues in everyday life for the purposes of reminiscing?
2. Can remembering be defined as a kind of experience, such that it may be qualified for the purposes of design?

3. How can serendipitous reminiscing be characterised and which considerations apply when designing and evaluating this kind of reminiscing?
4. How may interactive technology support serendipitous reminiscing through the use of personal digital photo collections?

The research in this thesis is exploratory in nature. It intends to provide a clearer perspective on the topic of serendipitous reminiscing, without relying on well-established operational definitions or methodological interpretations. Instead, the studies put forth aim to develop an understanding of both the area of interest and potential design solutions. This means, for example, that psychological effects of reminiscing may be explored but no models of such effects will be developed or evaluated. Also, we opted to focus on encounters with things that are likely to result in neutral to positive outcomes, even though we acknowledge that reminiscing has seen considerable study where it concerns its negative aspects, such as continued rumination (Quoidbach et al., 2010).

For the research presented in this thesis, it means the aim is to study the process of reminiscing in an everyday context, such that future designed products and systems may be better able to fit into and meet the needs and desires of people. This focus requires a firmer understanding of what exactly is understood by the seemingly self-evident but hard to define nature of the everyday. The next section covers the everyday in more detail. After this, we introduce the methodological stance, in advance of a more in-depth discussion in Chapter 2. The final section of this chapter lays out the structure of the thesis in relation to the above objectives.

This thesis was developed within the context of the Materialising Memories program. This research program aims to study and develop innovative media products that support remembering and forgetting (van den Hoven, 2014; van den Hoven & Connell, 2016). An example of collaboration with fellow researchers is covered in the introductory sections of Chapter 5, which partially derives its origins from a shared effort to better understand the role of experience in the relation between remembering and design (a clear corollary to Research Question 2).

1.4 The everyday as application area

The everyday defies a clear definition precisely because its ordinary, mundane nature evades critical attention. People go about their lives, follow particular routines, do things in ways that barely register in the grander story of things, and yet those routines move them along. In design research, the interest in the everyday stems from a desire to address issues that impact various facets of life, without specific reference to, for example, activities geared towards forms of productivity. It is, however, hard to define

the boundaries. On face value, everyday life is a continuum of rather mundane activities that are given little thought. It is often the exceptional moments that cause us to take note, perhaps snap a photo, share with others, and remember. Nonetheless, as Felski (1999) puts it, everyday life is “*the non-negotiable reality [and] the unavoidable basis for all other forms of human endeavour*” (p. 15). Exactly this ubiquity makes it relatable. Despite most people having a tacit sense of what the everyday is, Lefebvre (1987) noted it is often defined as what remains after specialised activities are abstracted.

Felski (1999) defines everyday life as grounded in three facets: time, space, and modality. The temporal facet refers to the repetition inherent in everyday life (a reoccurrence from day to day, month to month, year to year). This cyclical view of time is often posed against that of linear, forward movement where supposedly true progress can be achieved (Lefebvre & Levich, 1987). The spatial ordering of Felski’s definition refers to a sense of home, which seems best interpreted as a familiar base to which we return. What makes this idea of home interesting is that it is a stage for affective and pragmatic needs. Everyday life’s characteristic mode of experiencing the everyday is that of habit. In Felski’s view, habit is not just an action but also an attitude. Habits are carried out in a less deliberate or semi-automatic manner (ibid., p. 26). Even then, habitual behaviour is still an activity that relies on and is influenced by cognitive, emotional, and other contextual factors such that it is not fully automatic nor static. Habits can and do change over time.

A closely related notion to habit, and one that informs some of the ethnographic efforts to describe human-technology interactions, is that of practice. A useful sociological concept, practices are considered the fundamental units of social existence (Schatzki, 1996). Practices are “*a routinised type of behaviour which consists of several elements, interconnected to one another: forms of bodily activities, forms of mental activities, ‘things’ and their use, a background knowledge in the form of understanding, know-how, states of emotion and motivational knowledge*” (Reckwitz, 2002, p. 249). To become and remain a practice, a behaviour depends on recurrent performance by real-life practitioners (Schatzki, 1996). This conceptualisation of practice suggests that the ongoing dynamics of everyday life may also be expressed as a sequence of sometimes concurrent, sometimes sequential practices.

The above brings us to conclude that habitual practice is the epitome of everydayness. It is repetitive, often distracted, and therefore seemingly involuntary as it offers a default course to action. It marks the absence of one’s devotion of attention and deliberation in favour of a reliance on previously employed practices. Even so, habits are not static and develop in response to changing needs and desires. Serendipity, as it is discussed in this chapter, is one such sudden change that may sway someone, perhaps only temporarily, from a habitual path.

Despite its ubiquity and mundane nature, the everyday remains fascinating because one person's version of it may be alien to someone else's. It is also an interesting backdrop against the motivations to elicit serendipity, which emerges from unexpected moments that defy the habitual to inspire reflective thinking. Reminiscing takes someone out of their habitual preoccupation with the everyday and, at the least momentarily, replaces this with a consideration of past events, relations, and feelings.

1.5 Research perspective of Interaction Design

In both its approach and outcomes, this thesis follows the practices of the field of Interaction Design. This section gives attention to its origins and characteristics – a discussion that is deepened in Chapter 2 – to highlight how the motivations of the present research align. The Interaction Design Association (2017) defines the field as follows:

Interaction Design (IXD) defines the structure and behaviour of interactive systems. Interaction Designers strive to create meaningful relationships between people and the products and services that they use, from computers to mobile devices to appliances and beyond.

IXDA considers Interaction Design a discipline that often, if not primarily, deals with digital devices (i.e., devices that incorporate some computational ability). This view is not surprising given the field's emergence from the longer established fields of industrial design and Human-Computer Interaction (HCI). In the 1980s, it became apparent that computer science and software engineering alone did not always result in effective and readily usable interactive systems (e.g., Norman, 1988). Traditional industrial design and cognitive ergonomics proved imperfect as designers of increasingly complicated systems struggled to apply old practices to new kinds of interactions, such as the graphical user interface (Norman, 1988). By the mid-80s, Bill Moggridge (2007) and Bill Verplank (2000) started to use and favour the term Interaction Design over user-interface design, because they felt the latter term undervalued the position of users' interactions in relation to a system's primary function.

These days, Interaction Design is often used as an encompassing term for interface design, the application field of Human-Computer Interaction (cf. Preece, Rogers, & Sharp, 2015), and has overlap with User Experience Design (cf. Hassenzahl, 2010). This is particularly true where it concerns the design and evaluation of interactive systems that also consider qualities beyond merely functional aspects, such as systems' place in broadened contexts of use and the pleasure in use and desirability (Bødker, 2015; Hassenzahl & Tractinsky, 2006). Norman (2004) refers to the latter as a turn to the emotional side of our daily use of products, as basic demands of functionality and usability cannot paint a full picture. This shift in attention and broadening of what interaction design caters to is sometimes

called the third wave in HCI (see Bødker, 2006; 2015).

Figure 1.3 captures an approximate rendition of the Interaction Design field's relation to other disciplines. In this figure, User Experience (UX) is treated as a broad concept that permeates related fields and also includes other areas of interest beyond the limits of this thesis. The strongest connections are with Human-Computer Interaction (HCI) and HCI's more cooperative and ethnographically-oriented neighbour Computer-Supported Collaborative Work (CSCW). Both fields 'do' Interaction Design as a way of research practice. A similar practical incorporation of Interaction Design can be found in the industrial design of everyday products and systems. The other fields identified in Figure 1.3 are typically distanced further from applying interaction design but are nonetheless influential for the origins and continued development of thinking within the field.

Following the IxDA definition for Interaction Design, its vital aspect of creating meaningful relationships between people and systems also applies to this thesis, which aims to study such relationships between people and their memories through personal media. This definition is thus helpful to give us a sense of the motivations behind Interaction Design. Preece, Sharp, and Rogers (2015) consider the field's main objective "designing interactive products to support the way people communicate and interact in their everyday and working lives" (p. 8). As a field of research, the focus is on synthesis of what is and imagination of what things could be (Fallman, 2008). Thus, it endeavours to both observe current practices and evaluate potential new practices, often with the use of prototype systems as interventions to tease out particulars of such existing and potential

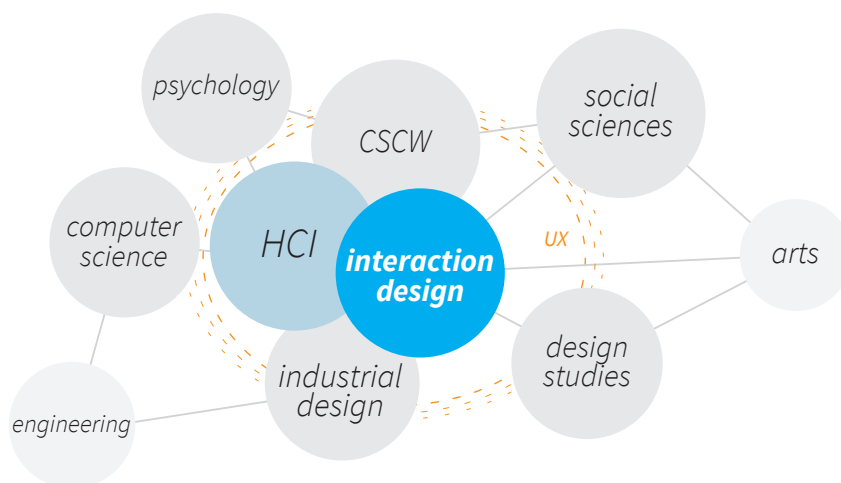


Figure 1.3. Overview of Interaction Design in relation to other fields, as per our subjective interpretation. Lines indicate the primary (but not exclusive) ways in which the fields relate to Interaction Design.

practices (Preece et al., 2015). This orientation sets Interaction Design apart from a more conventional science or engineering approach (that respectively aims to understand a problem or devise a solution to a known problem) (Fallman, 2008; Fallman & Stolterman, 2010).

Interaction Design, similar to more general notions of design, is often practised in a way where the understanding of a problem co-develops with the understanding of fitting solutions (e.g., an interactive product that suits people's needs) (Cross, 1982; Dorst & Cross, 2001). Co-development of problem and solution is iterative, as a designer moves between these steps. Each iteration requires making a step towards a more desirable state, accompanied by reflections on what a supposed desirable state is and how the current iteration moves towards it. This approach is particularly suited to address the issues within the context of everyday life, which – as §1.3 aimed to get across – is both mundane and 'obvious' to those living in it as that it is complex, ambiguous, and therefore rather difficult to design for.

1.6 Structure of this thesis

This thesis is structured into three parts, as shown in Figure 1.4. Each part contains two or three chapters and builds on insights from earlier parts. Each chapter will make clear how it contributes to the overall narrative of the thesis, an overview of which follows here.

Part I: Background

The first part describes the background of the thesis. In Chapter 2, the approach to the work done in later chapters is discussed in depth. Interaction Design research and its epistemological underpinnings are covered to provide a perspective on the research approach taken in this thesis.

Chapter 3 provides an extensive background on relevant literature. We review theories of memory and remembering, the place of things within a distributed view of the mind, how things and memory interact, and prior work that has addressed remembering in everyday life. At the end of the chapter, we formulate a view on serendipitous reminiscing in everyday life. This illustrates our understanding and makes the first steps towards potential ways of addressing such reminiscing.

Part II: Reminiscing as experience

In the second part, two chapters explore reminiscing as a form of experience. Chapter 4 presents a study of spontaneous, involuntary reminiscing in everyday life, as recorded using diaries. This study provided a large number of everyday encounters with things that brought back memories. The chapter aims to explore such items in more depth and relates them to their role in maintaining identity, as social signifiers, and as mementos. Insights

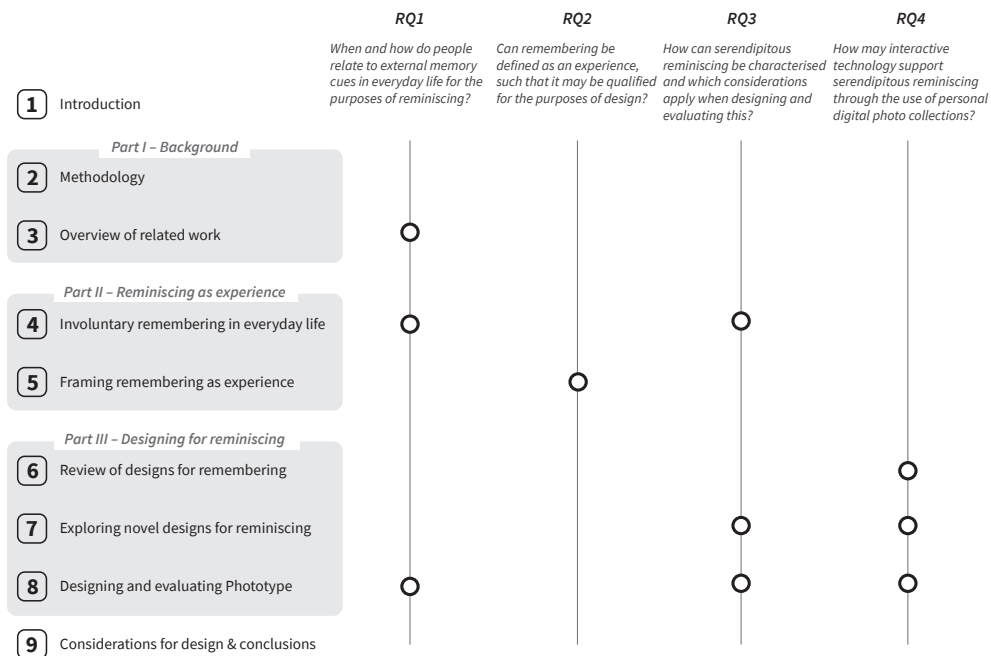


Figure 1.4. A schematic overview of the structure of this thesis. The dots highlight the chapters that contribute most significantly to the respective research questions.

from the study are used to inform a set of recommendations for designs that aim to support remembering in similar situations through the use of personal media.

Chapter 5 develops the notion that the kind of remembering studied in the prior chapter is a form of experience. The chapter reports a study of contrasting remembering experiences. Through these contrasts, the chapter gives insights into how people construe their past experiences. These findings provide a handle to approach the study of past experiences by charting an experiential vocabulary.

Part III: Design for serendipitous reminiscing

The third part makes a turn towards design explorations. In Chapter 6, we review prior design work that focused on remembering through personal media displays. Chapter 6 highlights directions and insights across these works. We note that this design is primarily done with a domestic focus, in which the past is made present through the display of photos or other personal media. Aspirations of the work studied indicate that the designers seek to have the displays inspire and support reminiscing, reflection, and the creation of a personal or social narrative.

Building on the review, Chapter 7 develops a design space that lays out relevant factors

and potential directions for further explorations. This model is then used in service of a study of early design explorations. Six mock-ups of interactive devices that could show personal photos are introduced. These mock-ups were evaluated in interviews with participants. Differences in appeal and other characteristics are discussed and generalised. Our results show that people may appreciate serendipitous photo displays if such interactive devices offer an experience that is both enjoyable without explicit interaction from a viewer's side and remains flexible to changing desires.

Chapter 8 advances the research-through-design cycle and presents a final prototype named Phototype. This device incorporates design ideas and builds on the outcomes of Chapter 7. We qualitatively evaluated the prototype after a three-week deployment in eleven participants' homes. Through interviews and usage data we derived that the prototype does support the kind of casual remembering that serendipitous reminiscing sets out to capture. In addition, we realised that for such encounters with the past to remain casual, tapping into people's personal media collections needs attention in the overall design approach for such technologies.

Finally, Chapter 9 compiles the insights across the prior chapters and presents the contributions made to the interaction design for reminiscing. We conclude that serendipitous reminiscing is welcome, but that its rendition is dependent on the media that people have. Also, by making personal photos present in the everyday, these become part of and have to fit in with a wider (social) context. The chapter further generalises insights and recommendations across this thesis. In addition, the final chapter reflects on the presented research, describes its conclusions, and gives pointers for future work in the area of serendipitous reminiscing.

Across the thesis, we present both the generation of knowledge and several designed artefacts as the outcomes. Although we think of these designs as a means to an end (that is, to generate knowledge), these designs are also valuable as a way to encapsulate, articulate and communicate design insights. Therefore, while this dissertation is less of a thesis by design (i.e., 'proefontwerp' in Dutch) compared to some other design theses, our explication of the design process is valuable to everyone with interest in designing for remembering.

Part I
Background

This first part aims to place this thesis in relation to prior work and relevant approaches to research. Chapter 2 provides an in-depth discussion of the methodological background for the field of Interaction Design in general and this thesis in particular. Then, Chapter 3 highlights related work on the topics of memory, reminiscing, and how ethnographic and design-oriented work has addressed the challenges around reminiscing using personal digital media. This part concludes with a set of characteristics of serendipitous reminiscing.

Methodological perspective

2

2.1 Introduction to this chapter

This thesis advances knowledge on designing for everyday reminiscing. As the introduction has highlighted, reminiscing is a highly complex and context-dependent process. To successfully support reminiscing, the design process of an interactive system requires a sensitivity to the role such a system plays in relation to people's personal motivations. The aim of this chapter is to elaborate how design research, as applied in this thesis, enables this desire to understand, acknowledge, and incorporate people's motivations. Subsequent chapters will take a clear course to support future design work, and the final part of the thesis also employs design concepts and interventions to gain insight into why, how, and what can be designed for human use.

This chapter does not go into detail on the specific methods used in the studies that follow and leaves that explanation to the relevant chapters. Instead, this chapter positions the present work relative to broader methodological perspectives. It makes clear how the various approaches of later chapters tie together. This methodological chapter starts with a discussion of the origins and epistemological underpinnings of the field of Interaction Design. It looks at how this work straddles the line between research to support design and research-through-design, and how this affects data collection and interpretation. The final section also considers relevant ethical issues.

2.2 Motivations for Interaction Design

To continue the discussion of Interaction Design's origins from §1.5, this section sets up its epistemological background. The field of Interaction Design strives to learn from current practices and propose novel practices, often with the explicit aim of finding new or unexpected uses for technological systems (Preece et al., 2015). In general, this suggests a desire to understand and cater to people's desires and practices. Often, this leads to new or updated products and services. As a field of research, the focus is on synthesis and imagination of what things could be (Fallman, 2008). Research motivations may also include the critical evaluation of industry trends and perspectives (e.g., is it truly advantageous that we may store unlimited photographs with ease? What positive or negative effect may it have?) and the consideration of things that receive little attention in industry.

Bill Verplank's (2000) take on Interaction Design gives a sense of the process, the how and what of design. In his view, Interaction Design is design for human use. It involves answering three questions (ibid.):

- How do you do? In what sort of ways do you affect the world: poke it, manipulate it, sit on it?
- How do you feel? What do you sense of the world and what are the sensory qualities

that shape media?

- How do you know? What are the ways that you learn and plan (or perhaps, how we want you to think)?

These questions, when considered together, cover the various elements that make up most interactions between humans and systems. From understanding what someone knows, it follows what they may understand what they can do, which in turn shapes what they may feel. These questions are explicitly cyclical and meant to be answered iteratively. Each iteration requires making a step towards a more desirable state, accompanied by reflections on what a supposed desirable state is and how the current iteration moves towards it. As such, Verplank's view on Interaction Design features similarities with the idea of the reflective practitioner (Schön, 1983). Schön highlights that practitioners (whether it be designers or otherwise) have many implicit skills that cannot be readily expressed but are tacitly known. In doing work, such knowledge manifests itself and enables experienced workers to reflect on their work and steer it in a way that appears intuitive. However, what seems intuitive to those with the relevant experience is often inaccessible and unseen to those without such tacit guidance.

The open-ended definition by Verplank (2000) also leaves room for new perspectives to develop as those involved become more aware and knowledgeable about the potential answers to the three questions. Once more, a parallel can be drawn to design thinking theory which posits design as a co-evolution of problem and solutions (e.g., Dorst & Cross, 2001). In particular, what sets apart design as a practice from others that aim to generate new systems for human use (e.g., engineering, computer science) is this emphasis of the co-evolution of problem space and solution space. Such a space is a range of problems or solutions that are considered relevant (more on this in a later section). In its ideal form, a design thinker is willing to accept and seek new perspectives on a problem to arrive at a new outlook on appropriate solutions to a now reimagined problem (Dorst, 2011; Schön & Wiggins, 1992). However, this emphasis on a reflexive process may at times prove a challenging marriage with traditional means of disseminating research findings, as starting principles may be questioned throughout a design process (Fallman & Stolterman, 2010; Zimmerman, Stolterman, & Forlizzi, 2010).

Hereafter, two specific approaches to doing design research are considered that align with the studies reported later in this thesis, namely research to support design and research-through-design.

2.3 Design as research practice

A contribution in the form of generative knowledge fits with a process usually labelled research-through-design or design-oriented research (e.g., Archer, 1995; Fallman, 2003;

Gaver, 2012). The latter may also be labelled design to support research. Characteristic of these approaches is the use of designed artefacts and empirical evaluation through use studies. There are differences between research-through-design and design-oriented research, most notably in the value ascribed to any designed artefact (Zimmerman et al., 2010). Research-through-design considers a design and its process part of the outcome, while design-oriented research ascribes more value to knowledge gained for use in future designs (and does not require a designed artefact to be part of the investigation that led to this knowledge). Common across these research paradigms is the investigation of people's current practices or introduction of a designed intervention in ecologically realistic environments. This explains why tightly controlled lab experiments are not common in this approach. Knowledge stems from interpreting (often qualitative) responses from participants, relating this to a body of existing work, and formulating ways in which current insights could shape future designs and new research questions (Preece et al., 2015; Stolterman, 2008). The form such knowledge takes can be theoretical, a process of designing, methods of investigation, user scenarios, and future design concepts (Fallman, 2008).

The use of speculative designs stands in contrast with classical definitions of science. Controlled testing and assessment of data to accept or refute theories rely on a belief in objective evidence, a belief that cannot easily be sustained in the light of design practices that welcome subjectivity (Archer, 1995; Fallman, 2003). Here, the acquisition of knowledge based on exploration through usually qualitative responses to speculative designs cannot deny some influence of subjectivity on behalf of the researcher. Furthermore, any speculative design work embodies the beliefs and theoretical understandings of its maker(s) (Archer, 1995). It is, therefore, important for designer-researchers to be aware of their subjectivity as a researcher and designer of any artefacts to be used for evaluation.

Nonetheless, as Fallman (2003) remarks, research prototypes many times just seem to 'happen,' with thoughts and decisions that went into designing often lost and not communicated. This critique on research-through-design argues that theory building is seldom explicit or arrives (long) after evaluation of a designed artefact, reducing its effectiveness as a robust method of inquiry (Zimmerman et al., 2010, p. 316). An emphasis on contributing to theoretical knowledge should thus be formally incorporated into research-through-design efforts and perhaps begets a critical evaluation across various 'design for remembering' efforts to support the development of theory. Chapter 6 makes an inquiry of this kind.

2.4 Epistemology of design

Knowledge-generating practices in the field of Interaction Design find their origins,

values, and methods rooted in both in Rationalism (with an emphasis on the search for an objective truth) and Empiricism, which values a process wrought in personal experience (see Archer, 1995). This section shines a light on the epistemological origins of the methods used in this thesis.

The objectives of this work call to find out whether existing practices of serendipitous reminiscing can be insightful, and whether new interactive technologies can be beneficial in the context of everyday life. This 'everydayness' implies the existing situation is often quite ordinary, both to participants and the researcher given a glimpse. It takes a reflective step away from the ordinariness to arrive at meaningful insights (e.g., Dourish, 2007; Pink, 2014). Such a reflection works on and through the bias inherent in the observer (be it the participant in the case of diary studies (as in Chapter 4) or the researcher in other works). Because such an endeavour is a study of human practice, the Interaction Design field has readily taken to influences on doing research from the social sciences (Preece et al., 2015).

The core of the social sciences is about paying analytical attention to certain aspects of social settings (Dourish, 2004). Teasing apart practices may reveal meaning. Ethnography is one example of the study of practice. Historically, it was employed to study other cultures (why are they doing things differently?), and over time ethnographers pivoted to study practices closer to home. This is how ethnography became integrated into design research as a way of understanding people and practices beyond what quantitative methods could reveal (Anderson, 1994; Dourish, 2007). Subtle and complex practices that cannot be reduced to simplistic models of human behaviour became more suitably described by an ethnographic approach.

The foundation for this subjective way of viewing the world lies in the qualitative orientation, which for the purposes of this text, is most clearly embedded in phenomenological theories (Moustakas, 1994; Verbeek, 2005). In this view, it is not possible for social facts to be objective beyond an individual or a group's ability to recognise and acknowledge them. As such, these social facts emerge from interactions within and between groups and are not a stable phenomenon. Instead, these can be contested and morphed to take on new meaning (Dourish, 2004). An obvious example of a social fact is human memory, in particular, the memory of a group for a historical event. The chain of events and their meaning are readily plastic to the subjective interpretation and reinterpretation of those remembering (e.g., Hirst & Rajaram, 2014). Thus, the idea of an objective truth that can be quantitatively asserted no longer holds much merit. Instead, phenomenological theories posit the view that objectivity is better understood as a consensus of interpretation (Moustakas, 1994). Therefore, meaning emerges out of (evolving) practices in which certain actions and objects acted with and upon have their

role (Dourish, 2004).

With this practice-oriented perspective, it is vital to acknowledge the role of context, not as a backdrop to whatever unfolds in the centre of attention but as an integrated whole (Dourish, 2004). Context is a relational and dynamic property that holds between objects or activities (Dourish, 2004). In this view, context is an emergent property of a specific activity (and in the case of research, of the observation of such an activity). For an (interactive) system to become a part of meaningful practice, it has to be available and fitting the prior context such that a new or evolving practice may embed it (Latour, 1992; Verbeek, 2005).

A suitable aim for research towards new or evolved interactive systems is thus a rich understanding of current and possible new practices around personal media use. For example, teasing apart current ways of meaningful personal media use may inform future design work (i.e., research to support design) or through the introduction of a designed system in a more interventionist approach (i.e., research-through-design). The latter attempts to generate knowledge by exploring what could be and what kinds of meaning people derive from such an intervention. This approach also leaves more room for a designer-researcher to shape and influence potential new practices.

2.5 Approach to inquiry

To move from the theoretical foundations towards the approach taken in this thesis, this section makes a brief stop for several common data collection methods and ways of analysis. Because this project intends to explore remembering experiences (which are personal, qualitative assessments) and how innovative interactive systems may influence such experiences, these methods primarily follow the interpretive ideas laid out before. This section serves to provide the 'why' behind the 'how' and what' of the methodological choices in the chapters to follow.

2.5.1 Interviews

Interviews are an effective method to get to know someone as they would like to reveal themselves. Nonetheless, interviews cannot reveal actual practice, at least not without taking into account the interviewee as a (to varying degrees) unreliable narrator (Hester & Francis, 1994). The concern is that interviews are retrospective and to some extent interpretive of prior behaviour. Someone will tell a different story from one instance to another depending on what comes to mind, what is considered relevant to the conversation, and other contextual factors. This implies a (varying) degree of interpretation between actual practices and the narration thereof during an interview.

Anthropologists also take issue with ethnographic interviews in that these are too short

an endeavour to get a good view on the subject matter, in contrast to their preferred long-term field studies doing naturalistic observations (Pink & Morgan, 2013). Pink and Morgan argue counter to such a view because long-term studies typically suffer a low density of interesting things happening while the researcher maintains a ‘fly on the wall’ attitude to immersion and participation. In the context of this work, an example would be to observe how and when people interact with their personal photo collection. Past work has shown such moments are few and far between, in particular, those that involve storytelling or are otherwise readily observed by a researcher or recording device on behalf of the researcher (e.g., Drazin & Frohlich, 2007; Kirk & Sellen, 2010; Whittaker et al., 2010). More time-compressed and more intensive ways of doing research provide a valid alternative, as argued for by Pink and Morgan (2013), as well as Millen (Millen, 2000). Interviews may well fit into this ‘more intensive’ classification and do away with some of the interpretive steps towards meaning by just asking people. Most importantly, interviews are time-efficient for both interviewee and researcher. Some of the qualms can be taken away if insights from interviews are triangulated with other ways of inquiry that are more actual or long-term in nature.

2.5.2 Self-reports and probing

Bridging the gap between passive observing and questioning are self-reports. This is primarily a way to get people to report salient moments or reflections on a particular phenomenon (Bolger, Davis, & Rafaeli, 2003; Carter & Mankoff, 2005). For example, Chapter 4 discusses a study that employed diaries for participants to record any time they were reminded of an autobiographical memory. Such a diary allows the researcher to collect valuable data without interfering in the recorded moment. The diary itself, as is the writing in the diary, is, of course, an intervening factor that may make certain events more readily brought to attention and thus has some influence on what and how often people report (Carter & Mankoff, 2005). Diary studies suffer from potential under-reporting as people filter what they write, or over-reporting as they try to make up for ‘lost’ moments when they forgot about the diary (or the moment to return the diary looms large, and it is still a bit empty).

In Chapter 4, diaries are used to get insight on involuntary remembering in everyday life and what may cue this. The diaries also proved helpful in kickstarting people’s awareness to such kinds of influences on their remembering, which in turn helps in making the most of the interviews held at the end of the diary-keeping period. This has overlap with cultural probes, which are best regarded as appetisers to stimulate conversation around a topic (Gaver, Boucher, Pennington, & Walker, 2004).

2.5.3 Designed interventions

The use of prototype designs is perhaps the signature aspect of Interaction Design

research. Varying in fidelity from simple sketches to crude paper prototypes and all the way to near-final systems, these conceptual devices aim to elicit a response to a hypothetical new way of going about a particular practice (Buxton, 2010; Moggridge, 2007; Stolterman & Wiberg, 2010). Part III of this thesis discusses a range of examples in Chapter 6 and develops several more in the two chapters that follow. The use of concepts has a strong history and established practice in the design field (Höök & Löwgren, 2012; Stolterman & Wiberg, 2010). Even if a design represents only a small step into a possible future, it makes concrete some of the ideas and assumptions of the designer about this particular future. It is, therefore, more readily understood and reflected on by potential users, other researchers, as well as the designer-researcher himself. In turn, when people interact with such expressions of conceptual ideas (like interactive prototypes), their actions speak louder than when asked for a response to less defined ideas.

As it gets clearer and higher in fidelity, a design also gets closer to being a speculative but real expression of another way to go about existing practices (Buxton, 2010). Ideally, this elicits a stronger response as people may have an easier time imagining what it could be like to have a particular system or service in their life. To make a comparison to science fiction, the most evocative fiction may be that which could well be real because it demands introspection on whether such a speculative future is desirable (cf. Blythe, 2013; Dourish & Bell, 2013).

The challenge for a researcher with this approach is to find the level of speculative design that opens up ideas about, for example, future ways to relate to our personal media and on the other hand to arrive at a design that is grounded in reality. If something feels real enough, it allows people to extrapolate from today's practice to the proposed new practice without a major leap of imagination. The insight that emerges from such an approach gives a hint of what is meaningful through the potential actions and supported practices, whether old or new. Again, the closer this speculative design can manifest itself to actual practices, the more likely it is that research-through-design delivers valid insights.

Compounding the issue of teasing out new insights is that it proves difficult to separate generated knowledge from the designed artefact. When it interacts with an existing phenomenon, both are transformed (Storni, 2015). Given the typically small size studies in the field, often due to the time and cost constraints of generating prototype devices, it is likely this approach is limited in its ability to speak with confidence about groups of people outside of the participant sample. Storni (2015) reasons that rigour comes if research-through-design outcomes are presented with modesty, in direct relation to the observed effects of the intervention, and by making clear the intentions behind the design. This includes being explicit about assumptions, particular features, and other motivations that went into the design. It allows others to understand the prior and new

knowledge, so that they may generate new ideas, questions, and improved designs.

2.6 Approach to analysis

Knowledge building in this thesis follows the interpretive tradition in Interaction Design. This means that it attempts to arrive at findings that (by abstraction) can be projected onto a larger population, albeit without claiming there is an objective reality underlying such findings. This tradition harkens back to social science influences as discussed in earlier sections and phenomenological concerns around the subjectivity of experience. The latter implicates the inherent tendency of positivist approaches to strive for a neglect of subjective interpretation on both the side of the person of interest and the researcher. This line of thought is most prevalent in Merleau-Ponty's (2012) philosophical work and that of those indebted to him, of whom there are many in the field of Interaction Design (although this has more to do with his work on embodied phenomenology) (see e.g., Dourish, 2001; Hummels & Overbeeke, 2010; Svanæs, 2013).

In the analyses of the studies included in this thesis, the principal idea is thus that any interpretation attempts to build from what is given by interview transcripts, activity data, and other (primarily qualitative) input. In defiance of a pure phenomenological and grounded approach, which promotes arriving at conclusions solely from the qualitative data in a bottom-up fashion with no a priori direction (Corbin & Strauss, 2008), the approach taken here leaves room for exploration of meaning and directed interpretation (as seen fit by the researcher). Such a take on qualitative analysis aligns with thematic analysis (Braun & Clarke, 2006) and content analysis (Hsieh & Shannon, 2005). When doing such an analysis, meaning is initially derived from qualitative statements through a process of coding of participants' statements. During analysis of a transcript the researcher attempts to classify statements by labelling those with keywords. For example, if a participant mentions that "*finding a scarf that was hidden in a drawer made her painfully aware of her relationship with the person who gave her this scarf,*" this can be coded as EMOTIONAL, PAINFUL, and OBJECT AS MEMORY CUE. After this first step, these codes may be arranged in (sub)categories which, after several such rounds of review, may lead to a hierarchical structure.

The purpose of this analysis is that it allows for comparison of participants' perspectives to highlight similarities (e.g., themes) and differences (Braun & Clarke, 2006). The final hierarchical structure may also be compared in this manner with earlier work to bring out new insights. Up to this point, thematic and content analyses follow a trajectory largely similar to grounded theory and phenomenology (Hsieh & Shannon, 2005, p. 1281). Where these methods differ is that the last two tend to go further into theory building and a more evolved understanding of the experience of interest. Depending on the desired outcomes, it may not be necessary to go to that level. For example, if a phenomenon

is well understood but a particular design intervention's effects are not, a pragmatic approach would build on the pre-existing understanding rather than reinvent this. With some theoretical direction, the analysis becomes a mix of bottom-up coding based on participants' perspectives along with predefined codes lifted from relevant theory (Braun & Clarke, 2006). In their review, Hsieh and Shannon (2005) refer to this as directed content analysis. In the context of this thesis, such direction may stem from both theory and intents behind a design intervention. The final part of the thesis uses design concepts and prototypes to study the place of technology in serendipitous reminiscing, and it is these designs and the conceptual thinking behind them that the studies aim to evaluate. With that in mind, an undirected approach to analysis only grounded in the data seems to miss the mark. Because each prototype is an embodiment of a hypothesis, the expectation of the researcher is not open ended. Therefore, an open-ended approach would fare not well as a means of extending the conceptual work at the base of the studies' premise.

A balance between observations and prior conceptualisation is struck on an individual basis for each of the studies in the chapters to come. The more explorative work such as the diary study reported on in Chapter 4 leans towards the undirected side, whereas the research-through-design Chapters 7 and 8 follow a more directed approach. In turn, these chapters also directly speak to the development of such conceptual work as proper outcomes of design research.

2.7 Types of contributions

Throughout the research included in this thesis, the contribution to knowledge comes in three forms. There is a contribution to the understanding of people and their practices, how these insights can help drive future work by designers and researchers, and the development and refinement of the design space of serendipitous reminiscing. Because the notion of a design space is rather nebulous in the literature, this is given additional attention below.

Insights into people and their practices represent outcomes most closely related to similar work in the social sciences, such as ethnography. The aim is to elucidate a particular set of preferences or common practices of a person, group, or culture. Typically, the focus is on a domain where technology could make a meaningful difference or is used in suboptimal or surprising ways. With this kind of insight, the aim is to lay bare these practices such that other researchers or designers may come to their own conclusions on how it translates to design work. A notable benefit of such insights without explicit reference or application to a current technology is that the findings may remain valid and inspirational even if technological progress marches on (Dourish, 2006; Dourish & Bell, 2011). Despite such criticism, insights for future design efforts, within the field better known as implications for design, constitute the second kind of contribution this thesis makes. This kind

typically originates in new or refined insights, which are then transformed into guidelines and other indications that may be helpful for the design for human use. The critique towards such implications, apart from de-emphasising ethnographic insights at the basis of the work (Dourish, 2006), is that blind adherence to resultant principles may obstruct or mute novel insights that do not fit the current understanding of a topic (S. Greenberg & Buxton, 2008).

There is no commonly accepted or typical way to communicate insights for design. Annotated portfolios are one proposal to increase transparency and accountability in research-through-design (Gaver & Bowers, 2012). This kind of portfolio presents a design artefact together with the ideas that went into its creation, along with other relevant aspects such that readers may reach an informed opinion. Höök and Löwgren (2012) proposed to generalise from specific insights and testing by articulating experiential qualities and so-called strong concepts. These notions may then transcend the original work into other design situations. The authors reason that experiential qualities capture the experience between user and system, whereas a strong concept relates to interactive behaviour and should hold across different applications. Recently, these endeavours have been labelled intermediate knowledge for their position in-between the concrete of particular designs and the general level of (developing) theory (Höök et al., 2015). As the merit stems from the applicability of the advice, it is inherently more specific about the kind of technologies and practices it relates to. However, these implications could also include pointing out which potential areas have not yet been covered well in the literature, or how a new perspective may open up to a new design space (Zimmerman et al., 2010).

A design space is a conceptual framework of the questions, variables, and potential solutions of interest in a design problem. This framing may in itself be a contribution to knowledge. Central to design thinking is the tenet that the understanding of both problem and solution co-develop (Dorst, 2011; Schön, 1983). A design space is a way to conceptualise thinking towards a potential (range of) solutions. Such a design space reflects the thinking not just about these solutions but also about the kind of solutions that are deemed appropriate for the current understanding of a problem (Dorst & Cross, 2001). Framing a problem in a different way may lead to another take on potential solutions, making the framing itself also a creative act (Dorst, 2015).

A design space identifies a comprehensible number of constraints, variables, dimensions, and trade-offs for designers to consider. According to Baumer (2015), a design space should be seen not as a problem space, but *“as a complex situation in which we can pose various design interventions”* (p.593). A design space is something that is not seen, at least never in full. Only through ‘trying’ different places within the potential space does a designer learn about the trade-offs at the dimensions of relevance there. A design space

can thus be characterised by considering a range of explored (hypothetical) solutions, for which the inherent qualities and trade-offs of these solutions demarcate the 'lay of the land' for the design space. Alternatively, a design space may be characterised by carefully considered parameters, variables, or dimensions that lay out potential design directions (for perhaps yet unknown solutions). Of particular value here is the pointing towards uncharted territory and laying out the trade-offs to be considered. These two insights together inform a generative design space, one that portrays a map of potential roads already explored and roads yet to be taken by those looking for solutions.

The value of a design space lies in shaping the thinking about potential design solutions and, in doing so, reflecting the perspective of the designer. For outsiders, it becomes a tool to follow, critique, and nudge a designer's perspective. For designers themselves, formulating a design space is helpful to grasp and reduce the complexity of a design task. Again, the whole design space may never be known, nor is it necessary to consider all aspects of a phenomenon to move forward (that is, to be able to generate new solutions or identify alternative perspectives) (Cross, 1982).

A contribution to the understanding of a design space can thus come in five ways:

1. Identifying or clarifying a particular trade-off or characteristic for designers to consider.
2. Charting a design space by putting existing or speculative work into a framework or at least highlight how various such solutions relate to each other, again exemplifying particular choices and their trade-offs.
3. Charting a design space and identifying unresolved tensions, uncharted perspectives, and point out new directions for thinking about the design space.
4. Tracing existing design solutions to their design space (i.e., relevant parameters and trade-offs) in an attempt to understand or clarify the reasoning behind that solution. It may serve to exemplify, communicate, or critique the examined work.
5. Generating new ideas and potential solutions to exemplify or test assumptions about a design space.

It is worth pointing out that the first four could be considered research-for-design, whereas point five is a clearer example of research-through-design provided the work is done with the explicit idea of building from and commenting on the design space.

This section made clear that design spaces have value at various moments during a design process. The clearest link with the iterative process of design thinking are the notions of divergent thinking (i.e., identifying and ideating opportunities) versus convergent thinking (i.e., selecting from options) (Lawson, 2006). The concept of a solution space is

closely related, albeit at least in name more about the possible solutions after imposing constraints. A design space as understood by most designers appears more holistic, less solution driven but perhaps given more weight to understanding the constraints and underlying phenomena at hand. Defining or refining a design space may thus contribute to a field's understanding and open up new avenues for future work.

2.8 Remarks & ethical considerations

This section considers several remarks concerning the approach taken in this research, including some of the ethical issues with delving into people's personal lives and memories. It helps to frame the research as an act motivated to shape the status quo into something more closely resembling an ideal (Latour, 1992; Verbeek, 2005). It is open to debate what such an ideal is, in this case surrounding the place of reminiscing in everyday life. It would, however, be wrong to deny that such motivations are involved, and it is more transparent to lay those bare. As Latour (1992) insists, even something as simple as the design of a self-closing door reflects and perpetuates the philosophical and social leanings of its creators (who naively might consider their machine as 'neutral'). In similar fashion, the choices involved in the design of a personal photo viewing device reflect the notion that indeed looking at those photos is a good idea, and that exposure to them may be beneficial. This view is exposed in many commercial offerings as well as HCI work (Jones, 2016), and to some extent perpetuated and questioned through the conceptual designs discussed in Chapters 7 and 8. Although our approach follows larger societal trends around personal media becoming more ubiquitous (see e.g., van Dijck, 2007), it is likely that at some moments participants may have been uncomfortable with being confronted with their past. For this reason, we sought prior ethics approval.

All the studies reported in this thesis were carried out with prior approval of the UTS Human Research Ethics Committee (with program approval numbers HREC 2012000570 and HREC 2015000629). Each person involved gave consent before participation. Despite the requisite planning of potential risks and benefits, such consent cannot cover for all possible effects of participating. Some personal stories reported by participants proved emotionally taxing to revisit and share. Participants were always free to refrain from sharing such matters, but that cannot halt the remembering process and associated emotions. Such events are of course not unexpected for this kind of research, nor should it be avoided if participants are willing to go there. It is typically straightforward for the researcher to accommodate in a one-on-one setting, such as interviews, for example by taking a short break.

The in-the-wild approach taken in the final study (Chapter 8) made such accommodations more complicated. The ethics approval and consent were limited to the person involved in the study but the design intervention made no such distinction; all members of

a household were able to use the interactive device and, by extent, be affected by it. In some households, minors were encountered, but they could not be asked for their opinions, as the ethics approval was limited to those 18 years and over. In such cases, the adult participants were free to comment on any observations they made regarding the younger users. As Munteanu, Molyneaux, Moncur, et al. (2015) reason, most formal ethics procedures do not cater well to such ‘murky waters’ in which not all factors can be controlled for. The authors point out that some encounters (such as retelling stories of the past) are hard to predict beforehand in terms of emotional impact and risk.

Another complication related to the longer timeframe of the device-at-home deployment is that participants cannot easily reduce or negotiate their involvement at any point. This is also true for others entering the space where a device is located. If they interact with or view any photos shown on a device, does this make them (non-consensual) participants? In the case of the study reported in Chapter 8, the device’s logging capabilities were limited on purpose to avoid a strong sense of being ‘spied on’ whenever in the vicinity of the device. Munteanu et al. (2015) give a more rounded account of such ethical concerns, and remark that navigating in-the-wild ethics requires stronger researcher-participant rapport to get people at ease with raising their concerns. Note here the tension with the observations about researcher perspectives and bias at the start of this section.

A specific concern for the present research is the potential exposure to undesired photos. That is, images that people believe have little value (e.g., blurry images, a ‘note’ of some coupon), are inappropriate for a particular audience (e.g., conservative grandparents may frown upon some scenes), or images that are otherwise undesired (e.g., romantic selfies with an ex-partner). Part of the objectives of this thesis is to understand better what aspects make some images more desirable in everyday encounters than others. Exploring these boundaries is likely to wade into areas of unease, although efforts were made to limit participants’ discomfort.

2.9 Conclusions

This chapter has provided a theoretical foundation for the methodology applied in this thesis. Research in the field of Interaction Design is diverse, which is no surprise given its roots in several epistemological traditions. This thesis follows the subjective flavour of research to support design (in Part II) along with research-through-design elements (in Part III). Taken together, the studies contribute to the literature by providing insights into behaviour around everyday reminiscing and translate such insights in more generalised suggestions that may prove useful to improve future interactive systems to support remembering. By providing a background on the specific methods explained in the individual chapters, this chapter also provides a springboard for reflections on the approach in the chapter.

*A review of reminiscing
and serendipity*

3

3.1 Introduction to this chapter

To reminisce means to indulge in the recollection of past events, often with the intent to enjoy this recollection. Given the potential pleasure derived from reminiscing, it makes sense to evoke personal memories and stimulate reminiscing. However, this pleasant application is not the sole motivation for people to reminisce, nor is enjoyment the only possible outcome.

This chapter reviews relevant literature on memory and reminiscing from interaction design and related fields, to cover cognitive, social, and cultural views on memory. The text does so by first laying out how remembering works from a cognitive and ecological perspective. After this, the chapter turns to why reminiscing is valuable, before addressing in what ways reminiscing manifests in everyday life. From there, it builds on the argument put forth in the introductory chapter that reminiscing in everyday life may sometimes be triggered through encounters with things that relate to the past. To this end, the text deepens the discussion on serendipity and reminiscing. We make the argument that reminiscing in everyday life often happens without the explicit intention to ‘sit down’ and reminisce. Instead, it is embedded and manifests itself in the routine of everyday life. Although it forms an inseparable part of the everyday’s unstructured activities, reminiscing may stand out, at least momentarily, from someone’s ongoing activities.

We may speak of serendipitous reminiscing when referring to chance encounters with memories of one’s past and the things that bring such memories to mind. The final section of this chapter puts forth a definition for serendipitous reminiscing and identifies five characteristics. By illustrating both the background and perspective taken for our work, this chapter lays the groundwork for the role that designed artefacts and systems can play in supporting serendipitous reminiscing.

3.2 Autobiographical memory

This section lays out the available literature on our memory, its functions, and mechanisms from a cognitive perspective to paint a picture of what memory is and is for. The most relevant kinds of memories for reminiscing in everyday life are autobiographic and episodic memories. The latter are summary records of concrete, singular events from the past, while autobiographical memories may span over a longer time frame (Conway, 2009; Gilboa, 2004). Conway (1993) defined autobiographical memory as the “*memory for the events of one’s life.*” It intends to support the self and critically, a continuous story of the self, in which personal goals, self-identity and emotional salience form a coherent package (Cohen, 1996). Greenberg and Rubin (2003) consider the experiential aspect of reliving key to the idea of autobiographical memory because it necessitates the person remembering to be aware of the prior conscious experience. Therefore, they define autobiographical memory as “*a memory of a personally experienced event that comes with a*

sense of recollection or reliving" (p. 688). This frames remembering as relevant to personal experience, a connection that subsequent chapters build out further.

Remembered events can differ in specificity and timespan: from the smallest unit, event-specific knowledge (ESK) for events lasting up to hours at most (e.g., a dinner party), to general events lasting days to months (e.g., a holiday), up to the much longer span of lifetime periods (e.g., being a teenager) (Conway & Pleydell-Pearce, 2000).

3.2.1 Functions of autobiographical memory

Autobiographical memory serves self, directive, and social functions (e.g., Bluck, 2003; Conway, 2005). The self refers to the support of individual identity based on one's remembered past. The directive function uses memories to solve current problems and guide future plans, while the social function relates to the use of memories to bond with others and maintain relationships. Reminiscing, "*the volitional or nonvolitional act or process of recollecting memories of one's self in the past*" (Bluck & Levine, 1998, p. 188), provides a suitable way to enact these functions. With no clear empirically superior model of reminiscing functions available, several categorisations are viable.

Webster (2003) divides a reminiscing framework into pro-social functions (inform/teach others, conversation), self-positive (death preparation, problem-solving, identity), and self-negative functions (boredom reduction, bitterness revival, intimacy maintenance). Stating empirical issues with the commonly accepted three-function classification, Harris, Rasmussen, and Berntsen (2014) proposed an alternative classification of motivations to reminiscence in four classes: reflective, generative, ruminative, and social. In this model, reflection is "*self-focused attention motivated by curiosity or interest in one's self and one's behaviour,*" and is considered a positive, adaptive form of self-focus (ibid., p. 17). Its more negatively inclined counterpart, rumination, is "*self-focused attention motivated by perceived losses and threats.*" Generative uses, such as teaching others and preparing for death, stem from a motivation to impact one's environment positively and build a legacy. The social motivation is squarely aimed at bonding with others. The authors note that emotion regulation is another fruitful purpose of reminiscing.

Westerhof and Bohlmeijer (2014) divide reminiscing into three functions. First, it serves a social purpose, as sharing stories in everyday conversations fosters bonding. Second, reminiscing can be instrumental in coping. By recalling past experiences, people may learn and prepare for the future. Third, reminiscing is integrative, as it provides a way to reflect on the past to define one's identity. In contrast, Sellen and Whittaker (2010) opt for a narrower definition: Within their outline of five functions of autobiographical memory, reminiscing is the recollection and reliving of previous experiences, often for enjoyment and restorative purposes. For example, a couple may browse through a photo album to

relive a marriage and rekindle with their feelings on that day. The authors argue that most systems that aim to support remembering operate at a recollective level, because relevant properties are readily captured (e.g., date and time, who was present, what a place looked like). More abstract functions – in particular, those that support reflection and re-assessing the self in relation to others – are harder to support, as related values and practices are more ambiguous to interpret.

This overview of autobiographical memory functions helps to illustrate that prior knowledge, personal relevance, and affect are central in the formation of memories (Rubin, 1995b). These three ingredients inform how relevant any new experience is to the self, and therefore how valuable it is to keep a memory of such an experience. The same valuation process affects adaptation of existing memories. Thus, prior memories can be shaped to reflect current goals and someone's desired identity (Bannon, 2006; Harris, Sutton, & Barnier, 2010). This implies that less relevant memories become less salient and over time, may no longer be activated (Harris et al., 2010). In other words, those memories are practically forgotten.

3.2.2 Constructionist view on memory

The notion that memory is an adaptive and ever developing system stems from a constructionist view on memory (Baddeley, 1999). Alba and Hasher (1983) give a detailed account of memory as a constructive phenomenon. Any event goes through several phases of encoding, namely selection (not all incoming stimuli will be encoded), abstraction (meaning is abstracted from the specific features), interpretation (relevant prior knowledge is invoked), and integration (to form a holistic representation of the event from the outcomes of the previous phases). At a later moment, reconstruction can take place: the mind reconstructs what might have happened based on accessible information of an event, combined with general knowledge.

This encoding, decoding, and re-encoding process of memories provides several benefits. It allows re-interpretation, reflection, and ultimately (through re-encoding) alteration of the original memory. Such alteration has upsides for memories of disturbing events, but can equally affect pleasant, treasured memories. The original memory may even be absolved or become indistinguishable from other, similar memories. While this may be the goal for certain clinical programs, forgetting is generally thought to be a negative aspect (Harris et al., 2010; Mayer-Schönberger, 2011). Fuelled by a desire to scaffold our fallible memories, Mayer-Schönberger (2011) argues that forgetting as a trait of memory is obstructed due to a myriad of innovations aimed at preserving memories indefinitely. The promise of such technologies is that forgetting is something we should no longer have to deal with in our modern age (Bos, 1995). However, if forgetting is framed as the outcome of a successful personal relevance filtering process (e.g., Conway, 2005; Harris

et al., 2010; Michaelian, 2011), obstructing this process by repeatedly bringing to mind irrelevant memories impacts our cognitive ability negatively (Mayer-Schönberger, 2011).

The function of memory is not to be able to reproduce facts or episodes from the past in an exact way, rather it enables the reflective, generative, ruminative, and social functions outlined earlier. Bannon (2006) points out that forgetting is a necessary activity to filter out the most relevant parts so that we can act on those. There is a case to make for a more sensible approach about which personal media are relevant to bring one's memories to mind, and which are not.

3.3 Bringing memories to mind

Memories come to our awareness based on intentional, voluntary effort (e.g., seeing a vase and then trying to remember how you got it), or involuntarily (e.g., remembering your neighbour gave you a vase upon seeing that vase) (Berntsen, 2009). Involuntary memories thus need some way of invocation, whether taking a cue from (for example) thoughts, activities, or external things (see Figure 3.1 for a representation). This distinction between voluntary and involuntary remembering is relevant to the design of supportive technology, as each process brings with it a different practice and experience. More specifically, involuntary remembering is brought about by aspects that are not fully in the control of the person remembering. Everything that reminds us of a memory, such as a location or a particular smell, can be regarded as a memory cue. Such cues may be regarded as memorised links, relying on recognition to retrieve the meaning and related memories.

In line with a constructionist view, memory should be considered as an associative system. Relatedness to other elements is what binds individual elements together, and association also provides a model for activation of memories. If some cue (i.e., a thought, or percept) triggers a pattern of activation, this implies some cognitive link between the cue and the memory eventually brought to mind. This would also explain why more related cues (i.e., stronger activation) are more effective at triggering a memory (Baddeley, 1999). Conway & Pleydell-Pearce (2000, p. 273) dub this direct retrieval, and identify another process named generative retrieval, which assumes a cyclic search process in which cues define criteria for each search iteration, until a satisfying memory is recalled.

Due to an incomplete understanding of the cueing process, it is not precisely known what aspects of a cue relate to a memory. Some correlation between a memory and a potential cue is assumed (Conway & Pleydell-Pearce, 2000). Based on diary studies, Berntsen (2009) finds that people become consciously aware of involuntary cueing between one to five times per day. It may, however, happen (much) more often on a non-conscious level. Cues are most often external (e.g., objects), some internal, with only a small number of

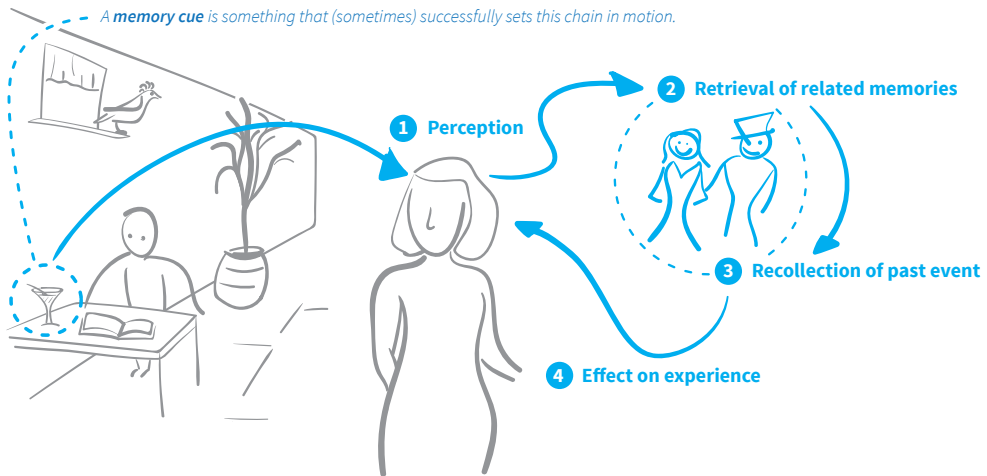


Figure 3.1. A simplified representation of the remembering process, starting with a cue that leads to the activation of a memory, and from there, to related emotions and experiences.

sensorial cues (e.g., sound, smell) or having no identifiable cues. Distinctiveness, recency, frequent rehearsal, or relation to a highly emotional event may improve a perceived thing's ability to cue a memory (Berntsen, 2009). Again using self-report diaries, Mace (2004) challenged the findings by Berntsen and her co-authors, arguing abstract cues (i.e., thought and language-based) are more prevalent than perceptual cues, even if those cues had been external to the person remembering. According to Mace, involuntary cueing features similarities to voluntary cueing as it relies on abstract associations made by the person remembering. Such cueing may be more congruent with already ongoing thoughts someone has, as it seemingly relies on internal association processing akin Conway's and Pleydell-Pearce's (2000) model mentioned earlier. External cues are always internalised first, in Conway's understanding (personal communication, 2014), and thus subject to the sense-making processes that construct our ongoing reality.

The notion that the current state of mind is guiding our remembering also implies other mental processes interact to modulate a cue's effects: one can see a photo frame many times without becoming aware of related memories. Such selective recall illustrates that motivations matter, as does the recent activation of related memories (e.g., Berntsen, 2009). For example, during mundane activities (e.g., cooking, cleaning) some people are more likely to be involuntarily triggered, perhaps because they are open to stimulation (Berntsen, 2009, p. 28). This falls in line with ideas on cognitive load and openness to stimulation, which suggests an adaptive role for supportive technologies based on the available attention someone may have (Bakker, van den Hoven, & Eggen, 2011). Thus, the cueing of memories is not only dependent on one's state of mind; contextual factors also

play an important role.

3.4 Remembering as ecology

Memory as an adaptive system surpasses the traditional boundaries of the mind, leaving room for external cues, such as personal media, to play a role in remembering. Remembering is not restricted to just our body but readily takes on information and cognitive help from the social and physical environment. People's actions and intentions cannot be seen separate from their environments and social interactions. Rather, Hutchins (1995) reasons that these mutually influence each other. Cognitive processes are best analysed within their context, that is, their ecology (Hutchins, 2010). Memory is not solely in us but can be distributed in the ecology surrounding us. Such a distribution, or symbiosis with external memory aids, is possible if rather than knowing something we can reliably know where to find the information. Sparrow, Liu, and Wegner (2011) draw a parallel to social remembering and memory processes involved in sharing information between people.

As a part of a distributed cognitive ecology (following Hutchins' (2010) terminology), technology can be an active part of such a distributed memory system. In such a system, all parts can play a constitutive role in remembering. Thus, technology can be seen as a means to remember. People use it for this purpose, and it can influence without prior intentions. A parallel can be drawn to music. According to Colombetti and Krueger (2014), music can be considered an emotion-extending external resource. These emotions, in turn, may be partially composed of factors outside the person experiencing the emotion. Thus, for this person, these emotions partially reside in a particular piece or genre of music. For another person, that same music may represent something else or not much at all. The music, or any other thing that could take its place, is thus not similar to biological memory, nor does it fulfil the same role (cf. Michaelian, 2012). Nonetheless, the idea of a cognitive ecology suggests we may have to adapt our body, music, photographs, surroundings, and other elements, to change our thinking and ongoing experience.

Hoskins (2011) remarks the role of media as a technological extension is not new and quotes media theorist Marshall McLuhan, who argued that "*all media are necessarily extensions in technological form of one or more of our senses*" (M. McLuhan, Molinaro, McLuhan, & Toye, 1987, p. 256). The notion of media, in this case, points to something that transcends the memory of one individual and can be taken up by a different and wider audience, perhaps becoming a cultural memory. Things, whether these are photos, music files, or physical artefacts, are thus not merely mnemonic cues for remembering, but take part in the cognitive ecology that results in remembering. Therefore, autobiographical memory may be seen as the product of interactions between one's past, the environment (including any interactive technologies), and other people.

The claim that remembering is a social activity ought to bring little surprise. Storytelling and reminiscing together is a way to bond over shared experiences. In the process of this, a group may negotiate a shared memory of a person, an event, or period. Halbwachs (1992) asserts that human memory is dependent on a collective context to function. Collective memory varies strongly depending on what members of the group bring in terms of goals, assumptions, and perspectives. Thus, memory is better regarded as a negotiated narrative in a social context (e.g., Q. Wang & Brockmeier, 2002). Over the past century, the idea of memory as a transactive, interpersonally negotiated system has gained traction (Halbwachs & Coser, 1992; van Dijck, 2007). As Harris, Sutton, and Barnier (2010) highlight, social influences on remembering are powerful. Social groups collectively go through a process of filtering, encoding, storing, and constructing memories in a transactive memory model. As this theory predicts, any disruption to such an ecology of people (and perhaps their shared things and spaces) should lead to an alteration of their shared memory and its potential loss (Harris et al., 2010, p. 275). In an everyday example, this kind of remembering together works for mundane tasks, such as recounting the particulars of a trip several years back. A couple may fill in the gaps between the individual partners' memories. Successfully doing so means the imperfections of one actor are scaffolded by another imperfect actor (Sutton, 2006). In essence, remembering is then a process of negotiation between several actors as they strive to fill in each other's blanks. These actors need not be just other people but may extend to the environment and (technological) artefacts. These artefacts (things as Brown (2001) would call them) support and complement thinking, according to Sutton's (2010) complementarity principle.

The ideas on distributed cognitive ecologies maintain a pivotal role for the human brain as the centre of memory. However, in a break with this idea on what memory is, some argue that memory is always a product of socio-cultural interaction (Harper et al., 2008). More precisely, memory is considered a label for types of action that reveal a knowledge of the past as relevant to the present (for example, telling someone about a similar experience ten years ago). Thus, memory is not that what is remembered. Instead, memory is an emergent property of actors with a shared socio-cultural understanding. Ergo, it cannot be studied or designed for as if it were in itself sufficient to be understood. Harper et al. (2008) make the case that this changes the position of technologies that aim to support remembering: such products and systems would not capture or mediate digital analogues for people's memory. Instead, these devices would 'provide resources for action,' that is, to recollect the stories of their past (ibid., p. 2). As a consequence, the authors imply that the useful value of memory arises in the dynamics of its context of 'retrieval,' which means that its 'use' must be framed in relation to a social use.

This section has framed remembering as taking part in the social and environmental

context, on top of the internal cognitive processes that were the focus of the previous sections. This is an important building block for reminiscing to take place in everyday life, which is characterised by its moving through a tapestry of mundane ecologies, in which technologies for reminiscing may be situated. The next section discusses how, amid the mundane, ecological elements (such as photos in a frame) may stand out to evoke serendipitous remembering.

3.5 Serendipity and reminiscing

Reminiscing, if involuntarily cued by thoughts or previously unnoticed elements in the environment, may be regarded as the outcome of a chance encounter. When this has a positive outcome, it is best described as serendipitous. Because the research presented in this thesis seeks to understand and evoke similar encounters with personal media, serendipity deserves attention.

In the words of Van Andel (1994), serendipity is “*the art of making an unsought finding*” (p. 631). Historically, the word has been closely associated with the nature of scientific discoveries (Andel, 1994; Merton & Barber, 2004). While looking into a particular relation or desired outcome, an anomalous finding prompts reconsideration and from there, possibly novel insights. This considers serendipity as the result of a two-step process. First, noting something odd or unexpected and second, making a realisation about that unusual thing or occurrence. Only when a chance encounter is synthesised into new insight would it be considered serendipitous (Andel, 1994; André et al., 2009). Thus, in this view, serendipity demands someone to be conscious of arriving at such a new insight, although it is not necessary that someone is aware of the influence that gave rise to the occasion.

For encounters with scientific findings or more everyday things to become serendipitous rather than unremarkable requires the observer to be at least somewhat unfamiliar. For this reason, Merton and Barber (2004) state that the encounter should be with an “*unanticipated, anomalous, and strategic datum,*” where datum refers to a scientific observation, a stand-out element, or as the case may be in this thesis, a personal photo. Unanticipated means that the observed datum is not the intended goal, even if it suffices to fulfil that goal (or a closely related one) once the observer realises this. Expectations also link to the datum being anomalous. It has to stand out as something extraordinary, although it may take skill and expertise to recognise it as such. Because of the latter, the strategic aspect refers to contextual circumstances. It is as much about what the observer brings to the moment of serendipity as it is about the occurrence itself (Merton & Barber, 2004). A classic example is the apocryphal account of Archimedes of Syracuse (as told by Vitruvius, 15 BCE; 2001) immersing himself into a bath, displacing water volume and from there, his realisation on measuring the true gold contents of a crown by comparing

its volume with its weight. This eponymous 'eureka!' moment relied on Archimedes making the intellectual leap from him bathing to the question of the crown. Van Andel (1994) considered such a personal analogy one of seventeen patterns of serendipity.

Although technological attempts to induce serendipity may cater particularly well to instigate chance encounters, André et al. (2009) stress the importance of the second, insight-generating step. The authors argue that the intellectual leap through the formation of a new perspective on a topic is what gives serendipitous findings their real value (and by extent, the motivation to study and invoke such encounters). However, as Csikszentmihalyi and Sawyer (1995) have laid out for creative insight (which bears many similarities to serendipitous encounters), the flash of that insightful moment draws upon a much longer process into which the person has invested themselves. This parallels personal memories as the foundation upon which reminiscing builds. By serendipitously bringing memories to mind through a cue of some kind, the process of remembering relies on making the connection between that cue and a prior memory. As such, it builds on someone being able to associate such a cue with prior events in life, similar to involuntary cueing and the importance of ecological context, as described in the previous section. When making sense of the world, certain surprising elements may capture the attention and 'demand' someone to make new meaning.

For the above reason, serendipity implies that out of chance encounters a more meaningful moment may emerge (Leong et al., 2008). In scientific discovery, this implies an intellectual leap towards a new understanding, but for everyday situations, it is more helpful to discuss such moments in terms of delivering possible delight and a meaningful experience (Leong et al., 2008). Unexpected encounters prompt people to consider new connections between established knowledge (e.g., memories) and the currently experienced ambiguity (Leong et al., 2011). It is in this process of making sense, through recollection, reminiscing, and abductive reasoning that people arrive at new insight and personally relevant meaning. To inspire such thinking, Leong and colleagues emphasise the value of defamiliarisation with personal media as a way of instigating serendipity. This may be accomplished through a randomised presentation or deliberate visual changes to personal photos (e.g., Guldenpfennig & Fitzpatrick, 2011; Leong et al., 2011). Frohlich, Wall, and Kiddle (2012) found that if personal photos were not reviewed for a considerable time, a similar defamiliarisation takes place, which could benefit the development of alternative insight on related events. This implies that both the embodiment of personal meaning by such photos and unfamiliarity due to the passage of time contribute to serendipity when re-encountering.

Accidental findings that may lead to serendipity come about through either opportunistic browsing or involuntary browsing (André et al., 2009; De Bruijn & Spence, 2008). The

former method entails exploring with the implicit intent of looking for interesting elements, patterns, or other aspects. The prevailing attitude is “*let’s see what’s there,*” (De Bruijn & Spence, 2008, p. 3). The latter method, involuntary browsing, is closer to the idea of unanticipated encounters without looking for it. Browsing in this context may be best interpreted as glancing or unintentionally getting cued. This is likely to happen in the process of doing other things (e.g., walking by, doing chores).

Serendipity is a desirable quality for reminiscing activities given its positive connotations, and a reasonable aim for work that seeks to evoke reminiscing in everyday life (as is done in the present thesis). It is however not the sole motivation to reminisce and certainly not the only quality that needs consideration in design. The next section addresses in further detail why reminiscing is an activity worthy of our time and attention.

3.6 Value of reminiscing

Earlier in this chapter, reminiscing was defined as the recollection and reliving of previous experiences. This section addresses the value of reminiscing and provides a basis for the motivations underlying reminiscing practices that will be discussed in the next section.

Reminiscing is a strategy for adaptive psychological functioning, as it serves reflective, generative, ruminative, and social functions (Harris et al., 2014) (see also Figure 3.2). These functions serve to regulate one’s emotions and mood (or those of someone else) and deal with any adverse sentiments or events (whether in the past, present, or future). Reminiscing does not exclusively serve to deliver a rosy, enjoyable experience although that may be one positive effect. To put past, present, and future experiences into perspective, it is valuable to remember and compare one’s own past with itself and with the experiences of others. Memory is thus a building block for such self-talk (Webster et al., 2010). Similarly, sharing and telling stories has always been a great way to bond with others (Rubin, 1995a). Our past provides a fruitful basket from which to pick suitable stories, considering that self-disclosure is an important aspect of building relationships (e.g., A. P. Aron, Aron, Tudor, & Nelson, 1991; Laurenceau, Barrett, & Pietromonaco, 1998). These aspects fuel the argument that remembering in general and reminiscing in particular help to understand ourselves, project towards our future, and bond with others (Thomas & Briggs, 2016; Westerhof & Bohlmeijer, 2014).

The benefits of reminiscing have been widely studied, in particular concerning older adults and those with symptoms of depression. While everyone reviews their past from time to time, a desire to review one’s life is stronger for those facing personal crises or mortality (Webster et al., 2010). Based on a meta-analysis of reminisce-based therapies, Pinquart and Forstmeier (2012) show that reminiscing produces notable positive effects on symptoms of depression, improved mastery, increased purpose in life, and improved

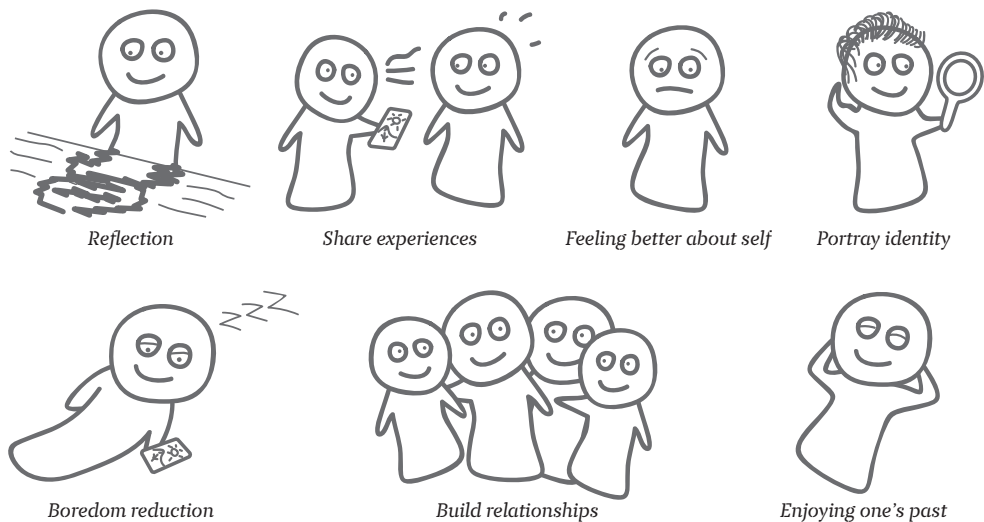


Figure 3.2. Sketches outlining common purposes for reminiscing.

social integration. The prevailing theory is that reminiscing helps to reshape and improve a concept of the self, for example by reviewing unhelpful views of the self, and promoting optimism (Hallford & Mellor, 2015). In a study with young adults, Hallford and Mellor (2015) indeed found a stronger effect towards a more positive self-concept and wellbeing for reminiscing that focused on problem-solving and identity purposes. Reminiscing is hinged on its context, such as sociocultural influences (Webster et al., 2010). It stands to reason that besides cultural, social, and personal differences, the opportunities offered by technological options in the environment also affect how a person may engage in reminiscing.

A mix of strategies for reminiscing (and their timely application) offers the best outcomes for increasing and maintaining positive emotional experiences (Quoidbach et al., 2010). These strategies can be grouped into savouring and dampening of the past and present. Savouring is a process that relishes positive aspects, whereas dampening does the opposite by focusing on negative details and rumination. The latter strategy may negatively contribute to positive affect and life satisfaction. Savouring, however, has also been considered as a conceptual tool for design that hopes to achieve positive user experiences (Pohlmeyer, 2014).

For an example of savouring strategies, Bryant, Smart and King (2005) studied how using the past could enhance short-term happiness. Like Hallford and Mellor, these authors evaluated whether having a specific strategy mattered compared to having none when reminiscing. Theory on guided imagery (e.g., Finke, 1985) suggests that mental imagery

may be more effective than external imagery in stimulating positive effects. If so, this would suggest that the use of memorabilia and personal media may restrict possible thoughts generated by a person reminiscing. Thoughts and feelings are not as well reactivated by common memory cues, which might direct attention towards particular details that are readily observable. A design-oriented study by Van den Hoven and Eggen (2009) provides some additional support for this idea. Participants were taken to a prehistoric theme park and made souvenirs there. A while later, these participants were asked to recall their memories of this trip. Those who were given no cue recollected more details compared to participants who were prompted using their souvenirs. This form of recollection is however subtly different from reminiscing: It is directed and prompted by the artificial constraints of the study, rather than personal motivations or unsuspected (involuntary) reminiscing brought on by observing the souvenirs. This is to say that the use of souvenirs and memorabilia should not be neglected. On some occasions, it is perhaps less effective for a fulfilling moment of remembering, yet external things are in the unique position to instigate such possibly serendipitous moments simply by being observable. Such was the conclusion of a study by Habermas and Paha (2002), who found that the use of memorabilia aided reminiscence for young adults transitioning to university life. The students' ability to use things to remind themselves of people and the past and to enhance their positive feelings, supports the evidence on external memory aids' value to reminiscing practices.

Returning our focus to reminiscing, Webster, Bohlmeijer, and Westerhof (2010) classified it into three levels of intensity. Although their classification was oriented towards psychological health practice, the lower, most common level provides a useful distinction for the role of reminiscing in emotional self-regulation. *Simple reminiscence* is primarily autobiographical storytelling and spontaneous reminiscing. It is relatively unstructured, as it often takes place in a relational context and serves to stimulate conversation, enhance social contacts, teach and inform, and regulate one's mood. It shores up short-term wellbeing. This is less about accurate recollection or deep reflection and is therefore easily transplanted into a conversation or thoughts we may have while doing other tasks (e.g., cleaning, cooking). Although recollection and reflection can also occur in short bouts, reminiscing is particularly oriented towards brief and casual encounters with our past. The objectives people have for the former functions are more strongly goal-oriented (retrieving details about a specific instance and changing one's perspective of self, for respectively recollection and reflection). Reminiscing, on the other hand, is less clearly goal-driven as it may be employed to satisfy current experiential needs (e.g., boredom reduction, or establishing rapport with someone). This makes reminiscing more amenable to embedding in other activities, as reminiscing often happens while doing other things.

3.7 Practices and design for reminiscing

So far, this chapter has established the cognitive side of reminiscing and the value of facilitating its functions. From this section onward, the attention moves to how reminiscing is done and stimulated in everyday life. It may emerge out of introspective self-talk, possibly with the use of meaningful things, or it may occur in a conversation. Often, things external to the minds of those conversing are instigators to such reminiscing activities.

There is a plethora of conceptual work, prototypes, and functional systems to support activities around our personal (digital) mementos (i.e., any thing that is meaningful for someone's memories, such as photos). A special issue in the *Human-Computer Interaction* journal in 2012 laid out three strands of research for 'design for personal memories' (van den Hoven, Sas, & Whittaker, 2012). First, investigations into current practices throughout ethnographic or data gathering methods, which often result in insights useful for the development of novel systems. The second strand concerns the design and evaluations of novel interactive systems, with the aim of learning from people's response to such systems. A third strand of work concerns lifelogging technologies (e.g., Elsdén, Kirk, & Durrant, 2015; Whittaker et al., 2012), which capture a broad amount of data in the hopes that such data may inspire reflection on one's behaviour or to remedy memory deficits (as with dementia and other forms of amnesia (Harper et al., 2008; e.g., Sellen et al., 2007)). Although lifelogging is outside the scope of this thesis, the other two strands of work provide valuable insight into the interactions with technology.

This section considers current practices with existing technology and the speculative use of novel technologies for reminiscing. We cover the role played by things and other sentimental artefacts, the central place of the home, and how newer digital technologies pose a demand for new ways of reminiscing.

3.7.1 The role of things to aid reminiscing

Things are valuable as externally distributed aids for memory. In discussions on material culture, the ability of things to hold a certain power over our thoughts and to direct actions has seen wide attention (e.g., B. Brown, 2001; Giaccardi & Karana, 2015; Ingold, 2011). Things do have a certain appeal and are instrumental in giving flesh to a sense of identity, place, and belonging. Such artefacts can come to symbolise meaningful places, times, people, and experiences with a striking flexibility (Csikszentmihalyi & Rochberg-Halton, 1981), and because of this, accrue sentimental value (Belk, 1990; Kirk & Sellen, 2010).

Indeed, things are able to stimulate vivid re-experience of the past (Csikszentmihalyi & Rochberg-Halton, 1981). People actively shape their environment to support and portray

their identity by curating items reminiscent of past memories, with the goal of keeping things around as symbols of the self (Csikszentmihalyi & Rochberg-Halton, 1981, p. 20). This behaviour, also known as autotopography (González, 1995), shows the complex relations between objects and the self. The popularity of everyday objects as mementos is “*by virtue of what the owner has invested in them, be it time or emotion*” (Petrelli, Whittaker, & Brockmeier, 2008, p. 56), and such meaning develops over time through cultivation, selection, and how things relate to others. Thus, like reminiscing in general, this process of choosing and pruning of mementos ‘produces’ the self and reinforces it both to oneself and to others (assuming these others read into it the same qualities). To illustrate this with an example, a family photograph may be printed in a larger than usual size, and then framed and placed in someone’s living room. To this person, as well as visitors, it underlines the family as something of value.

The framed photograph in the example, now rendered a valuable memento, can be considered an instantiation of the self in an artefact. It represents a slice of experience, and thus a means for preserving the self (Crete-Nishihata et al., 2012). Rather than merely cues to trigger memories, such instantiations also have transformable power regarding autobiographical memory itself. Floridi (2011) argues that the degree of freedom as to interpret the self is inversely related to the amount of ‘evidence’ available such as personal photos and other material. This suggests that more details are not necessarily advantageous in supporting the various introspective and social functions of reminiscing, which benefit from the ability to adapt and find new understandings. It may indeed be disadvantageous for systems to present cues as definite or correct, as suggested by Van den Hoven and Eggen (2008).

How thoughts, environment, other people, and things, in conjunction with our own cognition, perform cueing leaves many open questions. Although we may be able to tell what thing is a cue, it is harder to tell *when* something is a cue (van den Hoven & Eggen, 2014). A framed photograph, for example, may be ignored as it slips into the background when we rush out in the morning. Later in the evening, when sitting down, there may well be room to consider this image and let the mind wander from there. And yet, this pattern may be altered if a person depicted in the photo has recently passed away: our attention turns to this salient aspect. A better understanding of this cueing process, and more precisely the interactions between cues and remembering, can inform the design of novel systems. Because interactive devices can stimulate similar media use for reminiscing (for example (as further discussed in Chapter 6), via the display of photos (Bhömer, Helmes, O’Hara, & van den Hoven, 2010; e.g., Frohlich, Kuchinsky, Pering, Don, & Ariss, 2002), old messages (e.g., Cosley, Sosik, Schultz, Peesapati, & Lee, 2012; Thomas & Briggs, 2016), and audio recordings (e.g., Dib, Petrelli, & Whittaker, 2010; Niemantsverdriet & Versteeg, 2016)), and the fact that people readily appropriate novel technologies for such purposes,

it is relevant what types of cues people relate to. In part, this question forms the basis for a study on everyday involuntary remembering reported in Chapter 4.

3.7.2 The role of the home as a place for reminiscing

If we are to consider the role of things (whether physical or digital) in reminiscing practices, the home is the primary place for people to hold things meaningful to them. Such cherished objects, like a teddy bear or an old leather jacket, are able to evoke a wealth of memories, emotions, and stories (Turkle, 2007). As Kirk and Sellen (Kirk & Sellen, 2010) point out, the home is a negotiated place between members of the household and this extends to the placement of things. The role these things take on goes beyond their service towards the recollection of memories but also serve to portray the identity of individuals and the household as a group. This results in a domestic topography of meaningful things, an autotopography of the family to express a shared identity (Kirk & Sellen, 2010; Petrelli et al., 2008).

Because of the more complicated ‘social life’ of things featured in the home, Kirk and Sellen (2010) argue that considering such things as mere mementos that cue associated memories is a too simplistic approach that neglects other facets of their significance. Instead, the authors identify six motivations of home archiving, namely: connecting with the past, defining the self, framing the family, fulfilling duty, forgetting, and honouring those cared about (ibid., p. 15). Here, to fulfil duty implies that people archive in expectation of future value. The final motivation, to honour others, relies on things being on display such that these render a sense of presence for those honoured (e.g., absent loved ones). Kirk and Sellen (ibid.) reason that “*the display of artefacts renders them available for a form of interaction we could call ‘ready reminiscence’ [emphasis ours]. By this we mean that because the artefacts are readily to hand, always present, their associations with people or experiences need never be consciously brought to mind as they, always being present, never really leave it*” (p. 30). Honouring of others can also take place in very functional ways. Using a kitchen ladle may make someone feel closer to a deceased grandmother. The authors label this ‘tangential reminiscence’ because the object’s association with a particular purpose or action may invoke pleasant memories (ibid., p. 32).

This ‘ready reminiscence’ is clearly derived from a presence that is not easily afforded to digital things, such as cherished emails, or an image received via a chat application. It is thus not surprising that digital things are not immediately on people’s minds in studies of personally relevant memory objects (e.g., Kirk & Sellen, 2010; Petrelli et al., 2008; Petrelli, van den Hoven, & Whittaker, 2009). For example, participants in a study of mementos in the home (Petrelli & Whittaker, 2010) noted only a few instances of moments where reminiscence was initiated via digital things. These things are often unseen and hidden away on computing devices. Participants were initially dismissive of the collections they

kept until they reconsidered the value of these collections as mementos. At that point, the authors describe a sense of guilt felt by some, as if they left their valuable digital things unattended and under-utilised (*ibid.*, p. 160). To some extent, this sense can be ascribed to the inadequate technical means to unlock such things from their 'hideout' in everyday life. It should however be noted that family photo albums were never that frequently opened and browsed either (Chalfen, 1987). The latter implies that some of the inadequacy felt may be contributed to the awareness that capturing and keeping large amounts implicitly demands attention.

However, this belies that there is an ever-increasing use and reliance on digital capturing of such things (i.e., digital photos, social network communications, email). The ease or even automaticity of digital capturing has grown the collections people keep, as reflected by the lifelogging movement (e.g., Elsdén et al., 2015; Sellen & Whittaker, 2010), archiving of emails (e.g., Gerritsen et al., 2016), and domestic photo use. This may be partially motivated by the assumption that digital storage allows for complete storage and therefore, a more accurate ability to recall and remember the past (van Dijck, 2007). However, unlike everyday objects found in plain sight, digital things provide less room to interpret, portray, and display the family as a unit. At least, that is if we limit our focus to the home. Social networks such as Facebook provide a ready canvas for the more socially oriented motivations outlined by Kirk and Sellen (2010), a notion supported by Thomas and Briggs (2016) who studied the value of Facebook to support and prompt reminiscing.

One way in which digital things cannot gain value is through the changes inflicted by time and wear, as would be the case for physical things. Cracks and other signs of imperfection create a unique object out of a generic one, an object that becomes one's own as it continues to be used (Csikszentmihalyi & Rochberg-Halton, 1981; Petrelli et al., 2008). Kirk and Sellen (2010) point out that the non-degrading nature of digital things and the ease of duplication may challenge conventional notions of uniqueness (and the sentimental value derived from cherishing a single, quintessential thing). Gulotta, Odom, Forlizzi, and Faste (2013) noted that the preservation and legacy of digital possessions remains an underdeveloped area. This concerns both the long-lasting value to the owners of these possessions and any future inheritors. To this end, the authors devised several speculative systems for long-term photo display that played with ideas of wear, patina, and degrading image quality over time. Participants questioned this approach as it went against expectations of what digital offers over physical things, even as patina may sometimes add particular value in the latter case (Ikemiya & Rosner, 2013).

The desire to make the digital present in everyday life showed in a study by Odom, Zimmerman, and Forlizzi (2011) on teenagers and virtual possessions. Notably, a participant printed social media posts, including comments from friends, as a way of

preserving this meaningful thing. Thus, while digital things offer flexibility, these things also lack a sense of place and presence. The well-established and studied practices of making things meaningful in the home (and vice versa) tend to fall short when it comes to the digital, intangible nature. More precisely, established domestic technologies lack the ability to give digital things a proper place in the home.

3.7.3 The role of creation for reminiscing

For a better understanding of how things accrue meaning for reminiscing purposes, and how such practices may translate to the digital realm, it helps to pay attention to insights on the capture and creation of such materials. Several studies in the interaction design field have investigated this. An early effort in this area was the Memory Box by Frohlich and Murphy (2000). This wooden box had space for the inclusion of a small number of memorabilia and related audio annotations that people could record themselves (and link using small RFID near-field tags). Participants felt that recording for others had the most value, as that could be passed on as an heirloom. The Memory Box is a clear example of coupling digital annotations to physical things to obtain a hybrid result. The hybrid nature means that digital content is given a clear embodiment in the real world, which for these examples may aid their presence for reminiscing. There is evidence that hybrid crafting with personal digital media and physical building blocks can inspire exploration and motivate lasting, meaningful connections to such digital things (Golsteijn, van den Hoven, Frohlich, & Sellen, 2013).

Work by Mols, van den Hoven, and Eggen (2014) suggests that memories become valuable if these are repeated, had (and continue to have) social value, and were good examples of someone's character, or illustrated an intriguing contrast. Mols et al. argue that the creation and capture of things for later cueing of memories should aim to strive for the above characteristics. With their Ritual Camera, the same authors (2016) tried to automatically capture and visualise everyday events at participants' dining table. They concluded that when reviewed, people responded positively to the generated visualisations as they were able to appreciate otherwise mundane moments. This required someone to make sense of an abstract visualisation, a process which in itself might be a valuable creative activity.

Based on a study of older adults' creation of mementos to leave for posterity, Lindley (2012) proposes that for the development of a personal narrative a reliance on one's own memories – rather than various things – may be beneficial to pick the most formative and interesting events to capture. In contrast, when considering the interpretation of others, more detail may help to fill in unknowns once the creations are passed on and reviewed. In light of that, it is interesting to note the alternative observation of a study of the capture of time capsules to be viewed long into the future, perhaps after the creator's passing

(Petrelli et al., 2009). Participants were given free reign to compose a thing to serve as a time capsule. The authors noted that people were selective rather than exhaustive in their creation, relying more on the suggestive power of expressive, personal, and symbolic capsules over more prescriptive means, such as annotations. This reflects how these participants were looking forward to reminiscing.

That some leeway for interpretation is favourable can also be seen in work where the 'material for reminiscing' stays relatively close to the source. Studies on SenseCam, a wearable device that captures images throughout the day, provide a nuanced perspective on viewing the resultant photos (Harper et al., 2008; Lindley, Glancy, Harper, Randall, & Smyth, 2011; Sellen et al., 2007). Perhaps due to the fairly low-quality imagery (often blurry due to bodily movement), participants felt they gained an additional perspective on their past precisely because this imagery is different from what was remembered. The 'definite' nature of photographs as an accurate representation of a past moment appears challenged by the technical limitations of SenseCam imaging, which in turn was used by people for interpretation and reflection.

A similar process of use was observed in a study of the creation of and reminiscence with sound recordings (Dib et al., 2010). Families had recorded sounds on a holiday (to the exclusion of other media, at least for some days) and later listened together to these recordings. Families contextualised and interpreted the sometimes symbolic sounds, which stimulated reminiscing and creativity. However, this need to interpret and the temporal nature of audio put demands on the listeners' time and attention. The study's authors surmise these reasons explain why sounds recorded by listeners themselves (or those that connect to their own experience) inspired more engagement. Closely related to this work is the speculative use of FM Radio (Petrelli, Villar, Kalnikaite, Dib, & Whittaker, 2010), a hybrid device to replay audio clips recorded prior on a holiday. In a study involving several families, Petrelli et al. found that the physical tangibility of the old-fashioned radio invited exploration and reminiscing on the moments at which the audio was recorded. Taken together, these studies suggest that reminiscing using audio recordings requires a bespoke design of supporting systems compared to photography-oriented tools, and vice versa.

Work on for example audiophotography by Frohlich (2004) makes a clear case for the potential value that the inclusion of contextual audio fragments can add to 'silent' photography and related reminiscing. Reflecting on the role of personal media capture and viewing, Frohlich and Fennell (2007) argue that media, whether auditory, paper-based, or digital, should serve to instigate and support the introspective and interpersonal narrative. In line with the work mentioned above, the authors conclude that an approach to reviewing personal media that takes centre-stage (such as a slideshow presentation

style) gets in the way of the interpretative work that produces a personal or shared past. This principle holds whether we use audio recordings or, as is the case in this thesis, focus on digital photos.

The most common type of media created and collected are digital photos, which are cherished for their memory-related value and are not tied up in issues of work productivity and instant communication (like emails, text messages, and social media posts). For this reason, the design-oriented studies in this thesis focus on the use of photographs for reminiscing. To that end, a better understanding of the position of photography for everyday personal use is paramount.

3.7.4 The role of photography for reminiscing

Evolving practices of reminiscing involving photos largely follow the history of domestic photography, that is, the photographic activities of people for a personal or social goal (Sarvas & Frohlich, 2011, p. 5). This subsection will take a deeper look at the developing position and practices of photography. To better understand the role of photos within reminiscing activities, the diamond framework by Frohlich (2004) positions photography activities as an interplay between the photographer, the photograph, the subject, and the audience. Reminiscing is considered an activity that emerges from interactions between the photographer and the subject, the photograph itself taking a secondary, assistive role. A narrative may be interpreted from a photograph and prompt storytelling. This mix of reminiscing and storytelling is typical for 'phototalk' (Frohlich et al., 2002). The rich presentation and easy availability make photographs ideally suited for such interpretative and social purposes that mirror those of reminiscing.

Before photography was widely available to the masses, getting portrayed was a relatively formal affair. As film technology got better and cheaper, photography grew as a medium to capture and express more informal moments, for a wider population (Sarvas & Frohlich, 2011). Nonetheless, what and who is photographed, how this is framed, and later shared or discarded remains an expression of how people present themselves to peers and construct their individual, family, and cultural identities (Chalfen, 1987; Slater, 1995).

This practice of constructing identity is perhaps most clearly embodied in the family photo album. The selection and inclusion of printed photos into a book gives these photos value. Albums reflect the general content of domestic photography, namely that photos tend to be of familiar people such as friends and family (Chalfen, 1987; Frohlich, 2004). Photos in albums and framed in the home contribute to constructing personal identity and preserving memories of personal ties (Crabtree et al., 2004; Csikszentmihalyi & Rochberg-Halton, 1981). People in such photos are usually portrayed in a positive light,

often at the occasion of notable events that defy the everyday routine like birthdays, parties, and holidays. With the introduction of digital photography and its integration into smaller and more portable devices, the cost of doing photography declined further. People produce many more photographs, as the effort to capture them has been reduced to mere seconds, and also consume more images. According to empirical data discussed by Slater (1995), in 1982 most families opened their photo albums only about once a year (p. 138). It is unclear if this pattern still holds today, although it is likely that personal photos and those received from relatives and friends are now consumed on a frequent, perhaps daily basis.

Conceivably, the large number of photos captured go beyond our needs for them at a later stage. Taking photos of a particular moment has become a ritual to signify that moment as important. It is, by means of pointing the camera and clicking an image, now *my* experience. This implies that at least some of the time, the value resides in the actual taking of the photograph, not in what happens after. The lifecycle of photographs normally assumes value remains after capture. This is the premise for photowork practices as understood by Kirk, Sellen, Rother, and Wood (2006), who discuss a linear flow from capture, to download, to edit, to share and review stages.

However, the low cost of capturing photographs and the ease of sharing them brings about a more complicated long-term cost. This cost is primarily borne from people's tendency to take advantage of the opportunity to capture, share, and keep large volumes of images (e.g., Frohlich et al., 2002; Sellen & Whittaker, 2010; Whittaker et al., 2010). This cost has several facets, namely difficulty with the storage and backup, curatorial issues amid the large volume, and the altered relationship to personal media due to their ubiquity. The first facet of long-term storage appears at first a technical issue. It is technically feasible to arrange for proper backups and redundancy in case one device gets lost, sold, or otherwise becomes unavailable. In practice, the hurdles in 'cat herding' different devices with different capabilities often leave a patchwork result at best. Whittaker, Bergman, and Clough (2010) indeed found such problems among families' photo practices. This issue is compounded by overconfidence in the ability to retrieve particular images. The second issue concerns the curation of large volumes of personal media. Having more photographs does not equal an improved ability to use those photographs to share a story or reminisce. Motivations to prune collections often fail in the face of the sheer volume of files to sift through. Studies on how people manage their photo collections point out that people are not fond of this 'work' (e.g., Frohlich et al., 2002; Kirk et al., 2006; Whittaker et al., 2010). With little immediate value beyond the satisfaction of having achieved order, this issue remains an open challenge. It has prompted some to step away from thinking about photography as a workflow and instead propose to reframe such work as contributions towards valued use scenarios

(Broekhuijsen, van den Hoven, & Markopoulos, 2017b).

The third issue entails consideration of how everyday encounters with our personal media change our relation to these media and what they represent, namely our past. To explain this further, it helps to consider such digital personal media as taking part in the distributed ecologies of the mind (see §3.4). Schwarz (2014) opted to describe the relation people have to their personal media, such as photographs, as neighbourly. With a turn towards digital storage and retrieval of personal media, people have increased their chances of occasionally 'running into' their media. Such chance encounters blur the line between active recollection and passive evocation. Remembering the past becomes more frequent as we browse our digital archives looking for something else. Scrolling through a photo library on a smartphone is an example of this; many past events scroll by while we look for a specific photo of a specific event. It is, therefore, harder to keep things at bay, even if doing so would objectively be better. In turn, this makes it harder to alter one's interpretation at a later stage. Flusser (2013) remarks that images can become the things they once only represented, drowning out aspects of the past experience that were not captured. While the easy alteration and reconfiguration of malleable digital media may allow for revised perspectives on the past (compared to more fixed film photography) (van Dijck, 2007), their ubiquity in everyday practice runs against that. Thus, although new technology could assist in serendipitous reminiscing, refraining from revisiting a personal media collection also ought to be considered in the design of such technology.

Somewhat paradoxically, the increased emphasis on digital media to comprise people's mementos implies that in everyday life, there is less opportunity to encounter a large part of these mementos unless we gain access through a relevant digital portal (van Dijck, 2007). For example, some may feel attached to a collection of things they gathered within a digital game. Given the effort invested in obtaining these, the things may represent a valuable personal memory (Watkins, Sellen, & Lindley, 2015). However, without access to this game, it is challenging to see these things and use that to reminisce about the experiences of playing that game. For such things to feature as memory cues requires them to be mediated but their medium, a game, is tied to a particular technology. This stands in contrast to things in the physical world that can be seen, touched, or perceived otherwise without intervention other than our bodily abilities.

These three issues thus stand in the way of achieving and maintaining a longer-term value from personal media collections. Although a multitude of channels and (social) networks are available to capture, share, and enjoy these collections, this digital ecology is scattered across devices and places, altering its opportunity to evoke memories in everyday life. This is of particular concern for recollective and reminiscing purposes. Not being able to find particular photographs or spending too much time on this search process

might hinder the ability to aid reminiscing practices. Similarly, coming in touch with photographs someone is not (anymore) interested in (at least at a particular moment) deprecates the value of one's personal archive as a whole. The pertinent questions are: How can we improve the interactions with our personal media archives in such a way that it is beneficial to reminiscing in everyday life? How could we, for example, appropriate personal photos in a way that suits serendipitous reminiscing without falling foul to its issues?

Some suggest that the answer to the above questions is a better ability to search photographs, and that developments should orient towards letting systems understand what is in an image so that people may retrieve those by keywords, people, colours, or other features (a vision sketched in C. G. Bell & Gemmell, 2009). However, it is ill-suited for understanding hidden meaning, symbolic references, and memories only understood by those in the know. A priori curation for particular expected purposes may work if it was not for the motivational issues outlined above. More fruitful, it seems, is a focus on on-the-fly selection of relevant images, for example when storytelling (e.g., Niemantsverdriet, Broekhuijsen, van Essen, & Eggen, 2016). A wholly different approach is to do away with the idea of an ever-growing collection and instead rely on sharing and instant, ephemeral consumption as employed by the popular social network Snapchat (Cavalcanti, Pinto, Brubaker, & Dombrowski, 2017). Even though the latter fills a niche, it appears evident our desire to collect, collate, and review the evidence of our past will sustain. Therefore, the studies in this thesis will explore how existing collections of photos and other digital media can be of value for reminiscing in everyday life. The next section covers related explorations by interaction design researchers.

3.7.5 Speculative practices for reminiscing

New and different approaches are necessary to make the most of our digital possessions. Here, we discuss related work on speculative designs to highlight motivations, insights, and open questions that remain. Chapter 6 covers a more thorough review, such that the present selection serves to illustrate our position on serendipitous reminiscing and how designed systems may support it.

First, we turn towards those designs that remain closest to physical ways of storage. Kirk and Sellen (2010) built on their insights on home archiving practices to formulate several suggestions for the enjoyment of digital materials. They argue that part of the value of physical mementos is derived from their physicality, which situates it in everyday life without the need for specific reference to that thing. As with the framed photo example used earlier, it may well be ignored for days, yet it is there when attention turns to it. These kinds of situated displays “*take on a new kind of persistence and establish a physical and social space within the household*” (ibid., p. 39). Memory Box, for example



Figure 3.3. *Memory Box* (left) by Frohlich & Murphy (2000) and *Shoebox* (right) by Banks & Sellen (2009).

(Frohlich & Murphy, 2000 see Figure 3.3), functions as a means of annotating physical mementos, thereby extending the functionality of existing boxes in which people archive small memorabilia. Shoebox (Banks & Sellen, 2009 see Figure 3.3) applied the idea of the physical box to the storage and display of digital images. The authors reasoned that by capitalising on existing practices of storage and placement in the home, they could introduce new interactions around photo displays, for example, to support storytelling. It is, however, unclear how actual usage would play out because no evaluations were reported.

Kirk and Sellen (2010) also argued for a more explorative way of dealing with digital collections, perhaps through ‘rummaging’ or serendipitous display akin to stumbling across a long-forgotten thing. Findings from a study of time capsules would support this motivation (Petrelli et al., 2009), as does other work on home autotopography (e.g., Petrelli et al., 2008, p. 8): to avoid habituation, some means of concealing and revealing can make the contrast between the past and the present more salient. The underlying idea is that reminiscing activities benefit from occasional exposure and an element of surprise. Nonetheless, it is also important to consider limiting exposure to personal mementos. People archive some things because those are valuable as a token of a relationship or a particular period in one’s life. However, invoking related memories may be unpleasant, painful, or simply unwelcome on a regular basis. A design that is intended to become part of the everyday environment needs to consider a sensitivity to such issues. In this light, the design of *Story Shell* (Moncur, Julius, van den Hoven, & Kirk, 2015) stands out. Its plain white spherical shell needs deliberate touch to play audio recordings, hereby enabling the user to be in control of her exposure to its audio.

Returning to the idea of serendipity, Leong, Harper, and Regan (2011) applied the idea to the display of personal photos, using the notions of randomness, defamiliarisation, and temporality to guide the design. Serendipity may arise from random encounters with personal media and the need to familiarise once again with a photo. The photo display

system designed by Leong et al. incorporated these elements. Based on a three-week home deployment, the authors found evidence for several types of serendipity, namely: when an image resonated with someone's current thoughts and feelings, when an image corresponded to things happening in their surroundings, and when two random images were seen to have a meaningful connection (ibid., p5). Leong et al. argue that such random display of personal photos at home can spark people to make connections with their current state of mind or explore new meanings.

The Cueb prototypes made an explicit play for the freedom and consequent need to interpret any images displayed (Golsteijn & van den Hoven, 2013). Two cubes could be shaken to randomise the images shown on displays on all sides, with each Cueb representing one collection. When brought together, these Cuebs invite their two users to make a connection between what was shown. The idea was to bring together teenagers and parents through storytelling and shared reminiscing, each using their individual photo collections loaded onto the Cuebs as a starting point. In its brief evaluation, the playful approach facilitated exploration and communication between the Cuebs' users about their past.

Meerkat and Tuba (Helmes, O'Hara, Villar, & Taylor, 2011 Figure 3.4) also built on serendipitous motives and involuntary memory cueing. The former employed three small displays on a stilt. Meerkat would detect movement and the presence of people in its surroundings, a trigger to erect itself and show three random images from people's personal photo library. It would continue to make movements to attract attention. This very active nature provided engagement, particularly to younger household members, but parents were less impressed with the sometimes not so meaningful (distracting) movements and the selection of photos. Knowing what to present and when requires a keen understanding of what is personally meaningful, questions of interest in the present work. Tuba took a different approach, its appeal resting in the need for a user to explicitly lift the device to see its screen (which would show a randomly selected photo, Facebook post, general factoids, or play music after closing the device). This action and unknown response could instil a sense of anticipation and surprise. Unfortunately, the devices were often neglected in places where there was strong competition for attention, such as a TV in the living room. Alternative placement in an area where people are more likely to engage in conversation and other family activities, such as the kitchen, proved more conducive to the kinds of encounters envisaged by the authors (p. 387).

An interesting example of a design that aimed for group talk is 4 Photos (O'Hara et al., 2012 Figure 3.5). A tabletop device with four displays on each side, it gathered photos from individuals sharing a meal around a table. The authors situate their device within the social talk around the sharing of food and dining together. No one can see all four photos



Figure 3.4. *Meerkat (left) and Tuba (right) by Helmes et al. (2011).*

at once, or know in advance the upcoming set of photos and steer the conversation that way. This is an issue surrounding phototalk with printed photos, laptops, and other means where one party may take on a dominant role (Crabtree et al., 2004; Frohlich et al., 2002). Interactions with the device indeed promoted exploration and surprise, while control was distributed across the table. The use and issues that came up were adequately handled within the existing social relationships. However, as the authors acknowledge (O'Hara et al., 2012, p. 147), 4 Photos is perhaps too strong a presence at the dinner table to feature on a daily basis.

Pensieve (Cosley et al., 2012) explored the use of digital mementos by using earlier social media photos and posts, personal diary entries, and generic writing prompts (for new diary entries) as emailed triggers for reminiscing. A basis for these prompts stemmed from an appreciation of being reminded to reminisce, according to participants in earlier work of the authors. A belief that such prompts should fit into everyday life without the need to incorporate new tools and routines drove the decision to use email. In some ways, the system was not so effective. Some of the prompts were not considered meaningful, at least not at the moment of receiving, and were ignored. At the end of the testing period, those participants who felt that Pensieve required a change in their practices indicated they were less likely to continue their use of the system. For others, the system was an



Figure 3.5. *The 4 Photos prototype by O'Hara et al. (2012).*

alternative to their existing reminiscing activities, and as such, it did not intrinsically change their practices. Pensieve does not attempt to place cues for reminiscence in a physical space. This need not be an issue, as Petrelli et al. (2008) argue that the reflective value of a memento comes out of reencountering and re-evaluating our disposition towards a thing and its related memories. It should be noted this evaluative process happens in the mind and is not evident to interactive devices.

In an attempt at imbuing the viewing of digital photos with a sense of ‘slow interactions,’ Odom and colleagues (Odom et al., 2012; 2014) designed the Photobox. This is a box that would be placed in someone’s home, connected to their online photo collection, and then, every once in a while, it would print a photo from that collection. The participant would only know by regularly opening the lid of the box, similar to checking one’s postbox. The irregular, drawn out, and random nature of the box’s printing resulted in strong reactions from participants. There was initial frustration that over a fourteen-month period evolved into positive anticipation (Odom et al., 2014, p. 1965). People appreciated the ability of Photobox to remind them of forgotten things in their collection, prompting to reminisce about those moments (ibid., p. 1966).

This overview of speculative designs for reminiscing is by no means exhaustive (Chapter 6 sets a higher bar). However, it charted a variety of designs and the practices elicited by their prototypes deployed in the field, typically in people’s homes. Most of the designs discussed (and those left out here) have seen limited in-the-field deployment, so the anticipated uses remain speculative in the absence of additional long-term evidence. This provides an impetus to explore the development of new routines and practices in more longitudinal work towards reminiscing. The various designs have also taken different views on what it means to be situated in everyday life and in what form digital material may be brought to attention, so that people may be inspired to reminisce. There are nonetheless similarities in a desire to incorporate exploration and a sense of surprise or ambiguity, which is a notable break from established photo management software that strive for order. The latter applications orient themselves towards recollection and retrieval, whereas many of the speculative designs set out to support the more associative and open nature of serendipitous reminiscing.

3.8 Framing serendipitous reminiscing

Up to this point, this chapter has laid out the way in which serendipitous reminiscing comes to be, that is, evocation through chance encounters with things that remind of one’s past. These encounters underline the value of the context in which reminiscing takes place. Reminiscing in an everyday context is a casual dipping in and out of one’s past, which happens in conversation, when going through individual contemplation, or when it is cued by something in one’s environment. It is relatively unstructured and is typically

done without prior planning or set goals in mind. As such, while it may be possible to identify an obvious (serendipitous) beginning, pinpointing an end to the activity would be hard.

Because remembering – especially in the sense of serendipitous reminiscing – is intertwined with everyday activities, here we draw parallels to the concept of ‘everyday computing’ which frames interactions with computing in the age of their ubiquity (Abowd & Mynatt, 2000). The challenges that prompted that vision have overlap with the motivations for serendipitous reminiscing in everyday life. As interactive devices gained the capability to become more ubiquitous and embedded in daily lives, it forced a reconsideration of the way we interact with these devices (e.g., Suchman, 2007). Such interactions are not isolated without context but rather fit into a wider set of actions. Because these interactions are intertwined, often informal and unstructured, there may not be a clear-cut beginning and end.

For example, organising a family trip involves communicating with others, looking up information, making reservations, and so on. These activities can happen at different moments, be postponed for later discussion, and resumed at another moment in between, while any interactive device may be used to facilitate these activities. This realisation of the situated position of technology within everyday practices proved a challenge for older, more rigid views on human-technology interaction that often focused on single task desktop work (Suchman, 2007). Everyday practice is messier, builds on tacit knowledge (Weiser, 1991), and is generally more fluid in its goals and actions. As Suchman (2007) argues, human-computer interactions are better described as ‘performed’ between humans and things. This means that both things and people play off each other in a dialogic, improvisational way rather than an a priori choreography. Such fluidity breaks with the idea of designing for closure, a fixed endpoint in the interaction. Interruption is expected, as multiple activities operate concurrently. For all people involved, priorities and attention are in a state of flux, as is their awareness to one particular aspect within the context (or rather, the context itself may be dynamically reconfigured (see Dourish, 2004)). Serendipitous encounters that lead to reminiscing arise from a similar interrelation between context and ongoing thoughts.

The idea that the use of computing devices is not a localised, context-less phenomenon was key in driving many of the ideas and developments in the HCI world for the past decades (e.g., Abowd & Mynatt, 2000; Dourish, 2013; Suchman, 2007; Weiser, 1991). Similarly, personal media (such as digital photos and social media messages) have become more ubiquitous and changed our relationship with them and our past, as the previous sections laid out. This provides the impetus to develop ‘serendipitous reminiscing’ in similar ways. The key benefit of doing this is that it gives a framework to place reminiscing

in relation to other practices and contextual factors, including interactive products and systems.

At this point, the theoretical work on remembering and everyday practices around reminiscing give a clear view of what serendipitous reminiscing is. For this thesis, we define serendipitous reminiscing as follows:

Serendipitous reminiscing is the casual recollection and reliving of past experiences, for enjoyment, restorative, and social purposes, brought about by chance encounters with things that remind of one's past.

The key elements that set apart serendipitous reminiscing from the more generic definitions introduced in §3.2 are the casual nature – as opposed to the more evaluative, dedicated nature of reminiscing bordering on reflection, something people sit down and take time for – and the idea that it happens amid everyday activities, rather than that it is an activity in itself. It is a remembering practice rooted in a mental process but situated within everyday activities. This is how we envision serendipitous reminiscing as a rather spontaneous and fleeting phenomenon that happens in-between or concurrently with other activities (in particular those activities that leave the mind free to wander). This picture is instrumental in formulating a set of characteristics that the design for serendipitous reminiscing needs to consider:

- *Memory, and by extent reminiscing, is associative:* Moving from one thought to the other is the norm. Spontaneity, rather than linear progression, characterises how people remember. It is taken up effortlessly, in response to (social) cues. Such cues may be taken from technology and other impulses that inspire, facilitate, and scaffold memory, or because earlier and ongoing thoughts primed someone to notice such cues. More detail is not necessarily beneficial. It may be helpful for the recall and recollection of details, but these additional details might also remove leeway for someone to consider an alternative interpretation of the past.
- *Serendipitous reminiscing is in service of a personal or relational goal:* Rather than being a goal in itself, such as to recollect a past autobiographical episode accurately, reminiscing is often done in service of an implicit goal. Although such goals may be followed without being explicitly aware of them, these strive to lift the mood, reduce boredom, or to bond with others by recounting a shared experience or self-disclosure through a personal memory. It is therefore subject to (and malleable to) our current understanding of the world. In most circumstances, and in moderation, reminiscing is a healthy hedonic activity. Nonetheless, in the absence of motivations towards such

goals, refraining from reminiscing may be a viable choice that ought to be possible.

- *Serendipitous reminiscing happens in the context of other activities:* Interruptions that instigate reminiscing are likely, that is, these interruptions may form a source of inspiration for reminiscing, while a clear point of closure may not be apparent (this mimics qualities of everyday computing (Abowd & Mynatt, 2000, pp. 42-44)). As a relatively lightweight mental activity, thinking about some events in the past can be done while doing other things. This is particularly true for mundane activities that people do routinely (e.g., cleaning, driving, cooking) without devoting their full attention. When those activities do demand more attention, this personal past-driven conversation takes a backseat and is interrupted. Because of this need to respond to the current context, it is dynamic and sometimes fragmented.
- *Such reminiscing is both remarkable and unremarkable:* Any particular element that makes up our day is not likely to be given much significance. Such episodes are often short-lived, may feature in a later conversation, but are unremarkable enough to leave a lasting impression. A short bout of reminiscing when coming across a stack of old photos may be a brief interruption of the ongoing routine, and at that time be remarkable in its ability to influence one's ongoing experience and mood (the effects of which may linger), but the earlier routine is usually resumed shortly after.
- *Perspective is an important discriminator:* How someone responds to encountering something that may remind them of their past is strongly dependent on one's perspective towards that thing and the particular memory. In particular, for serendipitous encounters, it matters whether people can come to a new realisation about the event considered. Such a leap of insight depends on a shift in perspective, which may come about after the course of time (as in everyday computing (Abowd & Mynatt, 2000, pp. 42-44)), or other influences that bring forth different thoughts on a past event. For example, a recent conversation about a holiday twenty years ago will affect a current response to remembering the same event, compared to a situation where someone may not have given this holiday any thought the past two decades. What someone brings to the encounter in terms of their knowledge and perspective is as important as the encounter itself. Thus, perspective as discriminator also links to the first characteristic which holds that reminiscing is associative.

The above definition and characteristics serve two purposes. First, taken together, these statements exemplify our view on serendipitous reminiscing in the context of everyday life. It gives a platform to reason about and include or exclude certain practices: as a result, some practices are out of the scope of the investigation in this thesis. For example, the deliberate social storytelling around holiday photographs would not fit nicely within

the spontaneous and casual nature that is catered for here. A similar argument can be made for reminiscence-based therapies that aim for a deeper, more evaluative kind of reminiscing as an activity in itself (cf. Webster et al., 2010). It is perhaps true that some of the ideas and considerations for involuntarily cued serendipitous reminiscing are also germane to other forms of reminiscing. However, those situations are not our immediate aim.

Second, the above characteristics serve to frame the position and fit of current and novel technologies that may support serendipitous reminiscing. If we take this conception of serendipitous reminiscing on autobiographical memories, it follows that this fluidity of using and treating the past stands at odds with the rigidity in the way digital storage is organised. Where these two worlds meet, friction is to be expected. This kind of friction happens when people are left feeling their photo collections are underutilised (e.g., Crabtree et al., 2004; Frohlich & Fennell, 2007; K. Rodden & Wood, 2003; Whittaker et al., 2010). Similarly, it is such friction that Schwarz (2014) refers to with his notion of ‘neighbourly relationships’ with personal media that people come across during their everyday activities. A more ubiquitous, more present position of interactive systems that could cue autobiographical memories through the display of personal media runs the risk of such systems being imperfect neighbours; that is, the presentation of personal media such as photos may not just elicit occasional serendipity but also cause a less desirable effort. This challenge emphasises that the stakes are higher for a designer of such a system to get it right, which in turn motivates the attention to the design for serendipitous reminiscing.

3.9 Conclusions

In this chapter, we established serendipitous reminiscing as an encompassing term for the kind of reminiscing we seek to study in the messy reality of the mundane, everyday life. This idea of serendipitous reminiscing redresses remembering in daily life as an act that happens in the context of other activities and (social) environments. We grounded our construct in relevant literature from the fields of (distributed) cognitive psychology, ubiquitous computing, and interaction design. The chapter emphasised the usefulness of serendipitous reminiscing as a means of achieving enjoyment, mental restoration, and bond with others.

The second half of this chapter turned the attention towards reminiscing practices in everyday life and how various artefacts play a role in this. In doing so, we have highlighted the importance of personal media and other mementos, like digital photos, and how current and novel practices play into this. From there, we were able to lay out several avenues for future inquiry. The central tenet on which this thesis builds its argument is that serendipitous reminiscing, despite its casual and fleeting nature, is something

worth supporting as it can be beneficial (even if a relatively minor contributor to overall wellbeing). Digital cues for remembering are however in a disadvantaged and yet underdeveloped position to play a positive role in everyday practices. How future systems may establish themselves in that context and what kind of experiences people are appreciative of remains a challenge. It is this challenge to which the empirical work in this thesis contributes. The part that follows orients itself towards the latter question of the experience of remembering in everyday life, while the final part explores potentially interesting interactive systems that address the challenge laid out here.

Part II
Reminiscing as
experience

This part follows a qualitative and phenomenological approach to reminiscing. Chapter 4 describes a study of involuntary remembering in everyday life, which illustrates what kind of things bring back memories. In Chapter 5, we discuss a study that sets out to qualify remembering as an experience. These chapters also clarify how insights translate to and benefit the design to support serendipitous reminiscing.

*Involuntary reminiscing
in everyday life*

4

4.1 Introduction to this chapter

In everyday life, we often remember our past: sometimes by deliberate effort, and sometimes because thoughts, people or elements in our environment remind us. Think of using social media to view and share family stories, or reminiscing while taking a walk in the park. Such reminiscing and reflecting on autobiographical memories has clear mental benefits, as remembering is vital to our self-image, personal identity, how we express ourselves, and relate to others (Bluck, 2003; Conway, 2005). These activities based on memories, and by extension the elements in the environment that trigger such memories, help us feel well and balance emotional needs (as the review in Chapter 3 laid out). This chapter considers how people come to remember due to things that function as memory cues in everyday life and secondly, how people relate to such things. The aim for the study and reflections covered here is to understand serendipitous reminiscing as instigated by involuntary memory cueing throughout the day.

Our ulterior motivation is that stimulating positive reminiscing in daily life is a worthwhile goal that promotes personal and social adjustment (Harris et al., 2014; Webster et al., 2010). This is also underlined by recent attention within the field of Interaction Design (Sellen & Whittaker, 2010; e.g., van den Hoven et al., 2012). People have long used mementos for this purpose, and capture (for example) photographs to use as memory cues later on (Sellen & Whittaker, 2010). Interactive devices can support reminiscing using captured images and other data as memory cues, provided design efforts are based on a solid understanding of what makes people remember their past, how this remembering colours their experience, and whether such interactivity is appropriate at a given time. These considerations led us to the present study which serves to explore how these insights may translate to the interaction design domain.

Digital things stand a lesser chance of evoking memories and emotions compared to physical things due to lesser salience, often captured and stored but not reviewed (van Dijck, 2007). People put meaningful things on display and conversely tend to attach meaning to objects available in their environment (Csikszentmihalyi & Rochberg-Halton, 1981). Personal mementos are increasingly stored digitally and are becoming more numerous due to the lower cost of capture, which also reduces chances of finding it again to help remembering (Sellen & Whittaker, 2010). When people were asked to indicate valuable things during home visits, digital mementos were often overlooked (Kirk & Sellen, 2010; Petrelli et al., 2008). A transition from physical to digital storage of personal media can reduce opportunities to evoke memories without additional effort (van Dijck,

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2007). In contrast, Schwarz (2014) argues the opposite may occur as we frequently come across unrelated files (and other digital things) when looking for something else. The latter would alter our relation to those memories to become more casual as memory-related things would involuntarily cue us more often (beyond direct control over such exposures, which may be undesired).

This raises the challenge of how to assist the revisiting of personal digital things. We believe that if such revisiting (involuntary or otherwise) can influence wellbeing (as shown for positive memories (e.g., Bryant et al., 2005)), this challenges designers to do (or refrain from doing) so sensibly. Good design of supportive devices can make a difference, provided that people's experiential needs are met. Still, empirical understanding to inform design lacks in two ways (van den Hoven et al., 2012; Whittaker et al., 2012). First, the relation between cueing medium (e.g., digital or physical) and its effect on the experience of remembering is not clearly understood. It is not evident whether the representation of a memory cue (e.g., photo, audio, writing) influences cueing of a memory, and how we think about this memory (van den Hoven & Eggen, 2014). Some forms may stimulate a more positive remembering experience than others, perhaps because certain ways of cueing allow more freedom to reconstruct a memory of the event and emotions as desired. If, for example, photographs of an event do not support someone to relate to their own experience at the time (e.g., a photo may depict a different feeling), would another representation be more suitable for a device to adopt for experiential reliving? Second, the way this knowledge can be applied to actual interactive designs needs refinement.

In this chapter, we look into remembering experiences as cued by stimuli such as mementos, public images, and particular spaces. We relate memory cues with the memories and meaning within individuals' lives, and casted a wider net compared to earlier works focusing on a home context (e.g., Kirk & Sellen, 2010; Petrelli et al., 2008). Our focus is on external stimuli (in contrast to internal stimuli such as thoughts, which we cannot design or modify), as these external cues provide an opportunity for design to appropriate for serendipitous reminiscing. In addition, we discuss perceived differences between digital and physical things as cues. We argue this focus on digital, involuntary memory cues is warranted given the accumulation in people's archives and potential for appropriation by interactive devices. This chapter adds insight on involuntary memory cueing and related trade-offs to enable future design work to contextualise and explore this challenge.

4.2 Related work on cueing memories

In his novel 'In Search of Lost Time,' Marcel Proust (1913) gives a striking account of how the sensation of eating a madeleine cake takes him back to past memories. In his view, this sudden takeover is so vivid and pure, it trumps any 'intellectual' (i.e., voluntary)

effort to remember and experience the past. Although his conception of remembering is challenged by modern understanding of the cognitive processes at hand (e.g., Ball, Mace, & Corona, 2007; Mace, 2004), Proust was right in the sense that sensory/perceptual triggers are potent cues to bring memories to mind. Everything that reminds us of a memory, such as a location or a particular smell, can be regarded as a memory cue. Involuntary memories thus need some way of invocation, whether taking a cue from (for example) thoughts, activities, things, or other ecological artefacts (Berntsen, 2009; Conway & Pleydell-Pearce, 2000).

Prior work has indeed shown that people use and shape their environment to portray their identity, for example by keeping around things reminiscent of past memories, as symbols of the self (Brereton et al., 2014; e.g., Csikszentmihalyi & Rochberg-Halton, 1981; Kirk & Sellen, 2010; Petrelli et al., 2008). The meaning of such everyday objects as mementos develops over time through cultivation, selection, and how things relate to others (Petrelli et al., 2008). Of interest here is that these practices do not extend well to digital mementos, since these are not so easily made present in the everyday environment. For this reason, digital things feature infrequently in studies of personally relevant memory objects (Kirk & Sellen, 2010; Petrelli et al., 2008; 2009), despite their ubiquity in our digital lives (i.e., digital photos, social network communication, email) (Sellen & Whittaker, 2010; Whittaker et al., 2010). Work on digital legacy, inheritance and memorials highlights people may at times be confronted to deal with vast and often unstructured digital collections (e.g., Gulotta et al., 2013; Moncur & Kirk, 2014).

The above issues raise questions on what kind of things would be considered beneficial as memory cues, and at which moments this cueing might be done (if at all). We argue this ambiguity impedes successful design of interventions to support reminiscing in everyday life. In addition, changed practices of capturing and retrieval fundamentally alter the way we remember and support recollection (van Dijck, 2007), and the changing landscape begets answers on how design can best support this trend. This is why it is valuable to look into memory cues from a design perspective. What kind of things cue memories in everyday life, as opposed to lab studies or just the home environment? Memory retrieval may largely be an involuntary process, but cues could be in the surroundings for voluntary reasons (e.g., a photo frame deliberately put somewhere). To which cues do people attach value and for what reason? Is there a difference between digital and physical memory cues for the experience people have when remembering?

This study explores qualitatively what elements in daily life cue a remembering experience. This takes a different perspective and is complementary to the quantitative approach in studies using diaries for data gathering (Berntsen, 2009; Schlagman & Kvavilashvili, 2008; Schlagman, Kvavilashvili, & Schulz, 2007) and qualitative accounts of home visits (e.g.,

Csikszentmihalyi & Rochberg-Halton, 1981; Kirk & Sellen, 2010; Petrelli et al., 2008). We were interested in things as memory cues, their meaning, and any related experiences with remembering in which these things played a role. Besides a general interest in the kind of memory cues encountered, we were especially interested in digital memory cues (if encountered). We believe our findings contribute towards successful designing for remembering support systems by further unpacking the relation between things and cued memories, and by outlining opportunities for future work through elucidating dimensions and trade-offs that designers may consider. The latter aim also connects this part of the thesis with the design-oriented part that follows.

4.3 Diary study method

This study explored the relation between memory cues and reminiscing in everyday life, in which diaries and debriefing interviews were used for data collection. We oriented towards the type of cues and related memories, and how people relate to these cues. Involuntary memory cueing is a fleeting cognitive phenomenon quickly forgotten if not captured shortly after being cued. Akin to earlier work on involuntary memories (Berntsen, 2009; Schlagman et al., 2007; Schlagman & Kvavilashvili, 2008), participants were asked to record involuntary memories themselves in a diary as soon as they became aware of such a memory being cued. Self-reports provide a good account when initiated by a participant while the cued memory is still fresh, because reporting need not rely on retrospection (as might be the case with other methods such as experience sampling where delays between event and report are inevitable) (Carter & Mankoff, 2005). Although self-reports do come at the cost of some subjectivity, we seek to explore personal recollections and perspectives that are not hindered in this way. Diary entries also provided input for debriefing interviews, which expanded on and added qualitative insight to themes found across diary entries.

4.3.1 Participants

Fifteen adults participated (another five started but did not complete for various reasons). They were recruited via personal networks and university notices, via social network posts, emails, flyers, and in person. Participants were told the purpose of the study was to learn about the various ways people may be reminded of their past by encountering things in daily life (this info was repeated in the consent form, included in Appendix 4.1). All respondents were included to maximise diversity and no rewards were given for participation. Participants were aged 24 to 66 ($M=39$ years, $SD=13$), eleven were female (73%), and most were affiliated to the University of Technology Sydney as postgraduate students or staff. Living situations varied from single, with flatmates, divorced (with children), to families with children. Half were born in Australia; others had been there for at least one year and had comparable to native English language skills.

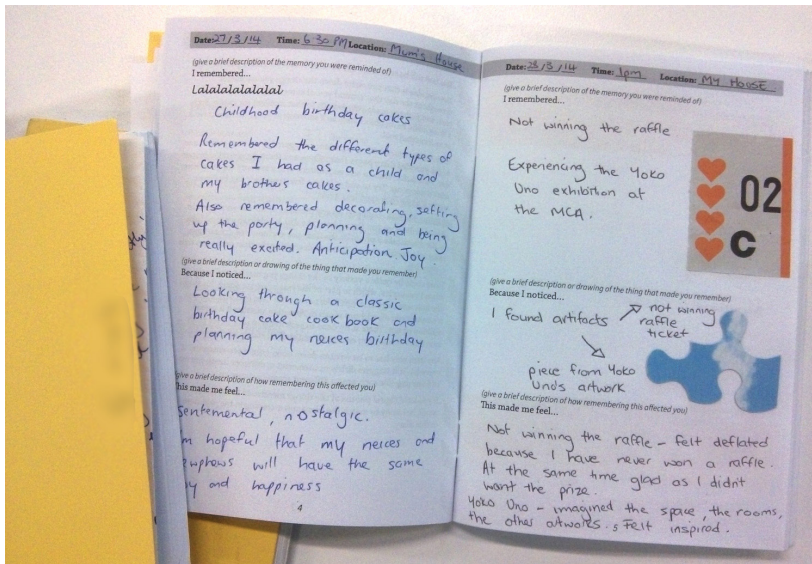


Figure 4.1. Example of a completed and filled in diary.

4.3.2 Diaries

Participants were handed a paper diary to record involuntary memories and related cues (see Figure 5.1). They were instructed to ‘write down things you encounter throughout the day that remind you of something about your own past and perhaps made you go back to that moment for a while.’ This phrase was chosen to ensure a focus on external memory cues while still trying to be open. It was explained to participants that ‘things’ could refer to all modalities. People logged their responses via sentence completion, with three questions to be completed per entry: ‘I remembered...’, ‘Because I noticed...’, and ‘This made me feel...’ This format garners free responses with a minimum of guidance necessary for the study interests. Participants kept the diary for a minimum of ten days, although it was allowed to keep the diary for longer if the first ten days proved unfruitful (e.g., due to forgetting of being cued or perhaps not realising that they had been cued). Diary entries were transcribed prior to interviews, with unclear and interesting entries marked for further questioning. Diaries were contrasted with earlier entries to help the grounding of early findings.

Appendix 4.2 describes the specific instructions and layout of the diaries. Participants had the opportunity to add up to eighty entries if they so desired. The diaries also included two additional tasks for participants to draw maps of the two spaces at home where they spend most of their time. On these maps, participants were asked to indicate where they keep mementos (thus, things kept primarily because of what they remind the participant of, rather than their functional value, aesthetics, or other reasons). These maps were used to inform the interview and are not reported on further.

4.3.3 Interviews

Within a week after handing in the diary an interview was held to aid interpretation of the diary and to discuss reminiscing practices and perspectives. The semi-structured interview elaborated on diary entries and how significant these listed memory cues were to the participant, how important reminiscing and reflection is in their life and in what way things play a role, and how they perceive differences (if any) between physical and digital mementos. Appendix 4.3 lists the structure and questions used. The interviews were held in a quiet space on campus and lasted up to one hour.

4.3.4 Analysis

Data from fifteen participants have been used (see Figure 4.3), including interview data for one participant who withheld her diary because she thought that its contents were too personal for her to share; another person handed in a diary but was not available for an interview. All interviews were transcribed prior to analysis, as were all diary entries. Seven diary entries did not relate to a past memory and were excluded (e.g., observations about in-the-moment events). Entries based on involuntary internal cueing (i.e., thoughts that cued other thoughts), although infrequent and not the focus here, were left in. This resulted in a total of 208 entries.

The data was subjected to a qualitative thematic analysis that aimed for data reduction through quantitative summaries of diary entries and that identified recurring themes through inductive coding of the data by a single coder (cf. Braun & Clarke, 2006). The use of a single coder reflects a particular reading of the data and, with that, a particular orientation that would not necessarily be improved upon with additional coders. Entries were coded twice: first in a directive approach on summative measures as in earlier work to enable comparison (i.e., categorising as objects, or smells, or people, etc.) (Berntsen, 2009), and second, entries were clustered based on emergent affinity which allowed finer grained categorisation and contrasts (i.e., not just objects as category, but split into tools, souvenirs, clothing, etc.). Further measures per entry included memory valence (positive/ambivalent/negative), memory specificity (lifetime periods/general events/event-specific knowledge (Conway & Pleydell-Pearce, 2000)), and whether the participant controlled the exposure to a memory cue (as interpreted by the coder via the text of the entry).

All relevant statements from the interviews (i.e., excluding elaborations on tangential matters) were printed and cut into separate paper strips. These strips from all participants were clustered by similarity into a hierarchical structure to support examination. Recurring themes emerging across interviews, and diverse views on these themes were used as the basis for organisation and analysis. Together with the diary clusters this provides the structure for our insights into what role memory cues play in people's lives, how people relate to their past, and what potential role interaction design can play.

4.4 Findings

We give an overview of the data and discuss several themes that emerged during analysis. The thematic structure reflects our focus on what cues memories and which of these cues are considered valuable. Here, we give a succinct overview of these themes ahead of more in-depth coverage in the remainder of this section.

The most pervasive theme is the *relation between cues and memories*. We identified several sub themes, including items and their influence on memory and identity (including the cueing process), the role of items now and in the past, items with on-going and active history, and for some, having little to no memory-related items. A second important theme is participants' *motivations to keep or discard cues*, in particular where these relate to personal and family identity, brought of feelings of regret, and in some cases, pride around the self-made nature, and decisions regarding their placement. Closely connected but a theme in its own right were insights on *reminiscing*, how the past cues and shapes reminiscing, and how reflection on one's life connects to the world and cues around participants.

On a more practical level, *memory boxes* for long term but out-of-view storage were a recurring theme. *Photos were not a common cue* in the diaries, although the interviews shed light on the importance of taking, keeping, and viewing photos. In addition, we touched upon the perceived differences between *physical and digital* photos, and items more generally. Instead, our participants gave more weight to cues that they *related to people*. For the cueing itself, and participants' *sensitivity to cues*, we observed a strong connection to *location-based cues* and those *emerging from activities*.

These themes are reflected in the remainder of this section. However, for the structure of the text we take the outcomes of the diaries as our starting point. These observations are augmented with the insights from the interviews to give a better perspective on why particular kinds of cues are important or otherwise reveal worthwhile themes. Findings are then related to our research questions. When relevant, findings are contrasted with earlier work. Quotes from diaries are marked (P2-d), interview quotes show (P2-i). Thus, these findings first address what cued memories, such as objects, photos, and environments. Second, we relate our findings on which of these cues were considered valuable.

4.4.1 What cues memories?

A brief quantitative impression of the diary entries is presented here. It should be noted that our qualitative findings do not depend on this quantitative information. The median number of reported cued memories was 11 (range: 2-37). This study limited itself to externally cued memories, while other studies included internal cues (e.g., thoughts)

Table 4.1. Classification of cue types across all participants, using similar categories to Berntsen (2009).

Type	Entries	Percentage
Physical object	97	52%
Environmental	31	14%
Digital	19	10%
People	19	9%
Activity	25	9%
Other	17	7%
Total	208	100%

and those reported a slightly higher average of recorded memories (Berntsen, 2009). Following a categorisation similar to that of Berntsen, most cues in Table 4.1 relate to physical objects (52%), locations (14%), activities (9%), people (9%), digital things (e.g., photos or social media; 10%), and 7% other (e.g., sensory, feeling, wording). Objects were mentioned more often compared to ~17% in earlier work on involuntary memories using diaries (e.g., Berntsen, 2009; Schlagman et al., 2007). This prevalence of objects is a likely outcome from our request for external cueing. Table 4.2 captures a second, more specific classification of the entries' types, which among other differences from Berntsen et al.'s classification, splits up the broader object category into finer subcategories. Figure 4.2 shows several visual examples, while Figure 4.3 gives two exemplar diary entries.

Valence of entries (Table 4.3) showed strong dominance of positive (51%) compared to negative (21%) and ambivalent feelings (27%). In prior diary studies a higher percentage of negative memories surfaced (positives were similar), although these studied also included internal memory cueing (Berntsen, 2009). The cued memories related to event-specific knowledge in 45% of entries, with 40% cueing general events, and 15% related to lifetime periods (see Table 4.4). Both measures showed variance between participants, which may either be genuine, due to style and specificity of writing, or due to a low number of entries for some participants. For half of the cues reported on, participants had some control over the exposure to a cue by means of ownership or deliberately seeking out these stimuli. This was clearly the case for categories such as tools, souvenirs, (digital) photos and websites visited. Other categories related to locations, music, social events, and social media did not give much control over exposure to cues.

Objects as cues

Physical things proved the most common memory cues. While the incidence of objects was higher compared to other diary studies, this was not the case for all participants.

Table 4.2. Classification of cue types across all participants.

Type (specific classification)	Entries	Percentage
Locations	32	15.4%
Food related	22	10.6%
Objects (generic, not otherwise classified)	19	9.1%
People & pets	17	8.2%
Actions	16	7.7%
Clothing	12	5.8%
Gifts	10	4.8%
Tools	9	4.3%
Social media	9	4.3%
Music	8	3.8%
Actions in specific locations	8	3.8%
Media & carrier (e.g., cd's, disk drive)	7	3.4%
Online video/text	5	2.4%
Photos (physical)	5	2.4%
Souvenirs / Heirlooms	4	1.9%
Film/TV	4	1.9%
Social events	4	1.9%
Discussion / collective thought	4	1.9%
Own thought (internal to self)	4	1.9%
Art/decoration (at home)	3	1.4%
Smell	3	1.4%
Art/decoration (elsewhere)	2	1.0%
Photos (digital)	1	0.5%
Total	208	100%

Table 4.3. Valence of cues, using subjective interpretation.

Valence	Entries	Percentage
Happy/positive	107	52%
Ambivalent/nostalgic	57	31%
Sad/negative	44	17%
Total	208	100%

Table 4.4. Period specificity of cues, following the schema by Conway and Pleydell-Pearce (2000).

Period specificity	Entries	Percentage
Event Specific Knowledge	93	17%
General events	84	46%
Lifetime	31	37%
Total	208	100%



Figure 4.2. Examples of things invoking memories for participants, with categories superimposed: Photo of a trip on Facebook; Thunderstorm; Boboti dish; Transistor radio; and a Scarf.

Some participants perceived less sensitivity to objects: “The nature of the diary led me to believe that physical objects were the cause of my memories, but what I found was that it was actions that made me remember things,” (P8-i) according to a participant who noted not keeping a lot of things around in his home.

The kind of objects varied widely, with tools, clothing, souvenirs, gifts, books, decorative pieces, images, and food being the main subcategories. Not every object may bring back memories, but for those that do there is usually a story in which the object played even a minor role and has since become a signifier for this story. This was the case for the following exemplary diary entry: “[I noticed] My transistor radio! I listen to the ABC through the day - sport, news, and classical music! [I remembered] my father listening to his transistor

[I REMEMBERED] breakfast in my childhood - my father made breakfast every day, and we always had a porridge as part of our breakfast, which he was very particular about cooking

[I REMEMBERED] sitting with my dad while he talked about 'how' to do things

[BECAUSE I NOTICED] I still love to cook & eat porridge for breakfast – but my porridge is from the supermarket. My dad bought a special mix from the health food shop

[BECAUSE I NOTICED] I was sitting explaining what the plumber was doing with my friend's son

[THIS MADE ME FEEL] connected back to my childhood, which was very happy and the routines + care of my father, which always gave me lots of safety + love.

[THIS MADE ME FEEL] very happy, teary

Figure 4.3. Two examples of typical diary entries, one per column. Text between square brackets was the prompt in the diary that participants then completed.

radio all day as he carried it about with him around the house & garden (...) *[This made me feel] fond + proud of my dad, and happy for everything that he taught me*" (P3-d). This entry illustrates that an object often cues memories not because of itself, but rather because it, or the cued memory, relates to other people. A part of the memories reported relate only to the participant but the majority involved a social relation. This can range from rather mundane (e.g., acquaintances having the same cutlery set, P12-d) to teddy bears that played a role in significant periods of someone's intimate relationships (P14-i).

Photos as cues

With few exceptions, people display photographs around the house, as told during interviews, but entries were infrequent for photos as cues. Most participants were active users of the camera function on their mobile phones. An interesting aspect of this use is the occasional glancing at taken photos that people engage in whenever they have some time to kill. Recent and not so recent photos are flicked through ever so often for relaxation purposes: "*On my phone I have a whole bunch of photos that are from trips of experiences that I keep on there, they're never going anywhere. When I go over my photos I look at them and I'm reminded of all the experiences I've had. They do matter as well. It's because they remind me of times and experiences and things, so yeah, photos are important,*" (P4-i). Because those instances would be initiated by the participant, it would be considered as voluntary remembering and was not reported in the diaries.

Practices and values on personal photographs differ widely between people, as some take fewer photographs and attach less value to images (e.g., P8-i), whereas others appreciate photography as a hobby and enjoy having aesthetically pleasing examples around (e.g., P5-i). Therefore, photos (and other things) in the home can take on a position beyond that of a memory cue as a medium of expression of (family) identity, a conclusion similar to earlier work (e.g., Kirk & Sellen, 2010; Petrelli et al., 2008; Sarvas & Frohlich, 2011). Photographs may be a familiar sight and did not capture attention with related memories. When prompted, people could report on related events but in daily life such things appear to be no constant source of involuntary memories: *“We do have lots of photographs around, but those in the living room weren’t the ones stimulating memories. (...) It’s nice to have some pictures around the house. I would be sorry if I’d lost them”* (P11-i).

Digital versus physical cues

Digital cues account for a small amount of entries, with social media posts most prevalent (e.g., photos posted by others). These photos were not deliberately sought out by participants but rather appeared in the digital environment people frequent. The viewing of images (and the content in general) in this situation would be a surprise and requires a process of familiarisation: is this something I know about, do I recognise people, am I even interested in continuing to view this? This process is much more alike involuntary remembering in other facets of everyday life – even though people voluntarily expose themselves to such moments by visiting social media – and it is therefore not surprising that participants mentioned it. For example, P1 explained her ambivalent relation to her Facebook profile for this reason: *“I have a new profile, because my old one was my life before and just after my relation with my ex. And I don’t use that one anymore, because that story is not one I do necessarily want to engage with, because it is the past now. But it’s still there.”*

All participants mentioned digital photos although only one diary entry listed a digital photo as a cue. Given this result, we surmise that people realise memory cueing more with physical than with digital things, including photographs. An example of such different perceptions is this quote by a male participant on family photos: *“I don’t really pay much attention to the computer-stored ones. For me family pictures in frames around the house are important.”* This seems in contrast with a later quote on digital photos: *“When the laptops are on there is a rotation of family pictures on them. And I do enjoy the process of seeing ‘m come up.”* (P11-i). Family pictures in frames take on extra meaning given their placement in the home. Digital media, when merely stored and not put to use as a background image or otherwise, as a result could be valued less. This finding, while not original (cf. Kalnikaite & Whittaker, 2011; Petrelli & Whittaker, 2010), appears robust across participants.

A majority expressed preference for physical compared to digital things as mementos. The following quote summarises the opinions well: *“Things... you can feel and touch*

something. (...) Whereas with the digital (...) there is something removed about that, in a sense." (P3-i). One participant explicitly mentioned his preference for digital media given that voluntarily bringing back memories feels equal to him, but physical things can be a practical burden (he kept hardly any himself).

Participants felt that digital media, such as photos taken on a phone, were perceived to have lower value and usefulness, and were "*almost ephemeral*" (P8-i). Such qualities have merit: digital snapshots are considered well suited to share with others as a means of keeping in touch. Preservation is not a big topic for some of the interviewees, with one participant mentioning she lost digital images by giving away an old phone to a friend and not feeling too bothered about the fact. A somewhat paradoxical case of preservation is seen in another participant's efforts to complete his life's timeline on Facebook by scanning and uploading old pictures. Despite considerable effort to make sure "*his story is told*" (P15-i), he mentioned not feeling much attachment to this result. In case of losing it (e.g., due to a possible future demise of Facebook), he would still have the memories, as well as the original photos. The tendency to ascribe lower value to digital mementos is generalisable (Petrelli et al., 2008; e.g., Petrelli & Whittaker, 2010). It appears positive values derived from digital media are less evident.

Locations as memory cues

Locations, and actions in specific locations, were reported on frequently. Most entries related to earlier experiences in the same environment, but just similarity was enough in some cases to invoke memories. For example, a sandy beach and high temperatures were distinct enough to cue memories of another beach far away in time and space (P17-d). In other cases, it was not so much the location as the opportunities afforded, such as the realisation of the ability to go somewhere at a ferry terminal (P3-d). The latter example could be described as reflective, similar to motivations to go to a park that, when there later on, sparks many related memories (P3-d).

This study provides no clear perspective on whether a location as a whole is the cue, or rather something specific within this environment. For example, in an entry noted at a beach, a low moon reflected in the ocean triggered a participant's memory of "*going in the ocean at night for the first time a couple of weeks ago. [This made me feel] excited: keen on going swimming at night soon again*" (P17-d). Being in the same place appears to evoke a similar state of mind and makes it likely some aspect pulls past events to the surface, making it difficult to retrospectively tell if it really was just that element as cue. Another entry underlines this by pointing to the column portico of a university building upon returning there. The act of going back and taking that familiar walk contributed to the sense of nostalgia before seeing the distinctive portico.

Activities as memory cues

Activity was often named as a cue for events in which a similar action had been performed. A few participants realised that for them it often was not specific things that brought back memories but rather it was doing something similar as in the past. For one person, aware of his proclivity to remember by doing, it became part of his practice (and tendency not to take many photos): *“When doing things, you get a déjà vu: what you were seeing, smelling, and feeling as well. (...) An image... I’d think ‘oh, yeah, that was really, really good,’ but doing something engages that whole process of remembering.”* (P8-i).

Why do activities cue memories? When trying to fit groceries in a bicycle bag, a participant was reminded of previous times she faced this challenge. Without an immediate challenge present, it is less straightforward: *“When I swim in the morning, I always remember my boyfriend. [Sporting] became part of something we did together (...) and then you think about a person and it becomes a habit”* (P4-i). We argue it may be repetition, and through this the accumulation of meaning that aids remembering of events in which the activity took place. Although mundane activities like cleaning and cooking were mentioned as well, it appears sports provide a unique opportunity through the repetition and relation to values in life. This diary entry captures it well: *“[I noticed] how good I felt after going for a jog, and arguably during the jog. [I remembered] how good I felt when I was more active. (Used to run frequently). [This made me feel] good, proud that I have restarted the regime.”* (P1-d).

Food related cues

Eating and food-related materials came up often, and included ingredients, making food, related tools, and sharing a meal (see for an example Figure 4.2). Although not mentioned often within HCI (cf. Grimes & Harper, 2008; O’Hara et al., 2012), food is one category where things, activities, social gatherings and accumulated meaning combine. Food-related cues prompted memories on social gatherings, past events, people’s preferences, and the relationship with family members: *“[I remembered] cooking with my mother – as a child living at home, [Because I noticed] her handwriting on a recipe I was about to use that evening. [This made me feel] a little sad – that I can no longer call her & chat about day-to-day things. That she is no longer with us.”* (P9-d). Figure 4.3 above covers another example that fits here. Like activities, food and its social practices appear to accumulate meaning over time and as such the repetition makes for a stronger memory. The cooking example indicates dishes can be specific to an event or a period and take on a role as signifier for those moments, presumably cementing its ability to cue memories later: *“I went to buy a crêpe and I am going almost every day since, it gives me the pleasure of eating something I know,”* (P20-d). Yet, this ability may be implicit and not readily obvious to people (that is, involuntary cueing seems stronger than self-initiated recall). Kalnikaitė and Whittaker (2011) found only a small percentage of memory-related things in a study in which people

did a voluntary matching of memories to locations in a prototypical, virtual home. In contrast, Petrelli et al. (2008) noted a prevalence of food-related things based on a home tour study.

4.4.2 Which memory cues are valuable?

While our focus was on involuntary cueing, discussions on valuable things as cues centred on practices in the home as the place for storage and display of things for their related memories and/or aesthetics. We found a relationship between the perceived need of access to related memories and thing placement. For some, things were deliberately put on display to serve as signifiers of positive moments and self-attributes (e.g., P4-d, P17-i, P20-i). These things thus served to display and cue positive attributes of identity: *“it’s like each of those things paint a stroke in your own painting”* (P4-i). The desire to have the home reflect identity is found with nearly all participants, and echoes prior work (e.g., Csikszentmihalyi & Rochberg-Halton, 1981; Kirk & Sellen, 2010; Petrelli et al., 2008). This highlights that the need for reminiscing ties into perspectives on the past, and how it relates to the present.

A thing’s relation to the present may transform over time as it may take on new meaning after influential events, and remain valuable partly because of this. For example, a hand-knitted scarf received once as a gift from a past friend has come to signify personal growth: *“it’s ultimately a symbol of rejection [in the past]; it’s also a symbol of love. (...) And when you keep things of your own failures around, it keeps you humble. (...) It encourages you to keep growing”* (P4-i). Such tokens of important life events relate to complex emotions. Other work on digital remains and heirlooms corroborate these findings (Kirk & Sellen, 2010).

Meaning develops over time for many personal things, as these things get put on display, get used, scarred, or fall out of use and are reencountered after a while. The scarf from the example above developed alternative associations that layer and work together, which in this instance led to the scarf being buried underneath other things so it would not be forgotten nor encountered too often. Another good example is a story on a bike that a participant uses to go to work daily, which was bought years ago and has since accompanied him around the world: *“I need to replace a few things. So I think ‘do I get a new bike? Or do I replace the components?’ And I replaced the components, because of the memories I think, and probably as a keepsake.”* (P8-i). Other people illustrated similar stories that showed a gradual attachment over time as a thing played a part in their life and was associated with treasured memories. This complements other work on personal belongings that emphasise the beneficial role of a repeatedly observed (or used) factor for investment of meaning (Kirk & Sellen, 2010; Petrelli et al., 2008).

4.5 Discussion

In the reported study, we investigated involuntary memory cueing in aiming for insights that could subsequently inform design for remembering. Our findings show that a broad range of external stimuli can trigger remembering experiences. We found physical things took precedence as involuntary memory cues; locations such as parks and beaches were also frequently mentioned, as did activities. The latter is not often discussed, perhaps because activities are not typically thought of as a cue for earlier events. Yet, psychological studies on involuntary memory cues back up our findings for these kinds of cues (e.g., Berntsen, 2009; Schlagman et al., 2007; Schlagman & Kvavilashvili, 2008).

The use of self-reports throughout the day brought in reports beyond personal and curated cues. However, for personal things people were able to relate stories and histories in which these things played a role. Meaningful things are often put on display (e.g., photos to display family bonds) or, like inherited dinner plates, are 'honouring through use' (Kirk & Sellen, 2010). Indeed, when discussing personal memory-related practices in the home, our findings dovetail with earlier ethnographic accounts (Csikszentmihalyi & Rochberg-Halton, 1981; Kirk & Sellen, 2010; Petrelli et al., 2008), although these works oriented towards voluntary memories, and employ a broader sociological perspective that focused on meaning rather than the means of invocation of such meaning (as we did in this study).

In earlier involuntary cueing work there was no attention to the media representation of a cue, so no comments were recorded on digital cues (e.g., Berntsen, 2009; Schlagman et al., 2007). We categorised these and found that digital things were not common as involuntary cues. Still, most participants who use digital social media were able to remember instances of reminiscing invoked this way. Browsing photos on a phone gave no diary entries, but was mentioned by several participants as a pleasant activity. It may be that participants regarded this as a voluntary act, while the focus here was on involuntary cueing. Alternatively, if digital media are encountered involuntarily as on social media, these can foster reminiscing. However, digital media are currently not having as prevalent a role in cueing reminiscing in our physical environment, as these are perhaps restricted by their availability primarily through the digital realm. Photos on phones may lower the bar, being within easy reach.

Despite the intent to focus on digital cues, this study does not make clear whether there is a difference in the way people remember for cues that could be both digitally and physically presented, and how any such differences may affect their emerging experience. How someone's experience is affected by (involuntary) memory cues is nonetheless a question of interest, also for the following chapter. Our findings suggest the ability to cue extends to a wide variety of things, but the availability to be observed is key. This notion

may explain the prevalence of physical things in the responses. From a design perspective this question of representation is in need of future attention, because if remembering experiences differ depending on the way a memory cue is presented this has implications for future devices that support remembering using cues.

4.5.1 Limitations of the study

Some methodological limitations apply. Using diaries enabled self-reports directly after being cued. However, some people wrote in the diary a while after such moments of interest because they felt burdened carrying it around. Such practices may introduce retrospection on memories invoked earlier or leave ephemeral and quickly forgotten memories unreported. Diaries were then filled out upon coming home, presumably around dinnertime, which may have primed food-related entries. Future studies could employ a staged capturing of data to ease reporting. That could mean just quickly noting a few keywords at first, with full descriptions added later, such that the initial involuntary remembering experience is not unnecessarily obstructed by the data collection method.

Observed differences between participants may be partly attributed to different task interpretations. In particular, some felt restricted to physical observations and, for example, excluded music as a potential cue. This may partly explain the higher count of objects in our data compared to other work (e.g., the studies reported in Berntsen, 2009), and such interpretations could have reduced the number of digital cues. However, comparing is difficult, as earlier work did not specify involuntary memory cues as digital or not. Furthermore, we suspect some filtering took place on what was recorded. While this is not unexpected when relying on someone's awareness of being involuntarily cued, some participants might have discarded cued memories that did not feel very personally relevant or were very fleeting, which may bias our findings.

We stressed in our instructions that participants should not look for things that reminded them of personal memories, but, rather, rely on involuntary cueing. However, we could not be sure this was indeed what they did, other than by retrospectively asking about their motivations to note certain entries. While responses suggest entries were indeed based on unintentional invocation of memories, in many instances in the home things were deliberately put on display to serve as occasional reminders and evidently did so, blurring the line on intentionality.

It needs acknowledgement that memory cueing is not a straightforward process and a cue can – via cascading thoughts – lead to a memory that may no longer be recognised as brought about by the original cue. The act of writing in the diary (or remembering to do so later) may equally modify one's perspective on the original cueing event and related memories. This modifying aspect is relevant to consider for interactive devices, but here it

can be seen as a potential influence outside our control.

4.5.2 Implications and opportunities

The remainder of this section relates implications and opportunities for interaction design to support reminiscing, which are described as dimensions of trade-offs to consider. These trade-offs build on the themes of our study and make an inroad towards the design for serendipitous reminiscing (hereby addressing Research Question 3, in particular the considerations that apply when designing for and evaluating this kind of reminiscing). Where the findings examined how people relate to things that cue memories, and which place such cues are afforded in their lives, this subsection highlights insights that matter to the application of technology to stimulate reminiscing. The findings made clear that cueing correlates with meaning read into or invested in a thing. While this connection is not always obvious or known in advance of such cueing, we did note a sensitivity to the context in which cueing takes place. Furthermore, this context is actively shaped through embedding things into the routine of everyday life and the repeated use or encounters with these things (e.g., the various food-related items the diaries revealed).

We took the emergent themes and considered how a designer may be able to elicit cueing of personal memories through technological means. This led us to reflect on the challenges inherit in such an endeavour, and through further inductive reasoning to the trade-offs we regard as central to the design of systems that seek to evoke serendipitous reminiscing. The dimensions introduced below are timing, exposure, and the process of becoming a meaningful memory cue (see Figure 4.4). Together with limitations that inform the edges of how far we can expect technology to go, these considerations reflect major important challenges for the design in support of serendipitous reminiscing.

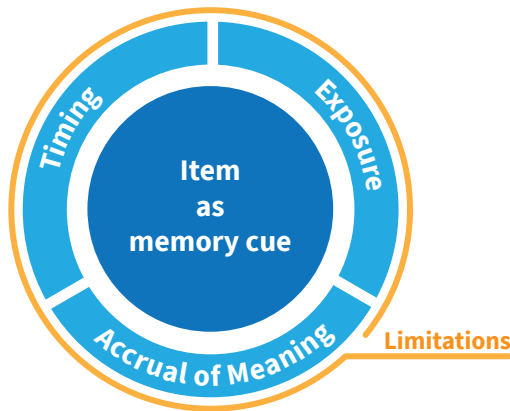


Figure 4.4. In this schematic drawing, considerations for design surround the application of a thing as memory cue, held within limits by technological (im)possibilities.

Timing: moments for presenting cues

Reminiscing and reflection are not activities people set out to do for a while, according to our participants. A reflective mood will certainly increase the odds, but it is rather something that comes up while doing another task (e.g., doing laundry, cooking, riding a bike). Depending on cognitive demands, a task may allow the main activity to move to the periphery of attention (cf. Bakker, van den Hoven, & Eggen, 2014). Opportunities for reminiscing can be facilitated by augmenting existing interactions that are prone to mind-wandering. Cooking was indicated as an example of such a low-key activity, and a device could capitalise on the opportunity to inspire positive reminiscing. Facilitation is certainly challenging because it may be hard to steer the wandering mind, but such suggestive devices embedded into everyday activities have the potential to tap into moments when people say they enjoy thinking about their lives.

To engage people in reminiscing via designed cueing requires sensitivity to opportune moments. By definition involuntary cueing is unsolicited, but devices that aim to do so would benefit from a way to sense (un)desirability, or alternatively, provide the means for people to indicate in retrospect whether they appreciated the experience of being cued. Over time, a system may be able to learn from such feedback. Other technical means may be available to sensing appreciation (e.g., facial expressions, time spent looking at a thing). Similarly, user activity could be classified as relaxed and open to interruption, or in a state of flow (cf. Csikszentmihalyi, 1990). The opposite end on this spectrum would entail no cueing is commenced without prior voluntary action.

Exposing a cue: what and how

A key element for any system is to find out which available things relate to a valued memory for someone, and in which way these things are best presented. Finding out about the perceived value (whether of a thing-as-cue or a related memory) could be done in advance through explicit inquiry, or retrospectively through feedback. One issue for the automated gathering of such knowledge is that the meaning of a thing is idiosyncratic, perhaps ambivalent and variant over time, as our findings indicate. While (for example) the number of interactions may be a telling signifier (e.g., how often a song was played), a system may not know why. Some prior work has sidestepped this issue by considering random viewing as a way of achieving serendipity (e.g., Cosley et al., 2012; Helmes et al., 2011; Leong, Vetere, & Howard, 2012).

Next comes the question of which form this exposure should take. While our data suggests a related memory is a stronger indicator of appreciation than the cueing itself, our findings leave room for exploration of this cueing manifestation. Remembering through action is worthwhile for further investigation. We imagine interactions can be leveraged not just as means to access content, but also be conducive to reminiscing. If a

device is aware of reminiscence-prone activities, there may be opportunities to reminisce on earlier events through stimulation of activities. Relating to positive memories could stimulate similar experiences, as seen with the jogging example.

People expressed no need to consider the past all the time. Potential overexposure is important to consider for interactive devices as digital devices enable us to frequently encounter many mementos: we can quickly retrieve any old thing, whenever we want, which may change how we develop relations with these mementos (Schwarz, 2014). It is a contrast with the normally hidden shoeboxes of old, and explorations building on this theme (e.g., Frohlich & Murphy, 2000). Frequent interaction with the past can have adverse effects, both for painful memories and the inability to move on with one's life, as pointed out by two participants familiar with depression. There is equal value in forgetting as part of a healthy memory system, and indiscriminate invocation of unpleasant memories can adversely affect people's wellbeing (Bannon, 2006; Harris et al., 2010; Mayer-Schönberger, 2011). Still, we believe that when done right, designs can engage with the process of reflecting on meaningful events of the past (e.g., Massimi & Baecker, 2010; Moncur et al., 2015).

Process of becoming meaningful as a cue

Can meaning be designed for or cultivated through design? This is a design challenge we seek to contribute to. The study presented in this paper was concerned with existing things that had the ability to bring back memories without being designed explicitly for that goal. Based on our findings we note that memories and meaning of a thing do not form a straightforward relationship with it. This sometimes tangential relationship can be idiosyncratic (Petrelli et al., 2008). For example, the scarf discussed earlier symbolises a lost friendship, but this symbol could have been another thing. We speculate everything might be able to become a memory cue depending on how people relate to it, but some designs may be better suited to bring back memories. The scarf's handmade materiality may be such a design element that signifies emotional investment, a quality harder to replicate in digital media (cf. Jung & Stolterman, 2012; Turkle, 2007). Therefore, especially for digital devices that could cue memories, we believe a very relevant question is how it can be designed to become meaningful.

The notion that meaning develops over time is interesting to investigate in future design work, and echoes similar findings by Petrelli et al. (2008). Repeated exposure and engagement with potential memory cues seems important, and such investment of time hampers digital cues to pick up meaning. Compared to physical cues, digital ones get comparatively less exposure in everyday life, if going by our results (although Schwarz (2014) points at a different trend). If repetition is key to accrue meaning, designs could explore ways in which meaning develops and grows over time (e.g., through repeated

exposure). If indeed how people come to relate to something is more relevant than what the thing is, we should consider how we could foster a relationship between a personal memory and a thing as cue. Designing for this process and facilitation of reminiscing and reflective thought appears a veritable direction of inquiry. This is different from designing a thing to be able to cue an autobiographical memory and, rather, may use things to facilitate the process. In a similar vein, based on a study of what happens to digital possessions after a breakup, Sas and Whittaker (2013) argued for design around meaningful (digital) things to facilitate change, closure and the ability to move on.

Whether the accrual of meaning is deliberately sought via interactions with someone (e.g., by repeated exposure) or, as per the opposite, that increasing meaning is derived from usage data (e.g., how often a thing is revisited), is a design decision to be made. It relates to the other dimensions by focusing on what could become valuable if given time. As an example, our findings suggest things that relate to social connections would be likely to become regarded as valuable, if this connection is indeed seen as such.

Limits to what technology could accomplish

The aforementioned dimensions all require trade-offs to be made considering the desirability of involuntary cueing from a user's perspective. For example, obtrusiveness of cueing relates to insensitive timing and/or misjudging exposure to a cue for an undesired memory. Whether a system can be successful in cueing memories in a pleasant way depends on how well it is able to understand the context of its use and how well it adapts to such knowledge. The challenge is to judge this desirability within the means of technology, and handle the cases where it cannot adequately know in an appropriate manner.

Getting the necessary understanding may depend on machine learning algorithms that may or may not be sufficiently capable to do so given hard to measure data such as personal attachment to a thing or openness to consider one's past. The latter issue implies a fully involuntarily experienced system may be imperfect, and a balance with some voluntary interactions could serve people's needs better (e.g., using retrospectively marking of certain cues as desired or not). Furthermore, there are aspects that are hard to prepare for with a technological system, as shown in earlier work on inheriting digital data (e.g., Gulotta et al., 2013; Moncur & Kirk, 2014). However, the ways imperfect moments play out are malleable. We believe designers should acknowledge the limitations of technology by not relying extensively on its ability to meet the requirements (which may be forever 'coming soon'). Rather, designers should opt for a dialogue, similar to how physical things, their meaning, and visible (dis)placement form a dialogue with their owner through manipulation of place (e.g., putting something on display or deliberately hiding things).

4.5.3 Reflections on research for remembering

Having made the argument that meaningful connections between things, the self, and memories are forged over time, this has implications for design research. Careful study of designed interventions should consider the effects of repeated user engagement and would therefore benefit from longitudinal evaluation. Most of the interaction design work discussed so far in this thesis studied design concepts for a limited period of time (as are many not discussed here), perhaps falling short of the time necessary to become related to at a deeper level. Because passage of time may alter our perspective on earlier events, it would be interesting to be able to compare reminiscing on, for example, a recent event and (some time later) that event further in the past. An emphasis on longitudinal evaluation can thus provide necessary insights on how to design for serendipitous reminiscing using personal digital media.

4.6 Conclusions

We believe understanding what makes people remember their past and how this colours their experience is important to inform designs that aim to support reminiscing in everyday, in particular when this is unexpected, perhaps serendipitously so. This chapter contributes to the literature by integrating diary self-reports with follow-up interviews to further our understanding about the relation between involuntary memories and the things that cue such memories, and how people relate to particularly meaningful things. The findings illustrate memory cueing happens everywhere: meaningful cues are not limited to the home, nor should its study be limited to that environment.

Repeated encounters in daily life, in which the thing may be essential or merely tangential to the task at hand, provide opportunities for things to take on meaning. Such practices do not easily extend to digital things, although nowadays many potential cues are digital. While physical things can be put on display or used for common tasks (e.g., inherited cutlery), we believe this proves a challenge for digital things to be used for everyday remembering as these are often not encountered on a regular basis (or serendipitously for that matter). Even though easy capture of media for future recall seems a problem solved – too well perhaps (Schwarz, 2014; van Dijck, 2007; Whittaker et al., 2010) – our work addressed how these things are currently encountered and can be used as support for reminiscing and enhancing wellbeing.

Considering our insights, we can now state what we believe to be effective practices for interaction design to support everyday remembering. First, designers may want to explore the integration with common activities that stimulate the mind to wander. These moments can provide opportunities for reminiscing stimulated by a designed system. However, involuntary cueing can lead to surprise revisiting of memories, including undesired ones. Designs should therefore allow for some control over (non) exposure

to certain cues. In support of the role of developing perspectives for serendipitous reminiscing (see §3.8), this study also underlines that meaningful connections grow over time: designs can support this process. Finally, our findings reiterate the idea that evaluation of interactive designs for remembering can benefit from a longitudinal focus.

The qualitative investigations of this chapter paint a rich picture of the experiences people have with their personally valued possessions and other things. In addition, these experiences are clearly contingent on contextual factors – a direct result of the in-the-wild nature of data collection. With the insights related here we acquired a better view of everyday reminiscing as it plays out in practice, and we were able to get a view onto the desired experiences that people seek. Using these insights, we were able to generate recommendations towards the design of future systems. More precisely, we concluded that a prime reason for digital media to play an underdeveloped role in reminiscing in everyday life is the reduced presence in everyday situations where reminiscing may occur. To alleviate this issue and make use of the prodigious personal digital media that people already own and store, a novel system may establish the physical presence of such media by creating a situated display (we hereby repeat the terms Kirk and Sellen use (2010)). However, the relatively small number of studies across the literature on digital media usage for reminiscing leave room for further investigations into established and speculative practices. After the next chapter, in the third part of this thesis the focus will indeed turn towards a research-through design approach to explore how a novel situated display may address some of the trade-offs and limitations we highlighted here.

This chapter has addressed several of the research questions set out in §1.4, more precisely those pertaining to the role of memory cues and how (digital) things may be appropriated as such cues in designed systems. What is left unclear, among other questions not pursued, is a more thorough understanding of how the way a cue makes itself present in the mind of someone affects how this person remembers related memories. In particular, questions remain around the experiential effects of a person's interaction with a memory cue: how such interactions influence someone's ongoing experience, as well as how someone's past experiences are reconsidered and make their mark on someone's state of mind. A clearer picture of these issues could provide grips for design to support reminiscing in everyday life. The following chapter continues on this path by developing remembering as a particular kind of experiential process.

*Categorising the
remembered experience*

5

5.1 Introduction to this chapter

Reminiscing is a practice that contributes to the maintenance of identity, social relationships, intimacy, and fostering a sense of a shared ‘we’ at certain moments (e.g., Bluck & Levine, 1998; Harris et al., 2014; Webster, 2003). This is to say that reminiscing (and more generally, remembering) influences and alters someone’s ongoing experience. Tulving (2002) remarked remembering is “*mental time travel*” (p. 2), which implies remembering is something that takes us to another (mental) place, and as a consequence, away from the present experience. If we adopt the perspective that an experience is an ongoing reflection on events someone currently goes through (following the definition of experience by Hassenzahl, 2010), it is not a stretch to consider that the reliving of the events of one’s life is also a form of experience (even if the events at the heart of this experience took place earlier). The focus of this chapter is to develop the idea of remembering as experience further. We seek to frame it as a particular form of experience that is distinct from a more general definition of experience. Setting it apart also implies it is a separate phenomenon that begets separate study, toward which the second part of this chapter turns its empirical focus.

The motivation to frame remembering as an experience stems from the growing interest in interactive technologies that support remembering. Such interactive systems provide one contextual aspect that can be designed to influence someone’s experience while remembering. For example, viewing a photo can trigger someone to remember the event at which the photo was taken. The way such material is presented through an interactive system could influence when, where, and how someone reviews and remembers the associated past experience. Designers and researchers wish to understand experience to inform the design of interactive products. With that lens, experiential events are instances of human-product interaction (Hassenzahl, 2010). As Wright, McCarthy, and Meekison (2003) argue, experience cannot be designed as such, but with understanding of people and their context, it can be designed for. Thus, research towards the support of reminiscing in everyday life benefits from an understanding of how people experience this kind of autobiographical remembering.

Despite clear similarities between personal remembered experiences and product-user

This chapter is based on:

van Gennip, D., Hoven, E., van den, & Markopoulos, P. (2016). The Phenomenology of Remembered Experience: A Repertoire for Design (pp. 1–8). In Proceedings of the European Conference on Cognitive Ergonomics 2016, Nottingham, UK.

Sections 5.1 and 5.2 also incorporate ideas and text from a multi-author manuscript under preparation, for which the collaborative writing process defies easy attribution; I was involved in the conception and development of the ideas exposed, and the writing and revising of several parts, in a manner equal to those of other contributors: Hoven, E., van den, Broekhuijsen, M., van Gennip, D., Mols, I., Zijlema, A., Eggen, B., & Markopoulos, P. (manuscript in preparation). RX: the Remembering Experience.

experiences, the user experience (UX) literature has so far not addressed a more general experiential understanding of personal memories. Because past events and related experiences someone had at that time are often at the basis of designs that aim to support remembering (for example, by showing photos of these past events), we argue that addressing this gap can serve as a guide for future work to chart and compare experiences people have with new designs. Benefits include being better able to canvas people's experiences in future studies (helped by a phenomenological frame of reference) and improved evaluations of how systems designed to affect remembering actually influence such experiences.

To this end, the next pages set out to refine the ways in which experiencing and remembering are similar, followed by a brief discussion on the phenomenology of memory and how the empirical study that follows contributes to design research.

5.2 Remembering as experience

The term user experience is in common use in Human-Computer Interaction and Interaction Design. However, user experience has been associated with a wide range of meanings and no generally agreed upon theory of experience exists (Forlizzi & Battarbee, 2004; Hassenzahl & Tractinsky, 2006; Roto, Law, Vermeeren, & Hoonhout, 2011). While the formulation of such a definition continues to be an ongoing debate, we adopt the explanation by Hekkert:

“The entire set of effects that is elicited by the interaction between a user and a product, including the degree to which all our senses are gratified (aesthetic experience), the meanings we attach to the product (experience of meaning), and the feelings and emotions that are elicited (emotional experience),” (Hekkert, 2006, p. 160).

Several researchers have attempted to decompose user experience into aspects that an experience may entail. Models developed by McCarthy and Wright (2004b), Hekkert (2006), Desmet and Hekkert (2007), and Hassenzahl and Tractinsky (2006) all emphasise three to four elements or perspectives on experience. Although using slightly different terms, these models include three aspects: sensory aspects (Hekkert refers to aesthetic experience, McCarthy & Wright talk about ‘the sensual’), emotional aspects, and the situatedness of the experience. Wright, McCarthy, and Meekison (2003) argue with regard to the latter that experience is spatio-temporal (it unfolds in a particular time and place) and that experience is holistic (parts interrelate to form a whole – these parts interact and modify each other). Forlizzi and Battarbee (2004) reason that any experience is made up of a large but indeterminate amount of smaller experiences, each relating to particular situational aspects (e.g., context, people, products).

The above explication shows a clear similarity between the conceptions of experience and remembering of a specific event. This is particularly true if autobiographical memory is seen as a set of episodic elements held together by a frame that ties these events together into a more complex, self-relevant event (Conway, 2009; Conway & Loveday, 2015), similar to how experience may be framed as the culmination of many experiential aspects (Forlizzi & Battarbee, 2004). Wright et al. (2003) note that “*a key part of sense making is relating an experience to previous and future experiences. (...) We relate it to our sense of self, our personal history and our hoped for future*” (p. 50). Thus, personal memories and experience can be brought together when such memories are considered as past experiential events. For this reason, we define a *remembered experience* as the experience one remembers having had at some point in the past. We refer to what is being remembered on an experiential level, which is similar to how Singer and Conway (2014) use the term remembered experience: an experience that is remembered. For example, imagine recalling what you experienced while enjoying time with friends last month. Where our framing of a remembered experience differs from a more general experience is that we intend for a remembered experience to refer to a holistic experiential package of a past event that someone lived through. A more general experience could refer to a variety of experiences, those specific to the use of a system, or otherwise limited in scope. In this thesis, we thus use the term remembered experience to refer to a specific experience of a past event as someone remembers it. This remembering is not necessarily a facsimile recall of the past event. Given the reconstructive nature of memories, one’s current mood influences the perspective on a past event (Conway & Pleydell-Pearce, 2000). Conversely, a remembered experience may also affect the present experience of the person remembering.

5.2.1 Remembering experience

A remembered experience is thus a past experience that someone is aware of and remembers at a later point in time. In Figure 5.1, the relation between time and remembered experience is depicted. The top figure (a) centres around an experience that plays out in the present (e.g., buying and eating ice-cream from a van in the street). In advance, someone may anticipate a particular experience and in doing that, already experience some joy (or dread, or any other experiential effect) that Pohlmeier (2014) refers to as a pre-experience. Afterwards, looking back on the experience may once again cue some emotional and other experiential effects. In reminiscing on the earlier event, someone may re-experience this past experience as it is currently remembered (which may be rose-tinted or otherwise not a veridical recall). The reminiscing in this case is thus done based on a remembered experience. Part (b) of Figure 5.1 illustrates this relation. Here, experience is considered an ongoing phenomenon, of which the particulars fade out the further these recede into the past (towards the left). Remembering assumes an earlier, remembered experience is brought forward in time towards the present. Now, it

imposes itself on but does not replace the current, ongoing experience. Instead, we argue, someone's ongoing experience is strongly influenced by the way the past manifests itself (i.e., the remembered experience) and how this past relates to the present. In effect, the ongoing experience becomes another, remembering-infused experience that we label the *Remembering Experience (RX)* and define as:

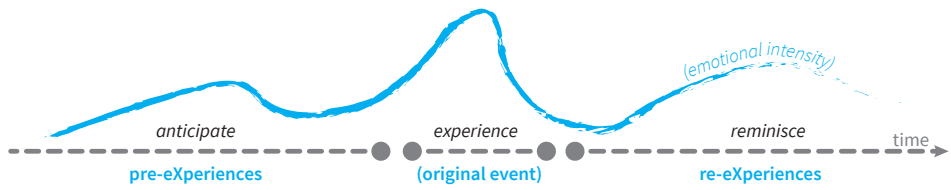
The set of effects that is initiated during the situated recall of a personal past episode.

The set of effects can be complex and rich, involving mental images, feelings, and thoughts, affected by its situatedness such as mood, use of media, physical and social context.

Thus, the remembering experience is the experience someone has while remembering something. That something is what we refer to as the remembered experience. Both concepts influence each other, in both directions: if the remembered experience was positive, it is more likely the remembering experience will be positive (but not always so, we can look back on old errors or misfortunes and laugh about them now). Influence also goes the other way: if the current experience while remembering is positive, it is more likely that past events are remembered more positively due to the constructive and situated nature of remembering. The remembering experience also bears resemblance to McCarthy and Wright's (2004a) conceptualisation of the recounting experience one has when remembering or telling someone else about an experience that unfolded earlier (the latter of which roughly equates to the remembered experience).

The remembering experience is not only affected by the contents and prior experience of the remembered personal past alone. As laid out in Chapter 3, remembering is situated (Harper et al., 2008; Sutton, Harris, Keil, & Barnier, 2010). The past is contextually recreated and given purpose, and thereby becomes a tool for thinking about oneself, events faced now or in the imagined future, or as a way of communicating with others. The situatedness of memory puts an emphasis of contextual factors. Echoing Dourish (2004), what is (not) contextually relevant in a particular instance of remembering is dependent on the relational factors of potential contextual elements. That is to say, at some point some elements may be considered relevant and therefore part of the context; at other moments, this applies to a different number of contextual elements. For example, an unpleasant or embarrassing memory can be a joyful experience when remembered and shared with friends and family. Thus, how remembering unfolds in terms of thoughts generated, things retold, and experiences felt, is truly a situated episode.

Because we are talking about remembering as a process, it is important to note that the remembering itself is not a single point in time: the reconstruction process takes some



(b)

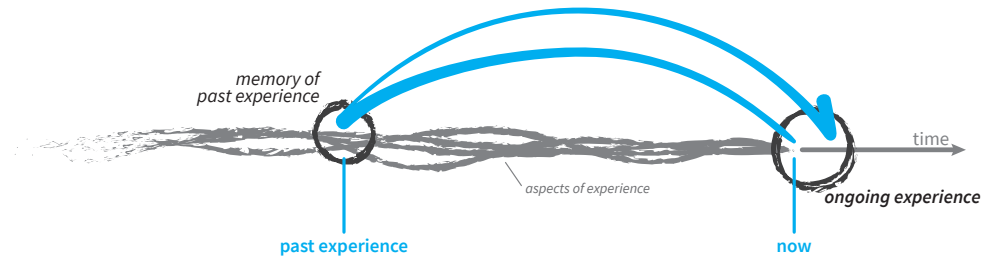


Figure 5.1. Two models of remembering as experience in relation to time; (a) Model of anticipation, experience, and re-experience (adapted from figure 1 in Pohlmeier (2014)); (b) Model of a remembered experience of the past, re-experienced in the now and integrated into one's ongoing experience.

time and some cognitive effort, as for example when going through a photo album, the memories can continue to contribute to the experience as a whole. A remembering experience can also linger on when no longer confronted with the photo album (or more generally, a system or object that cues a memory). The notion of remembering experience is less bound to a product than that of user experience, which is typically defined as those aspects that can be attributed to the interaction with a product, service, or company (Roto et al., 2011). Time is important because that is how we are able to go through the experience, but many factors can influence the overall, ongoing experience at different points in the process. However, when a remembering experience is actively supported by an interactive system, the distinction between remembering experience and user experience (with this system) is not so sharp. In this case, user experience cannot be considered in generic terms ignoring the fact that it serves and is embedded in a remembering experience. The two represent different perspectives on the same events and emergent experience.

5.2.2 Phenomenology of memory

We believe it is important to define the concept of remembering experience (RX), since a lot of previous work on design to support remembering is essentially about facilitating an RX, but lacking a language to describe what is being experienced. The RX definition

may provide the language to not only name the phenomenon, but also acknowledge that RX comprises of more elements than remembering alone, such as the visceral and emotional aspects of someone's experience when remembering. However, the RX concept as presented here is primarily a theoretical postulation – rather than an empirically validated phenomenon – that helps us to discuss relevant interactions and experiences. It must thus be considered as a point of departure for future work on what the RX entails and how design as a field may make use of RX. The studying of an individual's (or a social) RX is everything but straightforward. The effects and especially what has influenced these effects are difficult to measure. For example, it is hard to pinpoint the beginning and end of remembering and thus also the length of an RX. A user experience can be defined as those aspects that resulted from product use. But the RX is an amalgam of remembering and a physical and technological context, making it complex to measure. Instead, it is pragmatic to focus on one of the primary constituents of RX, namely the remembered experience.

The remembered experience, and in particular how people think, feel, and express themselves about a past experience is an easier target for study. Because it is something that happened in the past, it is a finite phenomenon with a clear beginning and end: a complete episode that people can look back and reflect on. It is a reconstructed view on something that happened in the past, as compared to a particular lens on one's ongoing experience that is RX. This makes it more amenable to adopt an experiential perspective on remembering to highlight how people address their past as a remembered experience. The motivation for this endeavour lies in the apparent lack of a vocabulary and categorisation of remembered experience that will provide a footing for future work on design to support remembering.

We are not the first to turn to an experiential, phenomenological account of autobiographical memory. It is an active area of research in cognitive psychology. Unpacking the essence of an experience lived by different individuals has been a core challenge for phenomenological research (Moustakas, 1994). Yet, the phenomenological study of memory has historically swayed towards the recollective aspect of remembering and less to a perspective on such remembering as an experience in itself (Sutin & Robins, 2007). Efforts to classify and capture the phenomenology of memory often take the form of questionnaire development. For instance, the Autobiographical Memory Questionnaire (Talarico, LaBar, & Rubin, 2004) can be used to survey one's recollection of a past event. Typical questions relate to how well respondents can see and immerse themselves in the memory of a past event, and to what extent they believe the memory is a faithful representation of the actual event. The Memory Experiences Questionnaire (Sutin & Robins, 2007) covered ten aspects of a memory's phenomenology: vividness, coherence, accessibility, time perspective, sensory detail, visual perspective, emotional intensity,

sharing, perspective taking, and valence. The Autobiographical Memory Characteristics Questionnaire (Boyacioglu & Akfirat, 2014) also considered notions like emotional distancing and inclination to share an event with others. However, the desire to develop a data driven and theoretically meaningful measuring instrument led to the exclusion of categories such as personal implications and emotional persistence, which makes them less applicable to guide the design of interactive systems for personal use, as an HCI perspective would entail.

In contrast to the questionnaire-based phenomenological work towards the understanding of autobiographical experience, constructivist ideas provide another perspective and argue that a person comprehends reality through subjective construal. By combining several facets of this construal, people make sense of their experience. This is reflected in personal construct theory (Kelly, 1955), which builds on the idea that people make sense of their world in their own terms, namely personal constructs. A personal construct comes in the form of a single dimension of meaning with two dichotomous poles such as light/dark or pleasant/annoying. A construct allows a person to reason about a phenomenon as (dis)similar to another one (Jankowicz, 2005). Combining two or more constructs, a person can further distinguish between their experiences with increasing vocabulary and granularity. This means that any experience can therefore be explained in terms of multiple personal constructs interacting with each other. Thus, to improve our understanding of remembered experiences, teasing apart the personal constructs people apply to them is a fitting approach for our research. This is indeed the process that we follow in the study presented from §5.3 onwards. In doing so, we seek to connect our findings on the construal of remembered experiences with the design for remembering.

5.2.3 Experience of remembering as a factor in design

A key purpose of autobiographical memories is to support a consistent narrative of one's identity (Conway & Pleydell-Pearce, 2000). By that logic, memory is a continually evolving phenomenon relevant to personal and social experience, which has piqued the interest of the HCI community as reflected in a growing number of publications (see van den Hoven et al., 2012). Some of this work orients itself towards functional support or to augment our ability to remember, such as life logging initiatives (see Sellen & Whittaker, 2010). Other work departs from a functional or performance oriented consideration of memory, focusing on emotional and experiential aspects of remembering (e.g., Cosley et al., 2012; Helmes et al., 2011; Moncur et al., 2015; Petrelli et al., 2010). Common to many works on design for remembering are the interactions between past experiences and a personal sense-making process, perhaps facilitated through exposure to and experience with an interactive system. These interactions are as diverse as the studies and systems but cover both the remembered experience (the past) and product-user experience (the present).

A good understanding of the nature of these interactions would thus benefit from an experiential understanding of the past. What do we feel when remembering and how could that affect the place the past occupies in our present life, and in particular, how may interactive systems support this?

If designers of similar systems could take the remembered experience into account it may be possible to optimise the choice of available content as memory triggers (e.g., which digital photo would be appropriate to show now?). Building a shared understanding of past experiences can benefit and steer the design process. However, the examples referred to in the previous paragraph (as is typical of similar HCI work we considered) often do not directly talk of remembered experiences, given their focus on experiences directly related to the design intervention. This non-focus on memory as a phenomenon of the past gets support from the argument by Harper et al. (Harper et al., 2008), who argue that memory should be seen as a product of the context in which it is retrieved, retold, and re-experienced. Yet, we believe that this view can match with the perspective of remembering as an experience, in which a deeper understanding of what feeds this experience (thus, present context and a past experience) can benefit the design of technology similar to the examples given.

To enable design for a certain desirable experience (e.g., enjoyable reminiscing in an everyday context) it is important to consider which factors influence an experience, such that these may be taken into account during the design process (Forlizzi & Ford, 2000). Exploring what aspects constitute an experience provides us with a language to discuss experiences, to compare and to explicate what a design strives for.

It is for the above reasons that the present study orients itself towards unpacking the remembered experience. Deriving how people construe their remembered experience offers an avenue for an empirically grounded vocabulary of participants' experiences. We developed a repertory grid study to identify constructs that people use to describe their remembered experiences. The identified constructs could be reliably coded in five categories referring to contentment, confidence and unease, social interactions, reflection, and intensity. These results align with earlier classifications of personal constructs and models of human emotion, as we shall discuss after presenting the results. The categorisation derived from this study provides an empirically founded characterisation of the design space of technologies for supporting remembering.

5.3 Repertory grid study

Key to the present work is the development of an empirically grounded vocabulary of participants' experiences. In a repertory grid interview, a vocabulary develops from a participant generating personal constructs to describe a set of contrasted elements

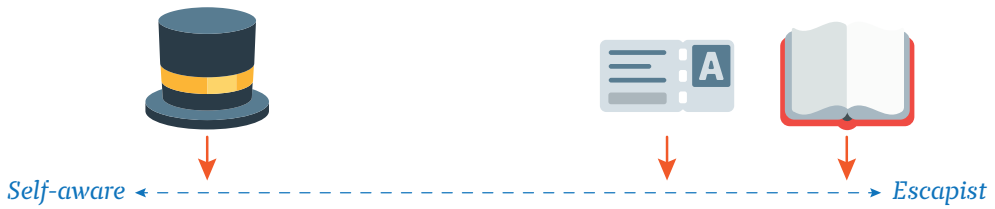


Figure 5.2. Repertory grids help to find polar adjectives, such as *Self-aware* and *Escapist*, which can be used to rate elements (e.g., a top hat, movie ticket, and book) on a scale between the polar opposites. Uses visuals by the Mozilla Foundations (CC-BY 4.0).

(Jankowicz, 2005). Typically, someone is shown three elements from a larger set (e.g., a book, a top hat, and a movie ticket) and asked to identify which two are similar and different from a third one. According to personal construct theory (Kelly, 1955), a person's reasoning reveals how she construes reality in terms that make sense to her. For example, the book and movie ticket both allow this person to escape reality whereas wearing an unusual top hat would make her self-aware. A participant may express the perceived similarity and difference as a dimension between contrast pairs (e.g., *Self-aware/Escapist*). In turn, these polar adjectives can be used to rate each element on this newfound scale (akin to semantic differential scales (Osgood, 1964)). Thus, the book and movie ticket would be rated towards the *Escapist* pole, whereas the top hat gets rated towards the *Self-aware* end of this scale (as shown in Figure 5.2). Repeating this with varying triads of elements fills a grid of construct pairs and ratings, and enables a researcher to elicit participants' personal constructs in a systematic way (Jankowicz, 2005).

Over the past years a number of HCI studies have employed the Repertory Grid Technique (RGT), for example to canvas how people think about abstract concepts such as usability (Hertzum et al., 2011), user experience (Fallman & Waterworth, 2010; Karapanos, Martens, & Hassenzahl, 2012), emotional attachment to products (P. Turner & Turner, 2011), design concept appraisal (Tomico, Karapanos, Levy, Mizutani, & Yamanaka, 2009), evaluating design ideas from a user perspective (Hassenzahl & Wessler, 2000), and to explore the design space of shape changing interfaces (Kwak, Hornbaek, Markopoulos, & Bruns Alonso, 2014). Its attraction lies in the reliable and precise acquisition of personal constructs while analysis is flexible.

5.3.1 Participants

Twenty-two adults were recruited via personal networks of the authors and university notices, via social network posts, emails, and in person. Participants were told the purpose of the study was an interview about comparing past personal events. Using purposive sampling, respondents were selected to maximise diversity. They were offered no substantial award for participation. Participants were aged 22 to 70 ($M=43$ years,

$SD=15$, 60% female) and most were affiliated to the University of Technology Sydney as postgraduate student or staff. Half were native English speakers and others had comparable language skills.

5.3.2 Memories as elements

Personal memories were used as elements for participants to compare and contrast. Participants were invited to write down six memories for later use during the interview. To help participants come up with a variety of memories, we gave six keywords to define stable themes: *Rejection*, *Childhood*, *Theme Party*, *Ceremony*, *Fleeing*, and *Chocolate*. We settled on these keywords after piloting to ensure diversity (e.g., inclusion of negative stories via *Rejection*, inclusion of distant memories via *Childhood*), without being overly restrictive. Participants were encouraged to write down one specific event from memory per theme to avoid overly broad descriptions that are harder to compare with other events. It would, for example, be problematic to compare one's general time in high school with a particular blind date gone sour. The specificity is not on the same level, hence our emphasis on distinct events rather than lifetime periods.

By using personal memories as elements, we risk that these elements used for generating a grid would be unique to an individual and thus not generalise across participants. A *Childhood* memory on, for instance, being disciplined would have little in common with building sandcastles on the beach. This is not problematic when comparing *how* people talk about remembered experiences (which is our aim), rather than comparing the experienced events themselves. However, it has non-trivial consequences for quantitative analysis across participants as oblique clustering analysis (further explained below) assumes elements under an identical label are similar. Thus, if two participants were to state something is pleasant (in contrast with unpleasant), the analytical method requires that people mean similar things with the same adjective. For pleasant this may be the case but other words could be more ambiguous. Yet, it was key to have participants describe and contrast their own experiences in their own vocabulary. We therefore preferred having constructs generated by our participants. To facilitate making inferences across participants we supplemented these with a common set of constructs (similar to P. Turner & Turner, 2011). Assuming a shared understanding of these constructs (i.e., everyone interprets a construct in a similar way and rates elements accordingly), other constructs generated by participants can be interpreted relative to the common set. For example, when a participant rates constructs about satisfying/frustrating and pleasant/disagreeable similarly, while another does so for satisfying/frustrating and fulfilling/unfulfilling, we may infer that pleasant and fulfilling have some commonality via their positive association with satisfying.

Participants would initially be solicited to generate their own constructs. Only when

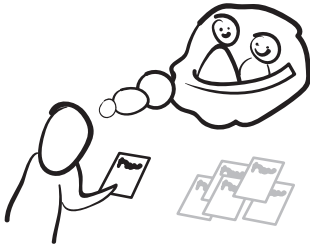
exhausted, we introduced seven constructs of our own. This avoids influencing participants prematurely while providing the requisite commonality to facilitate our quantitative analysis. The seven supplied constructs were selected to capture a range of experiential qualities: Lively/Dull, Personally relevant/Personally irrelevant, Meaningful/Meaningless, Positive/Negative, Intense/Mild, Mixed feelings/Clear or single feeling, and Satisfaction/Disappointment. This selection is based on relevant questions found in existing phenomenological questionnaires (Boyacioglu & Akfirat, 2014; Talarico et al., 2004), other RGT studies (Kwak et al., 2014; P. Turner & Turner, 2011), and our own observations from pilot interviews. Specifically, we took recurring constructs from the pilot interviews such as Positive/Negative and Intense/Mild. The other construct-pairs of our supplied set were selected based on their perceived relevance and commonality, such that participants would consider these relevant to their experiences. Results of the aforementioned related work were used to gauge this quality. No participants expressed difficulty in comprehending the contrast pairs.

5.3.3 Procedure

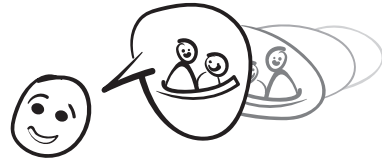
The interviewer would meet with the participant at a quiet space on campus. The topic and procedure were introduced and participants were asked for their consent (see Appendix 5.1 for the consent form). The repertory grid procedure was illustrated using an example with cat toys, highlighting that the focus was not on item properties (i.e., colour or texture), but rather the personal experience that results from playing with these different toys. Next, the participant filled in a brief demographic survey (i.e., age, sex, occupation), and wrote down a summary of one personal memory per theme. For this purpose, 6 A6-sized cards were provided, which explicitly asked to *'briefly describe the event,'* and *'describe your experience, how you felt, at that time'* (see Appendix 5.2 for an example). Participants were given ample time to relive and write down their stories in any preferred order (typically this took ten minutes). When done, the researcher invited them to talk briefly about each story to supplement their written summaries and form a common understanding.

With the memories-as-elements established, elicitation of personal constructs commenced (see also Figure 5.3). We used a standard procedure to elicit constructs, in which the researcher would take a triplet from the six cards with a participant's personal stories (Jankowicz, 2005). The selection order of triplets was randomised across participants to balance for even encounters of all elements. Participants were asked to consider which two of these three memories are alike in some way, and different from the third, in terms of their experience at the time. They were asked to come up with a personal construct to differentiate between the memories, typically in the form of a contrast pair (e.g., two were Happy, the other Sad). The researcher made sure elicited contrast pairs were indeed clear opposites, self-explanatory, and if needed, he discussed suitable

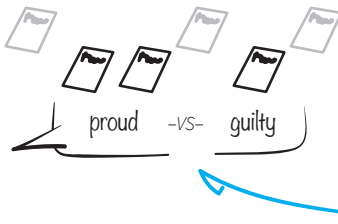
1 Remember based on keywords



2 Discuss six memories



3 Construct elicitation



4 Rate each memory on new construct

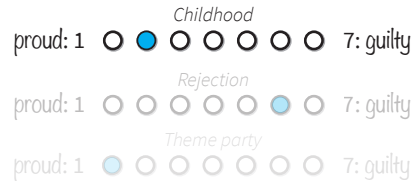


Figure 5.3. Schematic overview of the repertory grid technique procedure followed in this study.

Topic: Experience as remembered

		Rejection	Childhood	Theme party	Chocolate	Ceremony	Fleeing	
1	happy	7	2	1	2	3	6	sad
2	guilty	3	5	4	3	7	2	proud
3	life changing	3	5	6	7	3	1	frivolous
4								
5								

Figure 5.4. Screenshot of the digital grid sheet, with several rounds of comparisons already filled in. Blue squares indicate the memory elements in focus during a round. Tapping a row would reveal a questionnaire-style form to enter each memory's ranking for a particular contrast pair. We used a custom web application on a tablet to ease recording data: <http://dvangennip.github.io/repertory-grid-tool/>

alternatives if only one side of a pair was identified.

Participants were invited to rate each of the six elements on the newly identified dimension using a scale from 1 to 7 (e.g., a very Happy memory would be rated 1, very Sad 7). For this, contrast pairs were recorded using a digital grid sheet on a tablet device (see Figure 5.4). Each row of the grid represented one dimension, and the stories' keywords were used to denote the columns on which to enter the ratings. Once a round completed, a new triplet was chosen and another construct would be elicited. This continued until the participant was unable to generate new constructs. At this point the researcher introduced the seven common constructs for rating by the participant. Each element would then be rated for all supplied constructs, unless a participant had already generated an identical contrast pair beforehand.

Afterwards, participants were asked to share any insights that were not touched upon before. This completed the interview. Sessions lasted 60 to 90 minutes and were audio recorded.

5.3.4 Analysis

We used qualitative and quantitative approaches in our analysis, using both the generated constructs and the ratings to inform our findings.

Qualitative analysis

Three coders (two of which unfamiliar with the data) clustered the contrast-pairs (i.e., constructs) through inductive coding. For this purpose, the contrast-pairs were printed on paper strips, which were then used to generate an affinity diagram. The seven supplied pairs were kept in this analysis. The aim was to establish clusters of seemingly similar contrast-pairs and condense those clusters into clear categories, with a minimum of miscellaneous constructs that could not fit well into any category. As a result, an affinity diagram emerged from the hierarchical clustering. This process allowed for ample discussion and resulted in eleven categories with each given a definition. Later, another coder unfamiliar with the data classified the constructs using the categories established in the first round. The two independent coding sessions achieved an inter-rater reliability of Kappa = .75, suggesting substantial agreement (Landis & Koch, 1977). Afterwards, the categories' descriptions were refined to improve the clarity and reduce disagreement. The final categories are shown in the next section in Table 5.1.

Quantitative analysis

Grid data was analysed using principal component analysis (PCA) for individual grids and oblique clustering for analysis across participants. Oblique cluster analysis was used to find commonalities between participants. This method differs from typical multivariate

factor analysis (such as PCA), which aims to reduce data through maximising explained variance using a minimal number of (ideally orthogonal/independent) dimensions. Each original dimension (here, a construct/contrast pair) would have a non-zero loading towards each obtained dimension, hindering interpretation. In contrast, oblique clustering aims to limit the loading of underlying dimensions (i.e., a construct/contrast pair) to only one identified dimension. This offers the potential of a clearer clustering of constructs and thereby support the sense making process better. In lieu of this analysis' availability in popular analytical software packages we used custom software for our clustering needs. An additional, more visual explanation of the analysis is included in Appendix 5.4.

5.4 Findings

First, we give an overview of the personal memories used as elements. We discuss the elicited constructs and obtained categories, followed by other observations.

5.4.1 Memories as elements

Participants provided short written accounts of their memories, which were briefly discussed afterwards. The examples we illustrate here are transcripts of their writing. Because these elements were provided by participants based on their personal memories, we see variation in the events reported. This was certainly true for a broad theme like *Childhood*, which gave stories on first days in school, being locked in church as a kid, or undergoing collective punishment in a boarding school. For example, P13 remembered this specific childhood moment: *"We were cleaning the garden and putting all the leaves in the garbage. My parents put me in the bin to reduce the volume of the leaves in it and add more leaves. It was a rather happy moment where we were doing things together as a family. I was feeling it was quite not right or representative of what we were but I tried to forget it and enjoy the moment."*

In contrast, themes like *Ceremony* and *Theme party* appeared fairly stable content-wise (e.g., stories on weddings, graduation ceremonies, and indeed themed parties), although sentiments would differ. P19 remembered a theme party as follows: *"A friend of ours had a 50th birthday party where you had to dress in your favourite decade. I felt 'cool' because my choice was a bit obscure (and perhaps smug, I realised later). I also felt nostalgic because that decade I was so optimistic."* However, P6 felt apprehensive about her younger brother's wedding: *"You have to understand, the main point was that generally the younger brothers don't get married before their elder sister. I felt apprehensive and a bit awkward about people's reactions. They tend to make you feel insecure about yourself. So, I was a bit apprehensive about meeting them, family in particular."*

Stories relating to *Chocolate* were often fairly recent and dealt with the pleasure of

making, eating, being given, or sharing chocolate. A counterexample comes courtesy of P20: “On the weekend I tried Vegemite chocolate for the first time. I was intrigued and impatient. When I tried it, it was a bit confusing but I decided I didn’t really like it. Then it dripped all over me which was unpleasant and annoying.”

Rejection memories were diverse. Stories included failed presentations, rejected manuscripts, and broken relationships: “My husband left me some time ago. I felt devastated, alone, afraid, confused, a sense of despair. I never want to go there again (emotionally)” (P11). Another example concerns not being selected for a sports team on unfair grounds: “I used to play football in a football academy when I was a child until the age of 17. Once, I was selected by our province team to participate in the national tournament but they rejected me at the last minute. I found out a few years later that it was because of the status of my father (a farmer). I was 14 years old when I experienced that rejection and it took me a lot of time to realise why something like that happened. I was so disappointed about myself. But when I realised that the actual reason wasn’t my skill but my father’s status, I felt bad about all these people who believe that they are better” (P22).

Fleeing was interpreted in several ways: getting out from a bus catching fire, eloping one’s marriage, or taking a break from daily worries through running. P19 shared this memory related to fleeing: “As a child being swooped by a magpie. [I felt] abject terror. The magpie swooped me several times and the look of menace it had was very frightening.” It is notably different from P20’s story: “I remember a concert that I went to. (Like most, if not all concerts) at the end, I could not get away quick enough. I felt impatience to be away from the place, once the purpose (the concert) had finished. Worry of not catching/missing a bus. A fear of boredom.” It should be noted that all participants were able to recollect an appropriate personal event for a given theme. For two participants, this was not possible for respectively *Fleeing* and *Theme party*, which were omitted from their elicitation phase.

5.4.2 Construct categories of experience

Participants reported an average of 10 personal constructs ($SD= 2.8$, range 4-15, when excluding supplied contrast pairs), for a total of 337 contrast pairs (of which 207 were unique pairs). By coding for similarity, constructs/contrast pairs were grouped into twelve categories (Table 5.1). We shall briefly exemplify these categories.

About a fifth of the constructs concerned *Contentment*, for example Happy/Sad, Pleasant/Unpleasant. This category appears to capture the level of enjoyment with regard to a remembered experience. *Fulfilment* is related but subtly different from the first category in that it relates to how participant valued the (non)fulfilment of wishes and expectations, which places the memory in a wider personal perspective than just in-the-moment contentment. *Intensity* concerns constructs that classify the experiential involvement and

Table 5.1. Categories with explanations and example constructs. Doubles were omitted, leaving 207 unique pairs. Each pair could only be allocated to a single category.

Category	Explanation	Example constructs	N	%
Contentment	Contrast pairs that relate to emotional valence and that have a strong positivity and negativity direction to them.	Happy/Sad, Exciting/ Frustrating, Pleasant/ Unpleasant	40	19.3%
Confidence & (un)ease	This category deals with how confident and at ease, or alternatively, how sure unsure and anxious a participant felt. Constructs typically do not include the perceived ability to act on or influence the situation.	Confident/Anxious, Helpless/Feeling of Security, Certainty/ Uncertainty	28	13.5%
Social	Interactions with others and/or their influence, such as level of social connectedness, openness towards others, and the appraisal of others.	Companionship/Lonely, Secretive/Open, Effect on self/Effect on other	28	13.5%
Reflective	Contrast pairs concern a reflective stance towards the re-membered experience, for example through expression (or lack) of depth, changed perspective, personal growth, or importance.	Frivolous/Life changing, Not evolving/Growth, Original/Changed perspective	26	12.6%
Intensity	Constructs that attest of the intensity of the participant's experience and feelings. One or both words concern levels of arousal, (emotional) involvement, and expressed interest.	Exciting/Calm, Sense of wonder/Emptiness, Visceral/Intellectual	19	9.2%
Self-appraisal	Constructs that express judgment of the self, such as on one's authenticity, perceived privilege, and normative appraisal (e.g., guilt in a moral frame). What counts is that the experience is self-assessed or provides an example towards a personal or normative standard.	Guilty/Proud, Perform- ing/Acting naturally, Says good things about me/ Says bad things about me	16	7.7%
Fulfillment	One or both terms in this category specifically deal with how a participant valued the fulfillment of wishes, expectations, or needs, and the pleasure (not) derived from this.	Achievement/Loss, Satisfied/Disappointed, Fulfilled/Unfulfilled	12	5.8%
Descriptive	Constructs in this category are descriptive of the memory and attributes of its context. The terms do not relate to emotions of the participants or how they relate to the world.	Formal/Informal, Novel/ Familiar, Work/Leisure	12	5.8%
Agency	This category relates to the sense of agency someone experienced, that is the sense of control and autonomy one perceives to have in a situation, or alternatively that one is passive.	Active/Passive, Empowering/Not in control, Pleased with own creation/Pleased by someone	9	4.3%
Motivation	Constructs concern with how an experience relates to personal motivation, encouragement, and how a remembered experience instills or detracts from an orientation towards the future.	Gives energy/Exerting, Unsupported/ Encouraged, Future oriented/Archived	9	4.3%
Reliving	This category specifically covers the extent to which people would like to relive or move on from a past memory.	Sweet/Bitter memory, Nice to revisit/Never to go there again	6	2.9%
Ambiguity	This category concerns the clarity of the remembered experience, typically in terms of the clarity of one's feelings.	Mixed feelings / Clear or single feeling, Tangible/ Intangible	3	1.4%

interest of the participant.

Contemplating past memories as our participants did is reflective in nature and this shows for a quarter of the responses and their categories. *Reflective* constructs would relate the experience to one's life story, relevance to the self, and how well a participant was able to reflect and see the past experience as a moment of personal development. *Self-appraisal* constructs seem to relate one's experience and/or conduct to a normative standard. *Motivation* constructs also appear to take a future perspective. It is this enabling of perspective that groups the reflective categories.

Confidence & (un)ease and *Agency* constructs emphasise an in-the-moment sense of confidence, tranquillity, or insecurity (e.g., Confident/Unsure of outcome). These constructs place the participant's experience in relation to aspects beyond the self (e.g., the unknown response of others, a difficult or restrictive environment). These categories thus have a contextual nature. Another key category that places the participant in relation to others is *Social*. Nearly all participants generated constructs that relate to both the idea of being alone or social and the social context of a memory, including the appraisal of others.

Personal stories can be ambiguous or bitter sweet, such as a happy event that may now be viewed through a troubled lens due to more recent events. This *Ambiguity* is captured by constructs such as mixed feelings versus single feeling. Although the number of captured constructs was low (1.4%), the idea of ambiguity was mentioned by most participants during the interviews. *Reliving* was also infrequently captured, perhaps due to the nature of the interview's focus on the written events rather than relating such events to the current self. This category comprises a small number of constructs (3%) related to the desire to relive a memory. This desire to (not) relive appears a generally valid way of thinking about one's personal memories.

The interviews did not focus on constructs that described the contents and attributes of a memory although several were identified and categorised as *Descriptive*.

5.4.3 Commonality among participants

Using participants' ratings for oblique cluster analysis, we obtained a consensus configuration of the constructs/contrast pairs. The contrast pairs were first clustered into fourteen groups based on similarity in ratings (using a minimum Eigenvalue of 1.5, a measure for within-cluster coherence and ability to explain variance in its constituent items). Subsequently, these clusters were mapped as dimensions in a two-dimensional plane using principal components (PRINCOM map (cf. Shaw & Gaines, 1995), Figure 5.5, see also Appendix 5.4). The two components explained 74% of variance, slightly higher

than other studies using RGT (Hertzum et al., 2011; Kwak et al., 2014). Labels in Figure 5.5 indicate the overall motif of a cluster/dimension. It should be noted that while each cluster's constructs highly correlate from a quantitative perspective, their semantics are noisier. Some constructs were hard to place within the overall topic of a cluster, an effect exacerbated by the supplied constructs showing up in several clusters. As participants varied in their ratings, these supplied constructs would end up in different clusters and make interpreting and contrasting clusters more challenging. However, most clusters were deemed quite coherent and interpretable.

The first dimension of the consensus configuration (i.e., horizontal axis in Figure 5.5) seems to illustrate a largely positive/negative dimension, illustrated by mostly negative poles on the right hand (e.g., disappointed, unease, unpleasant, insecure) and their respective opposites on the left. This dimension shows strong overlap with the qualitative categories *Contentment*, *Confidence & (un)ease*, *Fulfilment*, and *Intensity*. The second dimension (vertical axis) only loads strongly with a cluster/dimension concerning change and curiosity (as opposed to certainty and passiveness), which relates to the qualitative category of *Agency*. Other clusters/dimensions that relate to both dimensions are about being connected and in control (as opposed to being apprehensive), personally relevance (as opposed to frivolous and inconsequential) and a lively experience (as opposed to boring). These dimensions relate to the *Reflective* and *Intensity* categories, and to a lesser extent *Fulfilment* and *Social*. *Self-appraisal* can be recognised in the diagonal dimension on confidence (as opposed to bad feelings and guilt). Nonetheless, some oddities can be noted: 'engaged and intense' (cluster 2) appears to line up with 'indistinct and unexciting' (cluster 10). Their opposites (respectively 'distant and insecure' versus 'significant and unique') are more harmonious.

Constructs that receive extreme scores may represent particularly important and/or more primary dimensions of construal (Jankowicz, 2005). We obtained a total of 1992 ratings, of which 48% were at the extreme ends (1 or 7). When looking at principal component analyses for individual participants (see for an example Figure 5.6), the most significant dimensions obtained show similarity to the *Contentment* and *Fulfilment* categories of the qualitative analysis. Other significant dimensions relate to *Intensity* and *Reflection*. The picture that emerges this way overlaps with the findings reported above, indicating consistency with the other approaches which reinforces the general reliability of the analysis.

5.4.4 Other observations

Based on the ratings per memory theme, some of these themes overlap in terms of the constructs people associate with them. *Rejection* and *Fleeing* stories are particularly close together. A similar observation can be made for *Ceremony* and *Theme party* ratings, which

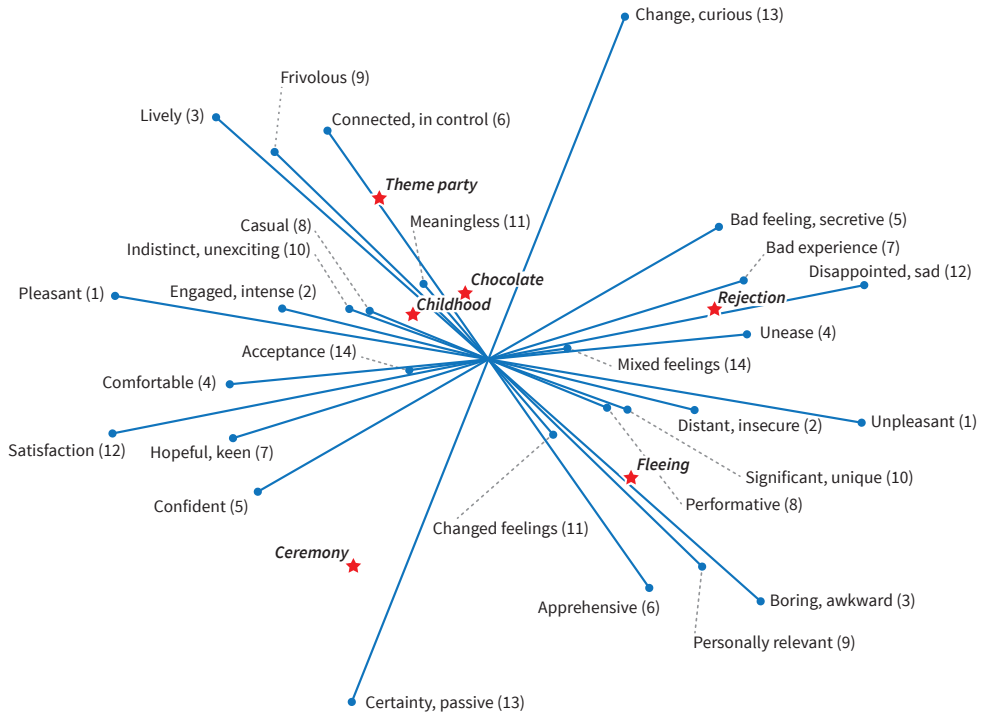


Figure 5.5. The 14 clusters/dimensions mapped onto a two-dimensional plane (using principal components analysis on the clusters), with the six memory themes (*) placed within these dimensions. Labels were subjectively interpreted from items within a cluster.

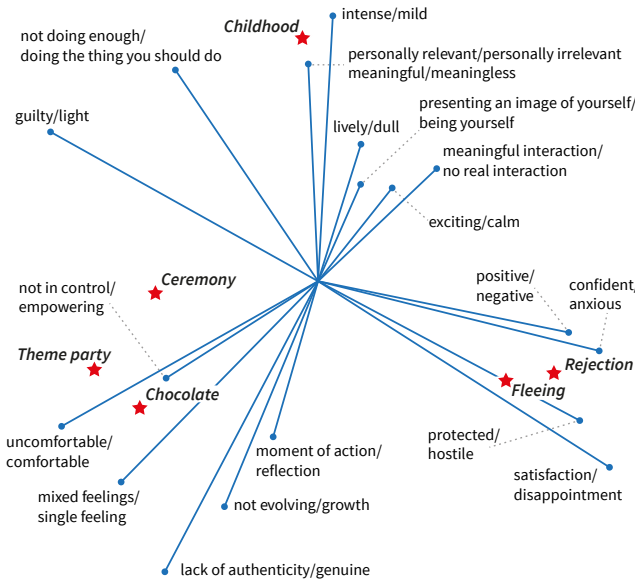


Figure 5.6. Mapping of one participant's (P13) constructs onto two principal component dimensions. Construct labels shown on only one side for legibility.

are perhaps related in scoping potential personal memories. *Rejection* memories were universally regarded as bad experiences. In contrast, *Childhood* encompasses a much wider range of possible stories to recollect and as a result this theme is mixed in terms of its relation to other themes. The latter implies any numerical analysis may have been affected by variation between participants, yet our quantitatively derived dimensions match the qualitatively derived categories.

Another approach to arrive at meaningful clusters, using network graphs based on correlations in ratings and semantic similarity between constructs, proved unhelpful. Appendix 5.5 holds further details that are omitted here.

5.5 Discussion

We developed a categorisation of participants' own descriptions of remembered experiences. Our findings used the personal memories that participants shared and the ways in which they contrasted them to reveal twelve categories. These categories reflect the most significant facets of a past episode in someone's life, at least in terms of the experience as people remember and express it. Namely, our results suggest that experiential qualities are expressed in a dominantly positive and negative dimension, interspersed with constructs around agency, both in the relation to one's idea of personal identity and to others. With this categorisation, we have made a first step towards making our notion of a remembered experience operational. It provides a preliminary answer to our quest for insight into what it means to (re)experience the past. In this section, we reflect on the method and the applicability of our findings to interaction design and related efforts.

5.5.1 Reflections on the study

To capture a person's own understanding of their remembered experiences, we used participants' autobiographical memories as elements for our grid elicitation. People were able to generate personally meaningful, yet comparable elements. Although the depth of these stories varied, most participants shared their personal stories willingly and without withholding painful experiences. Being able to include such non-trivial events has greatly helped to get at meaningful personal constructs. We regard this approach as successful.

Personal memories were initially written down and later discussed verbally. This process included some brief storytelling. Both forms of expression may have influenced the reconstruction of remembered experiences. It should also be acknowledged that talking to a researcher about personal stories is different from doing the same with friends and relatives. While for most participants the method revealed a meaningful vocabulary of their experiences, in some instances the session fell short of capturing a richer verbalisation. Some participants, when asked to differentiate between elements, would

give a richer description of experiential qualities than what they agreed upon as being relevant constructs to fill in the grid and rate. This is a pitfall of the current method, as was participants' occasional difficulty in identifying a suitable term for opposite contrast poles. Typically, forming a construct to express how one element is similar or different from two other elements came fairly easy. Finding its opposite sometimes required help from the interviewer, as potential terms were not evident or not clear opposites.

The highly structured and therefore straightforward nature of RGT lends itself well to generate both individual and consensus views of users on a topic of interest, which can be valuable early in a design process. RGT is well suited to capture ambiguous responses. The notion of mixed feelings (or changed appraisal of remembered experiences) would be difficult to capture otherwise with singular measures. For example, some experiences were labelled as 'satisfaction & guilt,' two terms that appear paradoxical together. Evaluating individual grids allows for such responses to be picked up upon. It must be noted that a consensus analysis across participants would not reflect such notions very well. This is because construal of (aspects of) one's experiences is subjective and relative to one's other constructs. The latter argument also applies to our classification of constructs, which cannot be regarded as objective outside their own context. Thus, the identified categories are meaningful relative to the complete set of categories.

Our categories do show, however, a high degree of overlap with the personal construct classification scheme by Feixas, Geldschläger, and Neimeyer (2002). This scheme aimed to capture the organisation of people's system of meaning. Feixas et al. identified six areas concerning moral, emotional, relational, personal, intellectual, and interests-related constructs. Most of our categories would fit into that scheme: for example, the moral area has overlap with our category for *Self-appraisal*, the emotional area matches *Confidence & (un)ease* and *Intensity*, and the relational one matches *Contentment*, *Social*, and *Agency* categories. Personal constructs overlap with some of those we classified as *Self-appraisal* and *Motivation-oriented*. The reverse is true for our *Descriptive* and *Reliving* constructs because these characterise details and appraisal of past events. Our work underlines that remembered experiences are also qualified, given meaning, and compared in terms of a participant's personal value system.

The above may explain why participants would sometimes construe one of their memories as negative but their later ratings may not reflect the earlier qualification. While the event had been negative (hence the construct), their perspective on that memory had since shifted. Something good may have come from it or it no longer had negative connotations for them. Other research on memory phenomenology found comparable results for negative events (Boyacioglu & Akfirat, 2014; Talarico et al., 2004). Indeed, the reconstructive nature of our memory system is biased toward the present and suggests

people might put a positive spin on negative events to maintain a coherent narrative of the self (Ritchie, Sedikides, & Skowronski, 2015). Work on SenseCam (Harper et al., 2008) also showed a similar use of the past as a means to reason about one's present self. This implies that evaluations of past events are variable over time, which for any designed system building on such events means that older data (on e.g., appraisal, or favourite imagery) may need to be invalidated after a while.

The obtained categories highlight the emotional and reflective aspects of a remembered experience. These also point to a unique aspect: the desire to relive (i.e., to re-experience) a particular memory. What sets our categorisation apart from the aforementioned views on UX (Hassenzahl, 2010; Wright et al., 2003) is foremost that we discussed a relived past experience, separate from any user-product interaction. User experience, as memories of user-product interactions, may be considered a subset of our more general approach to remembered experiences. Perhaps due to the nature of our interview method, minutiae of the experience were less prevalent as compared to reflections on the felt emotions, satisfaction, personal consequences, and ultimately the desirability of re-experiencing a personal memory. It allowed our participants to put a particular story into the perspective of other life events both past and present.

5.5.2 Relating findings to design

Our work has captured a categorisation of people talking about past experiences. Although this did not include human-computer interaction directly, we argue that having these categories is of value to the design community.

First, we see value in supporting designers in their understanding of people and exploration of memories. Our classification is particularly helpful to chart and relate reported experiences. For example, the previous chapter's diary study of involuntary remembering in everyday life explored these kinds of experiences. As one might expect, the way participants wrote and talked about their experiences aligns well with the categorisation here. In particular, we noted a similarity in how people position themselves within and relative to the reported experiences. This was expressed through a similar reflection in terms of valence (i.e., positive/negative) and orientation towards those elements of the most personal relevance. The involuntary nature of how memories came back to people captures a sense of surprise, often delight, and sometimes a bittersweet sentiment. The latter reflects the notions of *Agency*, *Motivations* towards past memories, and other *Reflective* constructs. Diary contents of cued memories (in Chapter 4) were not classified for underlying experiential qualities (as we aimed to surface here), yet such an analysis (using our categorisation as a framework) could yield a richer description of the collected material. Doing so could address (or provide an alternative perspective on) the questioned relation between past experiences and how those may play a role in everyday

life. In particular, matching participants' input in such a study against a classification as developed here may improve the interpretation and juxtaposition of such diary entries and experiential statements. For the present example, it may deliver clearer mapping between involuntary memory cues (i.e., those things that bring up memories) and their reflective or reminiscent qualities, which could benefit the design of systems with similar aims.

Thus, our categories can be used as a coding scheme in the analysis of remembering-related HCI work, in particular where memories or the response to these are of interest. The categories agree with prior work, which eases their adoption. We see such application as a necessary step to further develop the value of this categorisation. Therefore, the present work should be considered as a first step towards this methodological goal. Until then, some caveats apply. During our study people discussed their experiences in isolation from any product interaction, so future work is necessary to be able to reflect on the usefulness in relation to the experience with interactive systems. For example, as an extension on the diary evaluation in Chapter 4, it would be interesting to consider how different interactions may influence how people relate to their personal memories (and, for instance, reflect this in 'memory talk'). Using our classification as a guideline to chart any changes in experience can keep the focus on those memories and how people relate to those, in favour of a narrower focus on just user experience (e.g., using *AttrakDiff* (Hassenzahl, 2004)). If developed in this way, it answers our motivation to develop a useful vocabulary for the evaluation of interactive systems that aim to support remembering. In other words, our contribution is primarily methodological.

Second, we considered our categories as a (proto) design space. Our phenomenological charting of experiences is suited to the generation of further questions and insights, rather than a strictly evaluative approach. Although it exposes no parameters for designers to consider in building interactive systems, it may well highlight areas of experiential qualities that are typically given less attention. For instance, boring (low *Intensity* and *Contentment*), awkward, insecure (both low *Confidence* & *un(ease)*), or frightful experiences (negative *Intensity* and *Contentment*) are for understandable reasons not commonly touched upon. Yet, if design for remembering is to support people in reflecting on and coping with their past, such experiences should not be eschewed. Story Shell (Moncur et al., 2015), in co-designing a memorial for a bereaved mother, underlines this argument (as does related work (e.g., Massimi & Baecker, 2011; Moncur & Kirk, 2014; Uriu & Odom, 2016)). Its development outlined strong and conflicting experiences (e.g., laughing and crying). We noted similar patterns for some of our participants. Yet, our classification aimed to place constructs of experiences in certain clusters, which may deny richness in the interplay between felt emotions. For this reason, we kept the small but significant *Ambiguity* category.

Finally, discussing personal memories is a social experience and is as much about what happens between people as it is about the memories (Harper et al., 2008; Petrelli et al., 2010). Our participants talked about and construed their past experiences in a very individual manner whereas many interactions with the past happen in a social context. It would therefore be relevant to see if our findings can be extended to a more social setting, for example by exploring how well our categories hold up in a classification of social memory talk.

5.6 Conclusions

In this chapter, we reported on a study of the experiential understanding of autobiographical memories. Through contrasting and talking about such memories we derived how our participants construed their past experiences. Via a phenomenological exploration we obtained a wide range of personal constructs and classified these. The resultant categories highlight that people consider their remembered experience largely in a positive/negative dimension, in which reflection on the self is important. In line with previous work on 'memory talk,' we are keen to note that past experiences are reconstructed and retold in relation to the present ideas of the self. Reinterpretation and construal of one's past is an ongoing process of self-reflection, a strong motivation for recollection of and reminiscing on our memories. Our findings provide a handle to approach the study of past experiences by charting an experiential vocabulary to inform future design work to support remembering.

In doing this, this chapter fulfils a theoretically driven objective of understanding the experience of remembering, culminating in the categories and other phenomenological aspects summarised above. This text also worked to advance the ideas of remembered experience (RedX) and remembering experiences (RX) to facilitate thinking about remembering as a particular form of experience. Such an experience need not stand on its own, rather, it may be strongly influential toward or be a 'sub experience' of the ongoing experience someone has while they go about their life. A fuller, more complete exploration of these ideas is worthwhile but outside the current scope given the complexity of teasing apart aspects and influences on (user) experiences. Instead, these ideas were elaborated here in service of advancing the understanding of how people relate to their past. In turn, this understanding is directed towards supporting designers in their development and evaluation of interactive systems that may support reminiscing in everyday life. While it is apparent that the studies described here made progress towards the research objectives, their ultimate value lies in the ability to further thinking about reminiscing, particularly where it concerns design practice. Part III of this thesis, to follow next, makes a clearer move towards the design of novel interactive systems as a way of elucidating further insights on the interrelation between reminiscing and personal media as memory cues.

Part III
Designing for
serendipitous
reminiscing

This part follows a research-through-design approach. First, we evaluate prior work on for remembering in Chapter 6, after which Chapters 7 and 8 develop and study several concepts that strive to inspire serendipitous reminiscing in everyday life using personal digital photos.

*Charting a design space of
personal media displays*

6

6.1 Introduction to this chapter

In previous chapters, we have seen that people hold on to things for sentimental reasons. Decreasing barriers to photography, music, and other media (e.g., due to lower cost and wider availability) have led to a proliferation of these media in the everyday lives of many people, taking on roles similar to souvenirs and other physical artefacts. In academic literature and beyond, there is now a plethora of conceptual work, prototypes, and functional systems to support activities around our personal media. This includes novel systems that support the capture, triaging, and viewing of one's media, along with their use for remembering and storytelling. Van den Hoven, Sas, and Whittaker (2012) identified three strands of active research. First are investigations into current practices throughout ethnographic or data gathering methods, which often result in insights useful for the development of novel systems. The second strand concerns the design and evaluations of such innovative interactive systems, with the aim of learning from people's response to such systems. The third strand of work concerns lifelogging technologies, inspiring reflection on one's behaviour (e.g., the aim of the Quantified Self movement (cf. Elsdon et al., 2015)) or to remedy memory deficits (as with dementia and other forms of amnesia).

In this chapter, we take a critical look at the various perspectives and directions through a review of the literature. We focus on the second strand of research laid out by Van den Hoven et al. (2012), that is, the design and evaluation of novel systems to support remembering. More precisely, we review designed systems (or concepts and prototypes thereof) that specifically concern themselves with support for remembering through the display of personal media (be it visually, auditory, or otherwise). This restriction allows for a meaningful analysis and comparison while maintaining a reasonably sized corpus of the available literature.

We review this body of work in terms of its questions of interest, interaction techniques employed, personal media and data that has been used, methods of study, if applicable the level of the executed prototype and evaluation (e.g., merely conceptual versus long-term deployment), outcomes, and strength of the presented evidence. In this review, we pay particular attention to the revisiting of media, not its curation or organisation, although some of the designs also provide some means to address those steps. Where relevant, we mention and contrast with older methods of representing the personal past (e.g., photo albums and diaries). We highlight the various ways in which design for remembering has been expressed. In particular, we shall conclude that personal media displays are envisioned as a domestic technology. Because many of these works were developed as a way of finding out how people respond to these 'design provocations' in lab or field studies, we also consider the evidence as presented in the literature. The review identifies open questions that have been raised but lack considerable evidence, as a bridge to future

work. In doing so, this chapter contributes to contemporary and emerging questions of interest for the appropriation of personal digital media. No prior reviews of this area have been done, but we do revisit the perspectives for design for remembering as outlined by Van den Hoven et al. (2012).

6.2 Using personal media for remembering

Early work on the use of (personal) data for remembering assumed the role of interactive technology in service of accurate recall (most notably the Memex device by Bush, 1945). More recent work favours a more constructivist approach to memory, which implies remembering does not produce a facsimile of the original event. Rather, it argues our past is put to use for “*present concerns and needs*” (Halbwachs & Coser, 1992, p. 40), both individually and together with others. Interest in these applications has shifted to employing personal data as a means for self-understanding and (social) identity formation. This shift mimics developments in other areas of research, such as material culture (Giaccardi & Karana, 2015) and the expression of self and group identity (Csikszentmihalyi & Rochberg-Halton, 1981). Interaction design and closely related fields have also emphasised interactions in people’s everyday life, typically situated in the home as the epicentre (cf. Aipperspach, Hooker, & Woodruff, 2008; Desjardins, Wakkary, & Odom, 2015).

We briefly discuss research on the practices of viewing photos. This is the most common type of display in our review and has the strongest tradition of ethnographic research to guide our investigation. A pervasive theme of the available research is how curatorial and archival decisions are inseparable from the use of photos for reminiscing, reflection, sharing, storytelling, and other purposes. This usage is best known as photo-talk (Crabtree et al., 2004; Frohlich et al., 2002), while the curatorial decisions may be labelled photo-work (Kirk et al., 2006). Photo-use (Broekhuijsen, van den Hoven, & Markopoulos, 2017b) encompasses both types, reflecting their integration. This is grounded in the idea that in the moment of curation people consider in which ways photos will be usable or valuable (e.g., Crabtree et al., 2004; K. Rodden & Wood, 2003). The remainder of this section reflects the intertwined nature of these practices.

This line of research on social practices has stressed the role photography plays in the negotiation of identity and social relationships (e.g., Chalfen, 1987). These negotiations are similar to other kinds of personal and family mementos, whose arrangement is a reflection of deliberation, ideals, and pragmatic decisions (e.g., Kirk & Sellen, 2010; Petrelli et al., 2008; Petrelli, Bowen, & Whittaker, 2013). Frohlich, Wall, and Kiddle (2012) identified three motivations for photo archiving and (re)use: (1) visits of family and friends whom may inquire about or are directed to new photos, (2) serendipitous encounters through chance discovery that prompted further spontaneous exploration,

and (3) reminiscing about specific events in a more deliberate fashion (p. 732). Through the ways in which people talk about and with photos (Frohlich et al., 2002), memories are reconstructed by those participating and sharing their views. These practices continue when digital means for viewing and browsing photos are introduced (e.g., Balabanović, Chu, & Wolff, 2000; Crabtree et al., 2004); photos in any form represent only one facet of these social practices. There are however differences in how such images may be used.

For example, the selection and presentation of particular printed photographs over others in the domestic sphere reflect curatorial decisions of what events are important and for whom (Drazin & Frohlich, 2007; Durrant, Frohlich, Sellen, & Lyons, 2009a; Swan & Taylor, 2008). Kim and Zimmerman (2006) corroborate these findings by mapping where families keep what kind of photos in their home. For example, the authors found that the people they interviewed tend to keep more formal portrayals of family life in the more public areas (living room), whereas less formal, candid photos were likely to appear elsewhere. This practice is of course tied to social and cultural expectations (of which the authors do not specify the background), but the findings fit into a larger body of evidence which tells that these photos cater to share a narrative with others (e.g., Fawns, 2014; Frohlich et al., 2002). The specific kind of narrative and social interaction that is desirable is taken into account when deciding which photos are placed in view and where. For printed photographs, such a task is readily at hand given their physical nature. Durrant et al. (2009a) and Crabtree, Rodden, and Mariani (2004) reason that digital photography, with its move towards personal computers as the means for interaction, has curtailed the aforementioned practices. The challenge these authors (among others) identify is to bring digital photography into domestic living spaces to allow it to perform its social functions.

Swan and Taylor (2008) make the case that the material properties of printed photos enable people to express their ideas about importance, identity, and social relations. Where a photo display is placed, hung, affixed, or combined with other elements carries meaning. Inspired by Chalfen (1998), the authors provide a list of relevant properties of displays, namely: setup (framing, hanging, propping up), placement, means of support (freestanding, wall mounted, etc.), form, persistence (in time or space), portability, emphasis, uniformity, symmetry, and sequence (in form, size, and content) (Table 1 in Swan & Taylor, 2008, p. 267). Ultimately, these choices on how to display something represent effort. Swan and Taylor argue that the persistence of a displayed photo appears critical to its importance (p. 268). From that viewpoint, the authors reason that ever-changing digital photo displays go against the grain of the established role of photo frames in domestic practices. The low persistence of revolving imagery and their under-curated nature spells out a possible explanation for the lacklustre uptake of digital photo frames (compared to printed photo frames which remain a common sight in many homes).

Introducing into this social space a technological system that aims to display a collection of digital imagery but which is unaware of the content and meaning of this imagery can be counter-productive. As Jones (2016) points out, it is often assumed that “*the media content being presented and displayed has been curated somehow and is valuable for the user’s recollection*” (p. 3). Given that for many people such curation is a dreary affair, both in the finesse of its outcomes and experience as it is undertaken (e.g., Whittaker et al., 2010), Jones’ concern has merit. It is exactly these unprepared and perhaps unnecessary encounters with the past that Schwarz (2014) describes as ‘neighbourly’ in both the good and bad sense of the word. As explained in more detail in §3.7.4, Schwarz reasons that as digital media are frequently encountered when doing other things (for example on one’s computer), the relationship to these media changes.

To provide some nuance to the above arguments, Frohlich et al. (2012) studied the rediscovery of forgotten images in domestic photo collections and noted that such rediscovery can inspire the kind of reminiscing we study in this thesis. Through encountering evidence of events not considered for years, people may experience intrinsic enjoyment at these serendipitous encounters. However, the authors reason that this works best if people are given the ability to reinterpret and reassess the meaning of related events. This may be facilitated best if such events are allowed to be partially forgotten – or at least drift out of regular attention – so that people can review these with fresh eyes. Implicitly, the authors touch on an important aspect of human memory, namely the ability to forget. As discussed in §3.2, forgetting allows us to move on from particular details and, by extent, particular perspectives. Frequent revisits could hamper these developments. However, if some time is allowed to pass, each ‘photo outing’ may further enhance meaningful connotations and sentimental value. Frohlich et al. noted that this kind of photo use goes beyond merely viewing and browsing photos; it aids the understanding of one’s past, memories, and current self. Over-familiarisation may be detrimental to the above purposes. Based on their studies with participants’ photo viewing practices, the authors found that a change in context or juxtaposition with other materials inspired reinterpretation of images.

The ethnographic work that we so briefly touched upon here underlines that the particular ways in which a digital media display manifests itself (through its place, form, timing, etc.) influences which roles within the social sphere it is afforded. Although this discussion focused on photo archiving and use, similar practices can be observed for other types of media that will be covered in this review (e.g., music). The remainder of this chapter emphasises both the breadth of the approaches taken in the design of digital media displays as well as how their functioning hooks into established personal and social practices. In this manner, the review identifies common approaches, findings, and the potential for new or under-investigated opportunities.

6.3 Approach to the review

This review seeks to surface a variety of design efforts, with a strong emphasis on identifying the various directions of interaction design work undertaken to support remembering. However, our perspective was limited to those designs that apply to a general populace and are not (or at least not limited to) about overcoming deficiencies in remembering (e.g., dementia, or various forms of amnesia). To arrive at this critical review, we considered peer-reviewed journal articles and conference papers, books, and book chapters.

6.3.1 Selection procedure of relevant design work

Relevant works were selected from an initial search using the ACM Digital Library, Google Scholar, and Scopus. Articles were searched for by keywords including ‘memory/memories,’ ‘reminiscence/reminiscing,’ ‘design/interaction design,’ ‘personal,’ and ‘photo use’ in various combinations. Also, Scopus was employed to find papers that referenced one or more frequently cited papers in the field (i.e., Frohlich & Murphy, 2000; Sellen & Whittaker, 2010; van den Hoven et al., 2012; van den Hoven & Eggen, 2008). This identification process was complemented by scanning the reference lists of articles for additional material that may have been missed using the search procedure. After removing duplicates, the initial 450 papers on our list were checked against the inclusion and exclusion criteria based on their title, keywords, abstract, and where necessary the full text. This procedure (visualised in Figure 6.1) follows the PRISMA guidelines for systematic reviews (Moher, Liberati, Tetzlaff, Altman, The PRISMA Group, 2009).

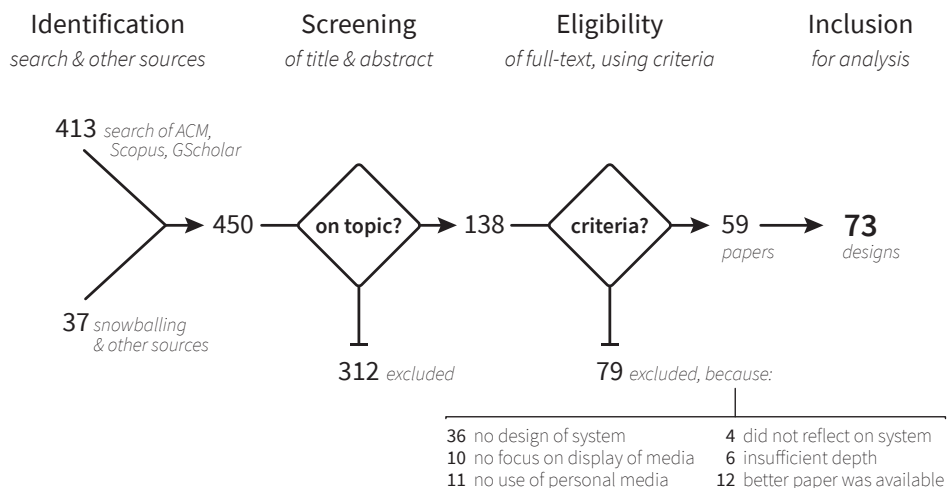


Figure 6.1. Flowchart of the literature search and selection of articles.

Inclusion criteria

Papers that discuss a system or prototype, whether at a conceptual level or put into practice, and thereby focus on how people may interact with such a system.

1. The system of interest documented in the paper aims to support reminiscing or reflection using digital media (typically of a personal nature).
2. Papers that include sufficient information to be reviewed. This also applies to short papers, such as the CHI Extended Abstracts, because these often provide sufficient depth to understand the design rationale and some level of evaluation.
3. The paper is available in English. We are not aware of systems designed within the interaction design community that do not have an equivalent publication in the English language, so it is unlikely we excluded well-fitting systems.

Exclusion criteria

1. Papers that do not explain, reflect on, or evaluate a design prototype or existing system in a meaningful way. This includes papers which are primarily about something else than the design or evaluation of a system.
2. Papers that discuss a system for which another, more mature paper is available. For example, a work-in-progress paper would be left out in favour of a well-rounded journal article, unless the earlier paper covered information not available in the later work.
3. Papers that focus on the capturing or management of digital media, rather than their display.
4. Papers that focus on topics related to Quantified Self or design for dementia and other memory deficiencies. These are considered related but ultimately different topics, as either the nature of the media or the user group is different from our current interests.

This process left 59 suitable papers in our corpus, across which we identified 73 different designs. Because we intend to survey the various directions of the field and related empirical evidence, the selection was not limited to the most cited articles, as that may also exclude recent work. A table outlining our corpus is available in Appendix 6.1, and Figure 6.2 provides a year-by-year distribution. Despite our inclusive intentions, the selection of designs is not exhaustive. Another concern is that work on personal media and its use in making meaning, portraying our identity, and storytelling is very common

outside of the academic community. The classic photo album, digital photo frames, and their computer and smartphone-based counterparts (e.g., Google Photos, Apple Photos, and similar software) in some ways address the same intents as do some of the designs discussed here. This also holds for social media, such as Facebook, WhatsApp, Twitter, and SnapChat (which receive treatment in the HCI community to understand people’s practices, but not as a designed system per se). Methodological concerns against the inclusion of commercial systems are twofold. First (and this applies mostly to digital platforms), their ever-developing design implies that any evaluations available to us tend to reflect particulars of older versions of a system (or parts thereof) that may no longer exist in their documented form. Also, unlike academic publications, it would be challenging for many such systems to point to a stable source or document for reference by future readers. Second, the inclusion of these systems would make the corpus impractically large, hindering our efficacy. Therefore, despite their relevance, such systems were not included.

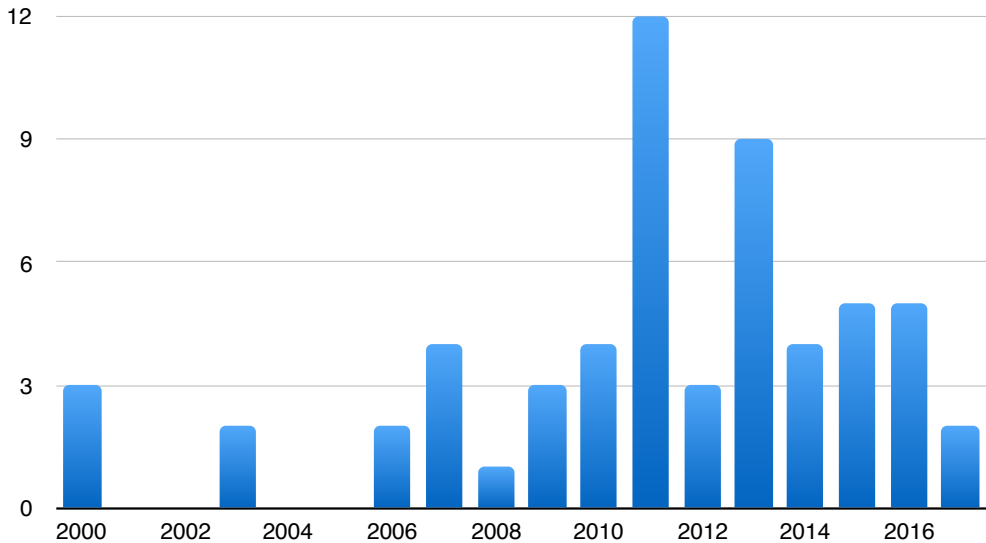


Figure 6.2. Distribution of the selected papers by year of publication. This distribution reveals an uptick in the late 2000s and has seen remaining interest since. No clear explanation is available for the peaks in 2011 and 2013.

6.3.2 Analysis of the corpus

For all selected papers, one researcher read the work and distilled the design(s) described. Each system’s function, the media it dealt with (e.g., photos, audio), where it was situated (e.g., the living room), and interactions it afforded were summarised. For each work, researchers’ questions of interest were noted, along with the evaluation method and a

summary of the results (if any evaluation was done). Any open questions stemming from the research were also added to our notes. Where possible, we gathered visual evidence of the designs as shown in the next section and Appendix 6.1.

We iteratively created categories for the designs we studied. These categories serve to outline shared directions, not to introduce rigid boundaries. Multiple designs traverse several categories both in their intent and actual design. We also considered commonalities and differences in the kind of questions researchers sought to explore, their approach, along with emerging issues, and areas that are relatively under-explored. This process is similar to the reviews of DiSalvo, Sengers, and Brynjarsdóttir (2010) and Desjardin, Wakkary, and Odom (2015).

6.4 Categories of personal media displays

This section presents five categories of research on personal media displays that are pervasive in the interaction design literature. The first three categories are concerned with making the digital present in the physical world, enabling the exploration of personal media in a variety of ways, and how displays can be put to use in social practices. The fourth category discusses designs that explore how the passage of time affects our relation to personal media, while the fifth category covers designs that challenge expectations in both the presentation and nature of personal media. We discuss the typical focus, aims, and outcomes for each category and illustrate this with the help of several exemplary projects. The full list of designs is available in Appendix 6.1.

6.4.1 Making the digital present in everyday life

A common theme in this area of research is the relation between the physical world and the digital. This theme is expressed through the desire to connect these two realms, either by including a concrete link between them or by augmenting physical objects with digital information. This category includes some of the early work in this area, such as Memory Box (Frohlich & Murphy, 2000) and Living Memory Box (Stevens, Abowd, Truong, & Vollmer, 2003), both of which aim to study how digital augmentation may provide value to existing objects (see Figure 6.3). Related work considers the use of souvenirs as tokens to access and explore one's photo collections (e.g., Nunes, Greenberg, & Neustaedter, 2009; van den Hoven & Eggen, 2003), or addresses digital archives through interactions in physical space. For example, MEMENTO (West, Quigley, & Kay, 2006) uses a pen-driven interface to bridge from physical photo albums to a digital equivalent, whereas the digital projector lamp in Family Album {Jaafar:2014uv} goes in the reverse direction to enable browsing of personal photos in a way similar to well-known practices. Common among these designs is the quest for a system that opens up digital opportunities without giving up the notion of a physical antecedent, be it a token or means of interaction (e.g., Balabanović et al., 2000; Petrelli et al., 2013). There appears a underlying value system

held by the designers of the systems in this category, who value physicality and try to bring some of the extant practices surrounding physical mementos in the new – and predominantly digital – era of connected devices (i.e., Internet of Things (cf. Koreshoff, Robertson, & Leong, 2013)).

A notable subcategory involves memory boxes of various kinds, analogues to the use of shoeboxes for storing memorabilia. These boxes display and allow the exploration of personal media collections. Several designs hint at the box design in name and form, such as Shoebox (Banks & Sellen, 2009), Backup Box (Banks, Kirk, & Sellen, 2012), Mobbox (Güldenpfennig & Fitzpatrick, 2014), and MemoryBook (Petrelli et al., 2013). Taking Shoebox, for example, takes that idea of the physical box but applies it to the storage and display of digital images. The authors reasoned that by capitalising on existing practices of storage and placement in the home, they could introduce new interactions around photo displays, for instance, to support storytelling. Shoebox gives a clear physical place where digital images live. MemoryLane (Kalnikaite & Whittaker, 2011) provides a software interface that enables its users to locate their media in stereotypical locations in the home (e.g., photos of a dinner can be linked to a digital kitchen area to facilitate retrieval later on). Questions of interest for these designs include how digital photography may be integrated into the practices and aesthetic of a family home. Across this category, authors tend to agree that domestic practices around photo talk (cf. Frohlich et al., 2002) and reminiscence through personal media are not yet fully developed to take advantage of new opportunities that digital platforms may offer.

Thus, a prominent shift in perspective is that more recent work considers the digital as its own domain with distinct characteristics that lend it unique qualities unavailable to the physical. Accordingly, efforts are directed towards exploring these characteristics rather than making up for a perceived loss.

6.4.2 Exploration of media

The use of digital photos is prevalent across our corpus, with 50 designs (69%) using them. Motivations include the ability to provide a rich characterisation of past events and their historical role in portraying personal and social identity. A number of interactive systems were designed to explore other types of media to support remembering, most notably through the use of audio. The Audiophoto Desk (Frohlich & Fennell, 2007), for example, investigated what kind of sounds people would link with photos, and if they take into consideration a future audience when doing so. Music proved beneficial to discussions, whereas voice-overs and sound effects contributed negatively. Along with this, the use and fit of the desk as a domestic technology was evaluated. Based on a small number of trials, it appears that a desk is too formal to engage in casual storytelling and reminiscing. MemoryTree (Jayaratne, 2016) and the Memento sound locket

(Niemantsverdriet & Versteeg, 2016) opted for a more casual and personal approach through the recording of short audio clips for later playback and reminiscing. The research concerned itself with the types of audio that people record and for which remembering-related purposes. Other work considered the social value of audio recordings of communal stories (e.g., Reitsma, Smith, & van den Hoven, 2013).

What binds these works together is an integration of audio creation with playback, presumably for remembering purposes, into one system. A small but interesting selection of research examines the use of personal data, bridging to remembering with quantitative data (cf. Elsdén et al., 2015). A case in point is MUSE (Hangal et al., 2011), which aims to revive memories using email archives. It does through a visualisation of email sentiments over time, split out by various senders and topics, and enabling the browsing of images received via email attachments. Other designs take a similar approach to personal histories of, for example, listening to music and travel (Baur et al., 2010; Thudt, Baur, Huron, & Carpendale, 2015). Interests lie with people's ability to use data visualisation as a means for reminiscing about their data histories, and whether the inclusion of more personal material into the mix – such as photos and calendar events – enhance this reminiscing. For the personal data-driven designs in particular, designers seem to build on the assumption that people are both willing to explore their media and data histories and able to extract interesting patterns or other aspects to feed into their reminiscing and reflection practices. To support such use, Baur et al. (Baur et al., 2010) reasoned future work might seek to point out interesting patterns or notable events (see Figure 6.4).

For the first category, we observed a shift towards the embrace of opportunities that digital media offer in defiance of a presumed 'lesser' position compared to physical things within social practices. Because designs in this category are more recent, these designs reflect this trend towards viewing personal digital media in their own right. As a consequence, the studies are predominantly an exploration of newly developing practices around digital media. Nevertheless, a good portion of the designs covered in this category are hybrids between physical space and manipulation and the digital media these designs story and display. This is true for the aforementioned Memento (Niemantsverdriet & Versteeg, 2016) and MemoryTree (Jayaratne, 2016), as well as for the Digital Shelf by Martin and Gaver (2000). The latter resembles a shelf of printed postcards that upon scanning with a sliding digital photo frame open up coupled digital audiophotographs. The designs mentioned above all received early prototype validation testing, but the results could not yet comment on their presumed actual use in everyday life.

6.4.3 Social use of displays

A clear theme for a large portion of the designs reviewed is their intended position within existing or new social practices. Prevalent among the designs that most strongly embody



Figure 6.3. *Memory Box* (Frohlich & Murphy, 2000), *Shoebox* (Banks & Sellen, 2009), and *Intel's Museum of Me* (Thomas & Briggs, 2015).

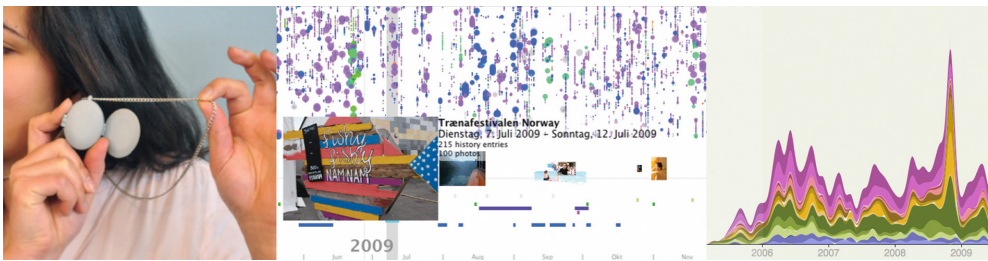


Figure 6.4. *Memento* (Niemantsverdriet & Versteeg, 2016), *LastHistory* (Baur, Seiffert, Sedlmair, & Boring, 2010), and a graph of emotional content in emails from MUSE (Hangal, Lam, & Heer, 2011).



Figure 6.5. *4 Photos* (O'Hara et al., 2012), *FM Radio* (Petrelli et al., 2010), *ProjectoFrame* (Petrelli et al., 2013), *Cueb* (Golsteijn & van den Hoven, 2013), *Pearl* (Jansen, van den Hoven, & Frohlich, 2013), and *Photo Switch* (Taylor, Swan, & Durrant, 2007).

social intentions is their use for storytelling (i.e., one form of photo-talk (Crabtree et al., 2004; Frohlich et al., 2002)). Typical for the proposed systems are relatively simple and accessible means to view photos and move between these (especially so compared to the more complex interfaces of the previous category) (e.g., Gaver et al., 2011; Hilliges & Kirk, 2009; Petrelli et al., 2010) (see Figure 6.5). 4 Photos (O'Hara et al., 2012) is representative for these design characteristics. Featuring four displays on each side, it enables everyone around a dining table to view and comment on the same photos. Interactions are limited to selecting a photo album, zooming in, and making a photo on one display available to all four at the same time. pHotOluck (Nishimoto, Amano, & Usuki, 2006) removes even this functionality; Photos of dining members are projected onto dishes to stimulate conversation.

An open question for this category concerns the potential uptake and development of practices around the interactive system. Thus, when and how people may use these systems outside of brief field evaluations is left for future work. To illustrate this, consider Cueb (Golsteijn & van den Hoven, 2013): Two cubical photo displays that when shaken display a random image on each side. Cuebs are intended to stimulate conversations between family members if brought together, assuming each Cueb reflects its owner. A brief evaluation indicated the device is capable of instigating such discussions, but it remains unclear how and when people take up their device and initiate a shake and share session. Nonetheless, the design intent carried through to the user practices during Cueb's brief evaluation, as it seemed to do for other designs in this category and others.

Other designs position themselves closer to the classic photo frame, albeit with enhancements afforded by technology. Photo Switch and Photo Mesh (Taylor et al., 2007), ProjectoFrame (Petrelli et al., 2013), and Pearl (Jansen et al., 2013) are typical examples. Important considerations for the designs in this category are the expected functions and aesthetics within the home and family life in general. To that end, the designs' appearance tends to blend in with their domestic environment (although this holds true for a large portion of the reviewed designs). Functionally, Photo Mesh, for example, represents a collage of photos ready for further exploration by someone who walks up to it. One photo may be picked and enlarged, and as the authors surmise, this matter of selection may bring to the fore discussions on which photos are fit for display within the family unit. This notion of photo display and impromptu, on-the-spot curation permeates several of the aforementioned systems. That is to say, the curation of photos is integrated into the viewing of these photos, without an explicit step beforehand. At least from the perspective of these systems' design, it is well possible such steps are taken ahead of its use. In the case of Pearl, people could move less desirable photos from the centre of the display to the periphery and vice versa. However, evaluation of Pearl revealed that the system often saw passive use (i.e., just viewing of photos instead of interacting with the

system). Participants questioned the value of systems such as Pearl for browsing their collections, although the occasional view of their photos was perceived as a positive.

Several designs addressed social connectedness. 4streams (Zargham, Čalić, & Frohlich, 2015) aimed to study whether a concurrent viewing of photos of friends and close family gives rise to a stronger sense of presence of these people as compared to asynchronous photo sharing media (e.g., Facebook, and messaging apps). Interesting social patterns developed around the displays and the expectations of viewers, as well the expectation of a 'reply' through the addition of new material that references earlier outings. In line with the examples discussed above, people tended to put the display in a position where it may function as a conversation starter. While these findings are perhaps not surprising – for example, the ASTRA project (Romero et al., 2006) observed similar patterns of use emerging with a home awareness system – these do reinforce the social nature of personal digital media.

6.4.4 Passage of time

Digital photos and other personal media are valued because these refer back to an earlier time, often with positive connotations. A number of concepts and prototypes address this passage of time by emphasising the consequences of photos getting older. While digital media by their nature do not deteriorate unlike their physical counterparts, several designs introduce such wear to challenge ideas of digital media as persistent. Examples include ForgetMeNot (Güldenpfennig & Fitzpatrick, 2011), BitLogic and DataFade (Gulotta et al., 2013), Photo Illume (Taylor et al., 2007), and NeverFadeAway (Petrelli et al., 2013) (see Figure 6.6). As the latter authors made clear, photo display in the domestic sphere is subject to rearrangement and renegotiation. By mandating occasional attention to NeverFadeAway, the digital photo frame may weave itself into established social practices. ForgetMeNot upstages the expected direction of digital deterioration over time; Photos become clearer over the years, filling in details that initially rely more on one's capacity to remember. Most of the designs in this category received only cursory evaluation, typically in discussions with the help of mock-ups or early demonstrator systems. Consequently, these explorations are best considered on their conceptual merits towards temporal qualities.

Some of these explorations make the passage of time an explicit element in the design. In Gather (Gulotta, Sciuto, Kelliher, & Forlizzi, 2015), the system gathers information about prior events and inserts these at a later point for someone to reminisce and reflect on. Ritual Camera (Mols et al., 2016) and Echo (Isaacs et al., 2013) orient specifically towards reflection on earlier moments, building on the notion that over the course of time people may desire to revisit and reconsider earlier moments and thoughts.



Figure 6.6. *NeverFadeAway* (Petrelli et al., 2013), *DataFade* (Gulotta et al., 2013), *Story Shell* (Moncur et al., 2015), and *Ritual Camera* (Mols et al., 2016).



Figure 6.7. *Photo Display System* (Leong et al., 2011), *Photobox* (Odom et al., 2014), *Reflexive Printer* (Tsai, Wang, Lee, Liang, & Hsu, 2014), *Meerkat and Tuba* (Helmes et al., 2011).

Several designs consider questions around the longevity of digital data itself. The lifetime of this data may surpass that of its owners, with the designs often implying such data is then inherited by family members (Banks et al., 2012; Chaudhari, Prakash, Tsaasan, Brubaker, & Tanenbaum, 2016; Gulotta et al., 2013; 2015; Jihwan Kim, Kim, Yu, Yoon, & Han, 2011; H.-C. Lee & Hsu, 2016; Moncur et al., 2015; Uriu & Okude, 2010). Typical questions raised in these works include how family members may maintain and find value in such extant personal media. With *Calendera*, Gulotta et al. (2015) give a clear example. It is a conceptual calendar application that integrates records from one's forbearers into a monthly schedule view. These historical records may then be reviewed. *Calendera* was developed to explore how systems might be involved in deriving meaning from

multigenerational records and present a form of legacy. Like this example, the designs in this subcategory are typically an expression of the conceptual questions identified above. As a result of this, few functional prototypes have been built in favour of conceptual designs fit for discussion, not actual use in the wild.

A subset of the design for intergenerational data use pertains to support remembering and mourning of the deceased (Chaudhari et al., 2016; Jihwan Kim et al., 2011; H.-C. Lee & Hsu, 2016; Moncur et al., 2015; Uriu & Okude, 2010). For these works, it is the person to whom data and personal media refer rather than these media themselves that are central to the purposes of the design. Honouring of the deceased and supporting bereavement is central to these designs, such as Story Shell (Moncur et al., 2015). This is a white spherical shell with more intricate inner detailing. When touched, the embedded electronics replay audio recordings from friends and relatives of the sole user's deceased child. The secluded nature and the need for explicit interaction to play the recordings enable the user to be in control of her exposure, even though the physicality of the shell asserts that this opportunity is never far away.

6.4.5 Challenging expectations

The final category represents designs that challenge expectations people may have, often by employing randomness or other means of defying anticipation. Most exemplary of this category are those designs that 'abdicate choice' in Leong's words (Leong et al., 2008). That is, designs require people to give up choice for surprise, gratification for anticipation, and control for serendipity. For example, Leong, Harper, and Regan's (2011) Photo Display System uses the notions of randomness, defamiliarisation, and temporality to guide its design (see Figure 6.7). By manipulating the appearance of a digital photo, the system was expected to inspire serendipity, which may arise from random encounters with personal media and the need to familiarise once again with a photo. Leong et al. argue that the random display of personal photos at home can spark people to make connections with their current state of mind or explore new meanings.

This play with anticipation and expectations is sometimes directed towards cues for casual reminiscence (in a similar vein to serendipitous reminiscing espoused earlier in this thesis). This is exemplified by Meerkat and Tuba (Helmes et al., 2011). Meerkat would detect movement and the presence of people in its surroundings, a trigger to erect itself and show three random images from people's personal photo library (see Figure 6.7). Tuba took a different approach, its appeal resting with the need for a user to explicitly lift the device to see its screen (which would show a random photo, Facebook post, general factoids, or play music after lowering the screen). This action and unknown response could instil a sense of anticipation and surprise. The necessity to close the device for it to move on gave participants the ability to leave it to display something attractive (ibid, p. 386).

Photobox (Odom et al., 2014) stands out for imbuing the viewing of digital photos with a sense of ‘slow interactions.’ This box would be placed in someone’s home, connected to their online photo collection, and then, every once in a while, it would print a photo from that collection. The irregular printing resulted in strong reactions from participants. There was initial frustration that over the course of months evolved into positive anticipation (Odom et al., 2014, p. 1965). By then, people appreciated the ability of Photobox to remind them of forgotten things in their collection, prompting to reminisce about those moments (ibid., p. 1966).

Pensieve (Cosley et al., 2012) explored the use of digital mementos by using earlier social media photos and posts, personal diary entries, and generic writing prompts (for new diary entries) as emailed cues for reminiscing. A basis for these prompts stemmed from an appreciation of being reminded to reminisce, according to participants in earlier work of the authors. A belief that such prompts should fit into everyday life without the need to incorporate new tools and routines drove the decision to use email. Pensieve does not attempt to place cues for reminiscence in a physical space (a break with the examples above). This need not be an issue, as Petrelli et al. (2008) argue that the reflective value of a memento comes out of re-encountering and re-evaluating our disposition towards a thing and its related memories. It should be noted this evaluative process happens in the mind and is not evident to interactive devices (as we shall comment on in the next section). The ambiguity of certain prompts and thus the need for interpretation matched the idea that unfamiliar encounters prompt people to consider new connections (Leong et al., 2011). In some ways, the Pensieve system was not so effective. Some of the prompts were not considered meaningful, at least not at the moment of receiving, leaving it to be ignored. At the end of the testing period, those participants who felt that Pensieve required a change in their practices indicated they were less likely to continue their use of the system. For others, the system was an alternative to their existing reminiscing activities, and as such, it did not intrinsically change their practices.

6.5 Observations across the corpus

This section turns to observations across the reviewed literature. We identified a number of aspirational themes. Some of these cut across the categories defined in the previous section, others are more clearly delineated and perhaps define these categories. We also consider the choices of media put on display and the evidence presented for some of the broader claims made in the literature. This section finishes with observations related to methodology throughout the corpus.

6.5.1 Aspirational themes

The most pervasive aspiration underpinning the collection of designs is that personal media (and social media to a lesser extent) can stimulate reminiscing. While some take

this assumption as a given, other (typically longer) papers point to the same body of literature we covered in Chapter 3. In doing so, authors connect the practices around physical memorabilia to their digital equivalents. Indeed, some of the earlier ethnographic HCI-driven enquiries into photo-talk (Balabanović et al., 2000; Crabtree et al., 2004; Frohlich et al., 2002) attempt to qualify established practices such that emerging technologies may build on their insights. By and large, the evaluations of such new technologies confirm that remembering can be supported.

Aspiring to invoke deeper consideration

Another aspiration popular among a segment of the corpus is to motivate people to slow down and give further consideration to their past and present, through spending time with particular personal media or other prompts. For example, the designs of the fifth category on challenging expectations use unpredictable encounters to invoke curiosity and motivate people to think about the media themselves and what these media represent to them. Although the designs in that category are often quite conceptual, several long-term evaluations lend credence to the ideas invested in them. Photobox (Odom et al., 2014), for instance, shows that over time people change their perspective towards such technology. On the other hand, designs like Tuba (Helmes et al., 2011) and Photo Display System (Leong et al., 2011) show that the reveal of personal media can inspire serendipity and further reflection, but their evaluations leave open how common these moments are and whether it would continue if devices were left with participants. EyeOfDetail (Güldenpfennig & Fitzpatrick, 2011) blurred images partially, which appeared to stir interest and refocused storytelling around the affected photos, but it was not studied in-the-field to evaluate how it would play out in everyday use. Because these and similar interactive systems rely on the development of new routines and practices around their functioning, longer-term evaluations would be helpful. However, most of the prototypes we reviewed were built to evaluate possibilities, that is, whether these ideas *could* direct new practices if pursued further.

Aspiring to explore and enrich media

The notion that time spent with personal data can improve insight into the self, one's past, or one's relationships to others, also contributes to other common aspirational themes. First is the devotion to the exploration of personal media and data. An assumption underlying several designs – in particular, those categorised under 'exploration of media' – is that people are keen to actively explore their data histories to find interesting aspects to reflect on. With this assumption, the papers in the aforementioned category attempt to build on extant work on the relationship between artefacts, possessions in particular, and the ability to reason and reflect on oneself. Belk (1990), Middleton and Brown (2005), among others, describe how things allow people to represent and think about their past. We have also discussed work in Chapter 3 which

connects these practices to digital possessions, for example, the ethnographic accounts by Kirk and Sellen (2010), Petrelli and colleagues (2008; 2013), and Dib et al. (2010). Whereas digital photos hold strong similarities to their printed counterparts, with practices adapting from print to displays, newer forms of personal data (e.g., location tracking, health tracking, social media check-ins) and the exploration thereof for identity and remembering purposes are still developing, as outlined by Li, Dey, and Forlizzi (2011). For this reason, Elsdén (2015) argues that studies on personal data are in the process of finding out how this data (and the exploration thereof) may support remembering.

A related aspiration is to use interactive features to enrich personal media use practices. Several of the works we have included from the early to mid-2000s cater to the use of audio annotations to augmented souvenirs and other valued objects (e.g., Memory Box (Frohlich & Murphy, 2000) and Living Memory Box (Stevens et al., 2003)). More recent work has explored engagement through interactions with systems that display personal media. MemoryLane (Kalnikaite & Whittaker, 2011) illustrates this direction, as do MUSE (Hangal et al., 2011), PhotoHelix (Hilliges & Kirk, 2009), and Pearl (Jansen et al., 2013). These designs aim to contribute to individual contemplation and social use in storytelling, hereby presenting a novel counterpart to physical photo albums that served similar functions (Chalfen, 1987; Sarvas & Frohlich, 2011). For some, this use was implicitly catered to, others like PhotoHelix explicitly capitalised on and encouraged conversational sidetracking. This sidetracking, or making new connections amid presented materials, draws a parallel to the notions of randomness and ambiguity that we paid attention to earlier. Hilliges and Kirk (2009) argue that the ability to make one's own story is key and that any technological means ought to function in support of that ability. In this light, we find that many evaluations did indeed confirm the ability of novel technology to influence and direct the thoughts and conversations. Whether such direction is an artefact of the mode of study (typically, brief evaluations with early prototypes) or a more generally valid conclusion is often left to future endeavours. It is however clear that new interactive systems can play a role in the support of remembering, but the amount of direction and structure it seeks to impose on practices old and new remains open to further exploration. As Balabanović et al. (2000) concluded, people move between photo-driven and story-driven modes. Hilliges and Kirk (2009) add that imposing a structure on a photo viewing activity could render moot any independent motivations to connect the dots and create a narrative. This tension in the dialogic interactions between people and system to 'perform memory' and create a past remains a challenge.

Aspiring to introduce change

Few of the designs examined attempted to change content in drastic ways. Most of the works ascribed to a view that employs media captured by people for future reminiscing and storytelling by those same people. The designs that did augment or alter content

did so only to serve alternative means of presentation. For example, EyeOfDetail and ForgetMeNot (Güldenpfennig & Fitzpatrick, 2011) and NeverFadeAway (Petrelli et al., 2013) only faded or blurred parts to draw attention. Even the seemingly more permanent Digital Artefacts (Gulotta et al., 2013) restrained their manipulations to fading and restricting future access. A counterexample comes in the way of the Reflexive Printer (Tsai et al., 2014), which transferred digital photos onto perishable thermal paper to force a reconsideration of a photo's value. However, some works have sought to generate new representations of one's experiences, either by complementing content captured earlier or doing so in such a transformative way that entirely new content is created. The Curatorial Agents (Gulotta et al., 2015) attempt to collate information from various sources to infuse new perspectives on past experiences. We discuss this further amid observations on choices of media below.

In contrast to the aspiration to introduce change or stimulate reconsideration, few designs present explicit ways to ensure digital longevity of one's photos and other media. When the desire to hold on to and preserve personal media is explicitly incorporated into the design, this often stems from a consideration of how future generations may use these materials to commemorate or reflect on a past that precedes them (e.g., Digital Artefacts and Curatorial Agents by Gulotta et al. (2013; 2015), and the Heirloom designs (Banks et al., 2012)). The Backup Box of the latter authors is perhaps the best expression of the long-term preservation of personal media. However, the authors made the box mostly non-interactive as they felt that this box would suit its role best if it does not impose a particular role for technology that may well be superseded by the emergence of newer and presumably better digital artefacts and systems.

6.5.2 Choice of media

Across the reviewed designs, digital photos proved the most common type of personal media. Apart from designs aiming for ambiguity and defamiliarisation (Gulotta et al., 2013; e.g., Güldenpfennig & Fitzpatrick, 2011; Leong et al., 2011), photos were presented in their original format. Thus, while the means of presentation and afforded interactions varied widely, the digital photos remained mostly as-is. This also holds for the work that incorporated audio. Because these media provide a direct representation of a particular moment in the past, alterations would affect the interpretation thereof. It appears only some of the more conceptual work was keen to play with this notion of representative truth (e.g., the aforementioned Reflexive Printer (Tsai et al., 2014) with its degraded thermal prints).

Video was underrepresented in the surveyed work, despite its ease and popularity of capturing (for a counterexample, see Moments by Heshmat, Neustaedter, & DeBrincat, 2017). The combination of moving imagery and accompanying sounds may hold a large

sway over our ability to interpret depicted events. While we surmise that this is helpful for recollection of factual matters or being able to consider a viewpoint different from one's current perspective, video may hinder the ability to form one's own perspective and using this material to support social functions, such as storytelling. Alternatively, people may simply not be keen to talk over the sound and visuals coming from a video. These arguments may explain the dearth of video in designs that aim to address people's needs and desires. This assumption would, however, be open to future empirical investigations.

Audiophotography (Frohlich, 2004) made its mark on a number of studies (Frohlich & Fennell, 2007; Lindley & Monk, 2005; Martin & Gaver, 2000), augmenting digital photos with (short) audio clips to communicate ambience or add a voiceover. The studies observed that the addition of audio did alter the way people used them for personal reminiscing and co-located storytelling. Interestingly, vocal annotations negatively affected audiophotographs' ability to stimulate discussion. This may, of course, play out differently for solo reminiscing but it lends credence to the above assumption for videos being less suitable to later (re)interpretation. Despite the research on potential practices around audiophotography, this relatively new medium has yet to take off in everyday life.

More interpretation took place in the presentation of emails and music (e.g., listening histories), perhaps because these media are less clearly tied to a particular moment and place and could be revisited for diverse reasons over the course of time. Somewhat different to the above are audio annotations, as seen in for example Memory Box (Frohlich & Murphy, 2000) and Living Memory Box (Stevens et al., 2003). These annotations make explicit connections between real-world objects and digital audio recordings, and thereby are typically tied to the proposed device (and not an independent form of personal media, available otherwise).

Social media messages, posts, and other content featured not as often as expected given their presence in the daily lives of many people. It is unclear whether this reflects the perceived ephemeral nature of such media, the need for more efforts towards the preservation and integration into reminiscing practices, the availability of suitable means to do so within the respective social media themselves, or the inability to freely incorporate some social media into other systems. Pensieve (Cosley et al., 2012), one of a few systems that did use social media messages, was also fairly unique in its (partial) use of prompts for reminiscing without the use of any personal media at all, instead relying on textual prompts. Few systems combined media into something new, rather opting to remain with one kind or show only one kind at a time. The conceptual designs of Curatorial Agents (Gulotta et al., 2015) defy this by generating assemblages of particular moments from first and third-party sources. Although the evaluation was limited, it appeared open to future explorations. However, the authors noted a desire of participants

to understand how a system would come to its shown result, hinting towards a need for transparency for any interactive system attempting to deviate from using personal media as-is.

6.5.3 The home as a central place

The majority of the reviewed systems are situated within the home, often deliberately as a domestic technology. This is not surprising but rather reflects the implicit belief that the home is a central setting in everyday life and a place where people designate time for reminiscing. For most people, their everyday experiences indeed start and end at home, with significant social relationships playing out in its domain. In HCI and wider literature, this has led to a view of the home as a nuanced and complex place where its inhabitants negotiate personal, social, cultural, and political beliefs and practices. The meaning of home is thus both intricate, highly individual, and yet common. O'Brien and Rodden (1997) reason that "*the home is at different times a place of escape, a place of work, a place of privacy and a place of public exhibition of the tastes and values of the householders living there*" (p. 257). This corroborates the notion that activities go beyond functional needs; "*they are also about making a house feel like home*" (Taylor et al., 2007, p. 82). These ideas, presumably embodied by many of the featured work (whether explicitly so or not), assume the home is a place of comfort and fit for reminiscing, whether alone or with close friends and family. Our corpus' focus on the domestic environment flows from a wide body of literature on the home as a significant place (e.g., Belk, 1990; Csikszentmihalyi & Rochberg-Halton, 1981). Nonetheless, digital storage of personal media makes it possible to use these media to bring this sense of home with us. Suchman (2007) argues "*smart devices are the expressions of a long-standing dream of artefacts that know us, accompany us, and ensure we are always at home*" (p. 206). In the corpus, 44 designs were situated in the home, with an additional 18 application-based but focused on desktop computer or laptop use, six mobile applications, and just two were wearable devices. There appears room to open up the design space of interactive systems for reminiscing beyond the confines of the domestic space, or at least of its interpretation of being situated at home.

6.5.4 Practices of use

Closely related to the central position afforded to the home are the practices situated there. It is apparent from most designs that these are intended for individual use. It is assumed that in their use, these interactive systems inspire or augment individual reminiscing on the past and the reconsideration of one's story of the self. Although many of the papers we reviewed had a clear view of when and where the systems would find use, the specifics of when individual reminiscing takes place are kept open. From the evidence across many studies, it appears such moments take place in an unpredictable fashion, instigated by some cue often not directly known to the researchers or participants. Given our findings on involuntary remembering in Chapter 4, it is not surprising that tracing a

moment of reminiscing back to its original cue is difficult. It may come about as a result of ever-evolving thoughts or, as several of the designs aspired to, as a result of observing one's personal media. What happens after the initial cueing is however open to further investigation because designs such as Meerkat (Helmes et al., 2011), Photo Display System (Leong et al., 2011), and Pearl (Jansen et al., 2013) appeared to struggle to retain participants' attention after the initial moment of interest. This may however not be an issue if the aim is merely to inspire occasional reminiscing.

Co-located storytelling and reminiscing is another practice many designs aspired to contribute to (our third category on social uses of media displays covers most relevant examples). It appears these systems cater to the family unit, rather than groups of friends or other social groups (e.g., neighbours). In this sense, these designs build on well-established practices around family memories and personal identity. Again, in a similar fashion to the individually-oriented designs, the personal media are used towards invoking discussion. Because the media need not take a central place (which is usually reserved for the familial discussion), designs in this direction touch on a desire to constrain their ability to move the narrative away from its present focus. For instance, the use of 4 Photos (O'Hara et al., 2012) for dinner table discussions had to be negotiated when younger members were too enamoured with its ability to spin and show different photos.

New and underserved practices

Several designs were intended to introduce new practices rather than augment existing ones. For individual use, this often concerns the introduction of additional stimuli into the everyday environment. For group use, this pertains to designs that attempt to stimulate conversation in ways different from established practices. Cueb (Golsteijn & van den Hoven, 2013), which we discussed in the previous section, attempted to bring together family members through the shaking and combining of cubic displays. Brief user testing confirmed that its use might get conversations going, but it remains unclear how and when such technology would be taken up in the longer term. Another area that saw the introduction of new practices was the design for bereavement. These explored how digital materials can find their place next to existing mourning practices. Examples include Story Shell (Moncur et al., 2015), and Digital Technology Heirlooms (Banks et al., 2012). This area may have the least established practices around the use of digital media but, as time goes on, the desire to put digital heirlooms to use for remembering is likely to increase (cf. Moncur & Kirk, 2014).

Some practices did however not feature as prominently. This pertains, for instance, to the use of social media for remembering. While some inroads have been made (e.g., with Pensieve (Cosley et al., 2012) and Tuba (Helmes et al., 2011)), the value of social

media resides in the interactions with others through the medium. The preservation of these social aspects and their consequent portrayal in another system appears so far understudied despite the apparent popularity of services like Facebook, Snapchat, Instagram, and Twitter. However, our anecdotal observation is that these platforms themselves are also not stellar at this and remain closed to use of their data by third parties (including but not limited to academic interests).

Long-term effects

Based on the reviewed evidence, we cannot conclude whether a particular kind of personal media display is better able to stimulate individual and social reminiscing compared to other designs, or other types of media (nor is it likely a best solution exists for all situations). We expect that this is not meaningfully different from earlier ethnographic work that we brought up in §6.2 and Chapter 3. However, for any design to facilitate and affect practices takes time. As the experiences with Pensieve (Cosley et al., 2012) have shown over a period of half a year, randomised, unplanned encounters with personal media can make the past more accessible. The value of such a display is however dependent on how well it fits in with preferred practices around reminiscing. Few designs were deployed long enough to shape and entrench themselves in new or altered practices. Those designs that did (including Pensieve (Cosley et al., 2012), Photobox (Odom et al., 2014), and Moments (Heshmat et al., 2017)), made clear that people's anticipations and responses may change over time. This implicates that the evaluation of similar designs also requires time to let such changes cultivate. Whether this is reasonable for future work depends on researchers' desired emphasis on evaluating design characteristics or the more ethnographic study of practices of use.

6.5.5 Commonalities in methodology

Almost without exception, the reviewed papers are design-oriented explorations. These works are concerned with questions of interest that are open. Consequently, where an evaluation is reported, findings are interpretative rather than confirmative. This approach is reflected in the methodologies we observed. For a minority of studies, the design was the outcome of an ethnographic enquiry, reflecting some of the interpretations made by the authors in response to what they observed. For example, the Photo Illume concept (Taylor et al., 2007) expresses critical views on photo frame placement. Nevertheless, the majority of the research covered starts with ideas translated into a design (or a small number of them), which is then evaluated through interviews, brief exposures to (early) prototypes, or field deployments.

Many designs are primarily conceptually driven. Even in the case of prior ethnographic insights, conceptual designs stem from a particular perspective towards those insights. Empirical evaluation often takes place in settings not entirely representative of the

envisioned context. The key interest in the studies is typically how the proposed designs and in particular their relation to personal media correspond to people's experiences, beliefs, and practices. There is less attention to issues of usability or efficiency in favour of a presumed focus on underlying motivations. It may, however, be considered problematic that these short evaluations tend to confirm presuppositions about the intended use and effects without challenging them enough. This is not to say that individual work is blind to underlying assumptions but, for the collection of works we brought together here, there is a tendency to accept others' assumptions and findings as evident without stringent critical assessment.

One of the reasons underlying the above issues is that the field of Interaction Design generally finds its empirical validation trailing behind conceptual developments (Fallman & Stolterman, 2010; Gaver, 2012; Zimmerman et al., 2010). This manifests itself in the presently reviewed corpus in several ways. An important concern is that the design rationales make a number of assumptions about people's value in reflection, serendipity, rediscovery, and reflection. There is not always sufficient evidence for the reader to validate the designs and to confirm that participants (and people more generally) share the values embodied by the various designs.

Second, the emphasis on user experience tends to put into the shadow the more difficult to ascertain psychological effects of reminiscing and memory more generally: for example, the ability to reflect on oneself and bond with others through shared stories. While memory may be considered a 'resource for action' rather than something inherently valuable in and of itself (Harper et al., 2008), the potential effects on reminiscing practices ought to warrant further attention. Just as we elaborated in Chapter 5, Cosley et al. (2012) note that people seeing personal media or interacting with such media does not equate reminiscing. Many of the reviewed papers were suggestive rather than explicit on this particular issue. As a consequence, it is hard to generalise across the body of work or compare results directly. Connecting the dots across the available literature proves challenging exactly because the uniqueness of each study's approach, the translation into designed concepts, and any evaluations depend strongly on their starting convictions. At times these are made explicit but not always so, a critique that parallels earlier comments (in §2.3) on the need for ideological transparency in design research (e.g., Fallman, 2003; Zimmerman et al., 2010).

For those designs where the passage of time is conceptually important, the lack of evaluation over a period of time is problematic from an empirical perspective. Nonetheless, this approach to research makes sense pragmatically, if we consider that highly conceptual work is better iterated on quickly once insights become apparent. Longer and more elaborate evaluations offer diminishing gains over time, albeit with

stronger empirical confidence. The examples illustrated before, like Photobox (Odom et al., 2014) and Moments (Heshmat et al., 2017), demonstrate the additional insight on how media displays may provide untapped value if given time. For these particular examples, longevity was instrumental to the idea of ‘slow design’ and thus incorporated into the design and study method. Still, in their suggestions for future work, many of the reviewed works call for further evaluation over a longer period. It is a nod towards the realisation that even those designs not aiming for a slow simmer require time to affect people’s practices in a meaningful way.

In this section, we discussed a range of aspirational themes and how these were expressed in various designs. Then, we considered the variety of personal media put on display before turning to (domestic) practices of remembering. Finally, this section covered methodological commonalities and related issues. Hereafter, we suggest several challenges for the design of personal media displays and outline potential directions for future work.

6.6 Challenges and directions

In §6.4, we introduced five categories of personal media displays. The guiding principles for this categorisation were the apparent aims of the 70+ designs we examined.

The previous section added several observations regarding this collection. We listed aspirations across these works, chief among which is that supporting remembering is a worthwhile area for technological intervention. We also observed that the approach to research took on an exploratory and often conceptual stance, rather than an approach that sought to confirm or work towards a theoretical framework. A small number of methodological concerns were highlighted, in particular regarding the critical reflection on assumptions authors have subscribed to, perhaps implicitly so.

This section addresses challenges and directions for future work. These items are derived from our observations, open questions we noted during the review, as well as the issues called to attention in the introduction to a HCI Special Issue on Designing for Personal Memories (van den Hoven et al., 2012). With regard to the latter, we indicate where progress has been made and which areas have seen a dearth of attention since.

6.6.1 Methodological challenges

It proved difficult to compare and contrast evidence across the corpus, even when questions of interest and approach were apparently similar. There has been little concerted effort across the presently reviewed works to develop an emerging frame of knowledge or theory. This happens in a rather piecemeal fashion, such that knowledge is fragmented and finds little integration. In addition, this means knowledge is sometimes lost between studies. For example, we noted that in some ways, findings of the ASTRA project (Romero et al., 2006) predate several of the systems included here. The implication

is that new research may fail to triangulate and build on earlier research, resulting in a systemic impediment to do cumulative science.

This pattern is perhaps emblematic of the Interaction Design research field. While consolidation of evidence, replication, and (consequent) theory building underpins many areas of HCI research, the Interaction Design field appears more perceptive towards the generation and discussion of novel ideas (Zimmerman et al., 2010). This may be a characteristic driven by a perceived need to challenge the status quo and nudge it forward through innovative interactive systems that embody a message different from what is currently available (Gaver, 2012). However, this inclination does come at the cost of efforts to consolidate the available evidence. Our review underlines that even with a relatively narrow focus on personal media displays, the varied nature of design directions, and the specific needs and requirements targeted are varied and ill-aligned for easy comparison.

We also noted that more thorough evaluations of existing systems were missing for a number of reasons. One may be the complexity and time-intensive nature of developing an interactive system, such that long-term or more in-depth evaluations fall beyond the scope and time available to projects. Second, even brief evaluations of early tests of novel ideas (which would cover many of the designs included here) may already cause a rethink of the conceptualisation or its implementation. This means designers move on to another iteration or nudge their continued exploration in a different direction. This ‘fail fast, fail often, and pivot’ mentality inherent to design thinking is ill at ease with the kind of consolidation efforts that mark other branches of scientific enquiry. We do not condemn the approach taken (and in all likelihood, are guilty of its sins in the chapters to come) but merely wish to raise awareness for future efforts towards consolidation.

6.6.2 Open questions and directions

A recurring driver among the reviewed work is the perceived lack of love for digital things (as we discussed in §3.7) and the desire to improve on this matter. In particular, the long-term viability of new systems and practices remains difficult to evaluate. As ethnographic accounts have shown, the desire for longevity is what turns interest away from digital media. This was also noted in the earlier HCI special issue (van den Hoven et al., 2012). We see that in the past decade this view has gradually changed, perhaps because digital media are becoming more accessible and ubiquitous in everyday life and storage is more redundant across devices and third-party (cloud) storage. Efforts have thus shifted towards making this digital data useful in its own right. Nonetheless, some of the issues at the heart of the ‘uncherished digital’ concerns are still at play. Thus, there remains space to consider how personal digital media can be given a place in everyday life where these contribute to remembering when so desired.

One area of interest related to making the digital work is its *use for reflective remembering*. Media (both personal and those not captured and managed by people themselves) can help with the construction (and continuation) of a narrative of the self. What we observed in our corpus is that this aim is frequently targeted, but its effects on the ability to reflect on the self are not always made explicit. Thus, it remains open to future investigations to answer how interactive systems may best employ personal media to support this function of our autobiographical memory.

We can connect the above issue to another long-standing critique. Design research is not always forthcoming with the specific *ways in which memory and remembering could be and are supported* by a particular concept or prototype (Sellen & Whittaker, 2010). As we mentioned before, these interactive systems, in a similar fashion to memory, serve to support functions of self-managed wellbeing. Reminiscing may be one way, interacting with a system may be another complementary method to achieve these goals. However, without more clarity on how memories, remembering, and system use interact it remains open in which ways the field can best align its resources to support wellbeing.

An open question that made a recurring appearance concerns how *expectations for novel interactive systems* may be teased out? A typical process involves the development of ideas, then early design mock-ups, following by brief prototype evaluations and more thorough testing. However, our remarks on methodology have also raised the issue that early phases may not adequately assure participants do indeed subscribe to the conceptual presuppositions of the designers. There is no likely panacea to ensure novel concepts cater to existing practices or enable fitting new ones, but this is a concern for future methodological discussion in design research. One approach could be the use of a relatively simple to distribute prototype (akin to a technology probe (Hutchinson et al., 2003)) that could reach a wider, more diverse group of people to give rise to early and broad evaluations.

Recent works turned their attention to *how digital collections may be valuable to others*. This could be as intergenerational data that is left to family members. How would people give this a place? Can people find a use for the digital data that reflect the life of a person now deceased? Moreover, in what ways can those departed exert influence on how their personal media are left and used? Since Van den Hoven et al. (2012) highlighted this issue in their overview, several design efforts have addressed questions in this direction to begin addressing open questions around commemoration and mourning. Gulotta et al. (2015) also consider the use of non-personal data, such as public records and daily news, to complement remembering of past events.

Below, we list several directions that are either new or otherwise under-examined

but remain promising for future attention. One such direction that has seen limited investigation but was flagged in several works concerns actively *steering people's attention toward certain topics*. Guiding people towards particular photos and other personal media may be a veritable avenue to help manage and make use of large collections of digital media. Up until now, this direction has largely been the domain of randomised choices for displays, but there may be place for more direction in these choices. Nonetheless, our corpus suggests there may be value in serendipitous, ambiguous, or otherwise unexpected encounters with personal media. These moments may inspire reminiscing or conversations without the need for initiation by a user. However, if this initiative lays with the user, it appears from several evaluations that there is a desire to explore related material (e.g., Balabanović et al., 2000; Hilliges & Kirk, 2009; Uriu, Shiratori, Hashimoto, Ishibashi, & Okude, 2009). Thus, *supporting the exploration of related media or emergent patterns* could be a worthwhile avenue for future work.

The above remarks tie in with another open question espoused in the corpus, namely *how an interactive system may learn the subjective importance* of a photo, audio recording, or another kind of file. Relatedly, what would be an appropriate situation for these files' use? Such insights, if not relying on readily available metadata (e.g., time, date, and place), would either be derived from people's input (a direction we consider in the following chapters), or an interactive system should apply some means to learn this. Ideally, even if input from people is leading, the system attempts to judge unrated items based on what it knows from rated items. This direction would rely on machine learning technology similar to recommender systems (cf. Ricci, Rokach, Shapira, & Kantor, 2011). Although several of the systems we reviewed made an attempt in this exploratory direction (in particular, those building on large and homogeneous data collections, such as LastHistory (Baur et al., 2010) for music and MUSE (Hangal et al., 2011) for email), none incorporated more complex abilities reliant on machine learning.

We expect that further developments in the direction of *automated learning and presentation of interesting media for further exploration* require collaborations with those knowledgeable on the implementation of machine learning. In commercial applications such as Google Photos and Apple Photos, we see these developments emerge. For example, Apple Photos generates collections based on events, a period, or groups of people (e.g., a 'Portraits of 2015' series featuring photos that primarily show people). These collections are derived from metadata and facial recognition. While we chose to focus on the academic literature, it is clear that there are interactive systems available on consumer devices today that in some ways go beyond what the interaction design community can accomplish with more modest means.

Counter to the above view is the question how far interactive systems should go in trying

to unearth underlying emotions and connections to personal media, as its use of such information can go either way. While the research has touched upon *ethical challenges*, such as the appropriateness of showing certain content in particular situations (e.g., party pictures when one's in-laws visit, or the use of material related to events rather not revisited). Consideration of such issues was usually only given in reflection but not explicitly so in the design phase. However, a careful investigation of the relation between remembering and emotion would in itself be welcome to establish more clearly *how remembering and experience interrelate* (as we argued for in Chapter 5).

Finally, we reiterate the call for *attention to forgetting* as it was made by Van den Hoven, Sas, and Whittaker (2012). The value of forgetting for a healthy and functional autobiographical memory could be addressed in future work. This may connect with the above remarks for seeking out valuable and interesting personal media for display, as it can signal which events of the past (and related media) are better left covered or at least not frequently revisited. Here, we may also recall the arguments by Frohlich et al. (2012) to allow time to pass to stimulate a fresh perspective on one's past.

6.7 Conclusions

In reviewing how the interaction design literature has addressed design to supporting remembering, we traced how questions around the use of personal digital data (e.g., photos, emails, audio clips) have evolved. This kind of reminiscing and reflection, through revisiting our memories, allow people to construct meaning about themselves and their relation to others. This chapter contributes to the literature in two ways. First, it presents a critical overview of existing work that has engaged with questions of personal data use for remembering and self-reflection. To the best of our knowledge, no such recent work is available with a focus on designed systems (whether at a conceptual level or evaluated prototypes). Second, the identification of aspirations and open questions delivers an important contribution for future work and thinking on the role of personal media in our contemporary 'examined' lives.

We identified five categories that outline trends around the design of personal media displays for remembering. These addressed how to make the digital present and ways in which people may explore their personal media and use them for storytelling and connecting with others. We also identified an interest of designers to consider the value of digital media over time, through the design for particular practices that evolve over time, can be revisited, or through the unanticipated, system-driven exposition of personal media. The latter could lead to serendipitous encounters with the past. The review also concluded that designers could be more explicit about the assumptions embodied by their designs. In addition, evidence on how designs affect existing and new practices of personal media use may require longer-term evaluations than what we typically see across

the examined corpus. This chapter has addressed several arguments in relation to this, suggesting further attention to theoretical framing both in conceptual development and its evaluation.

The remainder of this part of the thesis will discuss two studies towards the design of a domestic photo display. The next chapter starts with the development of a conceptual model to guide this design process, hereby building on the insights gained from the literature reviewed in this chapter. The eight chapter then turns to the deployment of a prototype design, incorporating insights from this chapter and the next.

*Exploring designs for
serendipitous reminiscing*



7.1 Introduction to this chapter

One of the objectives of this thesis is to develop design concepts to study further how the use of interactive technology can support serendipitous reminiscing. The previous chapter has outlined a design space through a review of concepts, prototypes, and more refined designs that could aid the casual recollection and reliving of past experiences. In our discussion of these works, we highlighted the dynamics between passive viewing and taking a more active role in seeking out one's own story through exploration of personal media. Also, questions remained pertaining to the longevity of digital information. This is particularly relevant where it concerns making order out of the digital collections that people have.

This chapter details our initial foray into design explorations. It does so in three steps. First, we move from the design space laid out in the previous chapter towards a model that describes the place of interactive photo displays within the context of serendipitous reminiscing. From this conceptual model, we derive several lines of enquiry. Specifically, we are interested in how a device brings digital photos to someone's attention, how this affects the bringing to mind of the past, and whether such system behaviour is appropriate and desirable. Insights in this direction are aimed at guiding future design efforts to support serendipitous reminiscing. We generate several design concepts that challenge or seek to affirm ideas about what a photo display could and should be like, with a particular focus on the kind of interactivity included in the design. For our research-through-design approach, this is a divergent step where we aim to broaden our scope. In the third and final act of this chapter, we evaluate the generated designs through interviews. To that end, we created paper mock-ups and short animations to communicate the concepts. Through eleven one-hour interviews we sought for participants to respond and give us feedback. The latter sections of this chapter report our empirical findings and include suggestions for future directions for interactive photo displays. These findings narrow down options (a convergent step in the design process) and serve as input for the next chapter in which a working prototype is developed and built.

7.2 Related work on personal photo use

The design explorations this chapter aim to highlight how particular systems' interactions between a participant and their media are perceived. In the interaction design literature, this is an active field of inquiry as we have shown in previous chapters. Despite this attention, the relation between how systems introduce, show, and let people interact with their personal media collections remains open to improvements. For example, remembering a recent sports victory may fulfil someone with a sense of pride; a medal or other token of the event may inspire reminiscing. How in digital form such personal tokens of the past (e.g., photos, instant messages, emails, social media posts) may be used to positive effect is a continuing topic of interest (e.g., van den Hoven et al., 2012).

In the research presented in this thesis, the overarching idea is that there may be value in taking personal media such as digital photos out of their 'hidden' state. These media, easily captured and stored, are under-appreciated at later points in time. Prior work has shown people tend to undervalue their digital media collections (e.g., Petrelli et al., 2008). In addition, the increased reliance on digital storage of personal media may reduce chances to evoke memories without additional effort (van Dijck, 2007). Indeed, the diary study in Chapter 4 provided further evidence that digital photos are not common cues for serendipitous reminiscing. We also observed (in line with other research by, e.g., Whittaker et al. (2010)) that people appreciate what photos tell them when steps are taken to review these photos. Thus, bringing digital photos into everyday life is an attempt to leverage people's collections with the intent of cultivating the value of these otherwise scarcely reviewed personal media. Doing so may foster interesting and serendipitous encounters with pictures from the past, in turn inspiring the kind of serendipitous reminiscing that we sought to define in Chapter 3. The previous chapter highlighted several design research efforts that strive for a similar aim, including Meerkat and Tuba (Helmes et al., 2011), Photo Display System (Leong et al., 2011), Pensieve (Cosley et al., 2012), and Photobox (Odom et al., 2014).

Ethnographic work on the use of digital photos has shown that the approach to present photos in the everyday environment has merit, provided the materials shown relate to and cue moments of the past. For example, Crabtree et al. (2004) suggest that taking photos away from the 'monolithic' computer into the everyday living space can benefit creative use by people (Durrant et al. (2009b) offer similar advice). Kirk and Sellen (2010) considered how digital things have to find new ways to enable 'ready reminiscence' as it happens via things in one's everyday living environment.

The challenge that has and continues to propel research is how novel digital technologies may find a place in everyday life. Recalling Frohlich, Wall, and Kiddle's (2012) motivations for photo (re)use (i.e., visits by family and friends, reminiscing about specific events, and serendipitous encounters), established technological means cater most to the first two uses. These search, retrieval, display, and storytelling functions are most clearly user and goal driven, whereas chance encounters depend on uncertain, serendipitous interactions that leave more control in the 'hands' of a technical artefact. Because it is this system that determines which personal media will be shown when (perhaps randomly or using a more sophisticated approach), this reduces the amount of control a user has over the system and shifts agency towards this system. It does challenge the designers of such systems to display the right materials at the right moments. However, doing so remains open to questions. These insights rhyme with our interpretations based on the diary study (Chapter 4), where we extrapolated that it is difficult for technological systems to learn and understand what is and what may become meaningful to people.

The following section is intended to present a model and make clearer in what ways personal motivations, memories, and contextual factors such as personal photos influence remembering.

7.3 A model for interactive photo displays

We develop a model of remembering with the interest of finding a starting point for our design explorations. Before turning to the model proper, it helps to revisit the idea of remembering as experience. In Chapter 5, this remembering experience was defined as the set of effects that are initiated during the situated recall of a personal past episode. It was cast as a rich experience that affects mental images, feelings and thoughts, among other aspects. Some of these aspects may carry more weight and sway someone's ongoing experience more clearly as compared to weaker, perhaps more peripheral aspects.

This section is intended to build a model that explicates how interactions with the environment lead to a remembering experience, with a specific focus on interactive photo displays. This model does not further explicate what such an experience may be (our question in Chapter 5). Instead, it emphasises how interactions between the environment and elements internal to our mind work together to produce new remembering experiences. Relevant factors were derived from the review of the literature and prior design work (Chapters 3 and 6), and include self-relevance, memory, experience, and distributed cognition. Figure 7.1 provides a visual overview of the model put forth. First, it gives a view of context as a subset of a broader distributed ecology. Second, it aims to describe how influences from this contextual ecology interact with ideas of the self, memory of the past, and a person's ongoing experience to result in remembering. Vice versa, remembering may influence the factors mentioned above and perhaps also cause people to shift attention (and by extent, their context). Before clarifying why the model is construed as it is, we intend to highlight each element and explain its function within the model, starting from the outside inward.

As detailed in §3.4, distributed ecology refers to a wide range of elements in the environment that may contribute to cognition and perhaps take on constitutive roles (Hutchins, 2010). The mind readily takes in such external cues and offloads cognitive load to support its functioning. Here, a distributed ecology refers to all elements in the environment that could take on a relevant role to aid remembering. It is however not necessary for an element to do so. Instead, only a subset of this ecology would be considered contextually relevant. Context in the present model is an emergent property of remembering, integrated not just as a backdrop to this activity but rather a dynamically adjusted 'tuning' to what is currently relevant (echoing Dourish, 2004). In Figure 7.2, this is visualised by some environmental elements being available but not paid attention to at the particular moment (i.e., a vase), and other elements that are considered relevant to

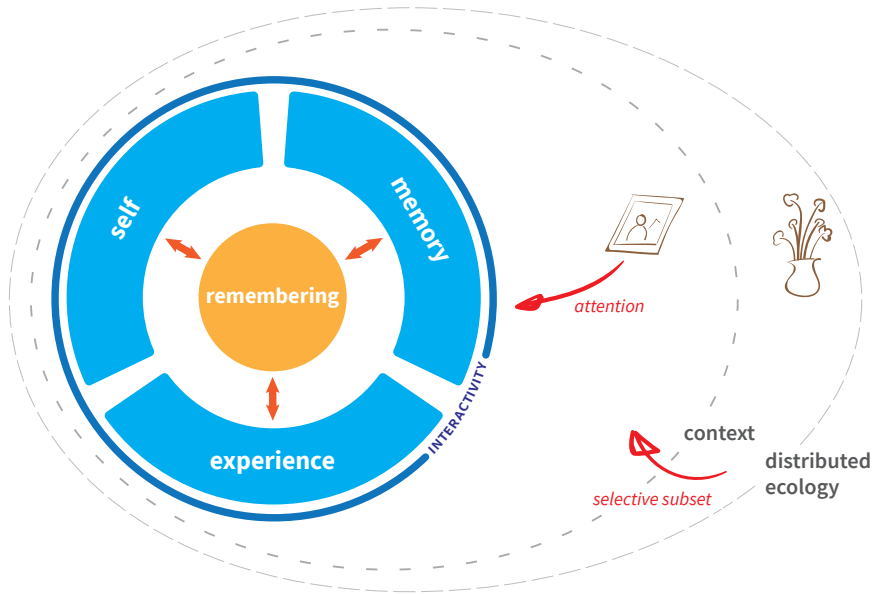


Figure 7.1. Visualisation of a model of remembering as a process of interactions between the self, memory, experience, and contextual elements. The line labelled interactivity demarcates internal versus external cognitive elements (for example, a vase or a framed photo). Contextual elements are modelled as a subset of elements within one’s distributed ecology that are deemed currently relevant (others would simply be ignored as Figure 7.2 shows).

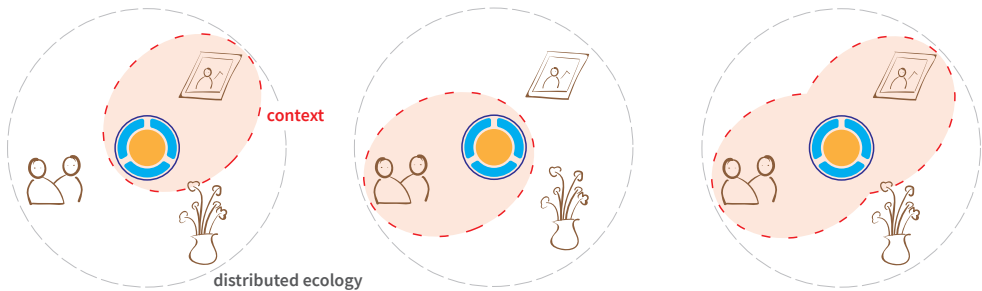


Figure 7.2. Context (shaded in red) as a subset of distributed cognitive ecology. As attention changes, different things can become part of the context or fall outside it, as shown through three possible instances in this figure.

the current context (i.e., the photo frame, other people). The idea is that these elements influence remembering and do so in a selective and adaptive process.

One’s current experience, sense of self, and memories of the past interact with the context to bring about remembering. Before explicating these contextual interactions,

we discuss these three components, which in Figure 7.1 are represented as a ring around remembering (the final stage). There is no particular order or hierarchy between them for our purposes. However, we do consider that all three have some influence on each other and remembering at any given time. *Experience* represents a person's ongoing experience, which includes the affective qualities of remembering, the extent to which our senses are gratified, and a sense of personal meaning. It also represents the ability of a person who is remembering to relate a new experience to earlier and current experiences. These characteristics are in keeping with earlier models of experience (see §5.2; Hassenzahl & Tractinsky, 2006; Hekkert, 2006; McCarthy & Wright, 2004b; Wright et al., 2003). It is clear that this component has strong connections to a sense of self, memories of the past, and how a person situates themselves within their context. Therefore, the Experience component reflects someone's openness to new influences and a willingness to engage in remembering. The latter qualities tie this component to a sense of *Self*, the leftmost component in Figure 7.1. It brings a sense of self-relevance and personal identity to remembering, which steers the interpretative nature of the process. Hereby, the component supports a continuous story of the self, in which personal goals and self-identity are given a place (Cohen, 1996).

The *Memory* component represents someone's knowledge of the past and the ability to relate the past to the present in a constructive, re-interpretative process. Thus, this 'knowledge of the past' creates – in tandem with someone's sense of self and their current experience – remembering. Compared to the literature on memory, which considers it a complete system of relating to the past (e.g., Bluck, 2003; Conway, 2005; 2009), we give more weight to and require the two other components. Our motivation is that this makes it easier to construe remembering as a process that is dependent on several interrelating components. Experience, Self, and Memory remain close to their conceptualisation in the literature, such that we do not break these down further into subcomponents for reasons of brevity (Chapters 3 and 5 provide such background).

Interactivity is given a place as an outer ring surrounding the three aforementioned components. The idea is that someone's interactions with contextual elements, such as a photo frame, a vase, other people, or an interactive photo display, can be described through the constituent subcomponents of *Interactivity*. Figure 7.3 gives more details on how elements external to the self can make their mark in the remembering process. Five subcomponents attempt to capture how contextual elements mediate this constructive process, which we shall attempt to explain using a digital photo frame as an example.

Time is an important discriminator, as explained in our definition of serendipitous reminiscing (see §3.8). If the exemplary frame shows a photo someone has not seen in a long time, it may catch attention in ways a more recently seen image would not. Along

with the passage of time, pacing matters as well. Slowly evolving imagery will have a different effect from a frame that only shows a photo for a few seconds before moving on. This subcomponent also maps nicely onto the key characteristic of the ‘passage of time’ category of designs we surveyed in Chapter 6. The designs discussed therein emphasised that both perspective on the past and usefulness of media depicting this past change as time passes.

Where a photo display frame is *placed* and which *form* it takes on affects its ability to be part of and salient within a given environment. The kind of attention given and time spent with a device will be different if it is located in a hallway or the living room; its size may call attention to particular images more easily or less so. Variations of personal media displays along these lines were most clearly seen in the categories ‘making the digital present’ and the ‘exploration of media’ discussed in Chapter 6. Designs in these categories sought to give the digital a place in everyday life and present these in such a way that observation and exploration may be possible and encouraged.

Clarity refers to whether an element is clear or ambiguous to interpret. For example, abstractions of personal photos may inspire interest and the taking of a perspective different from earlier viewings. Doing so may also hinder the ability to make a connection with relevant personal memories. Some of the designs in Chapter 6 deliberately subverted this and aimed to stir interest and reflection through ambiguity. Thus, clarity refers to the ease of interpretation of a particular element. We opted to use the term clarity instead of interpretation, as the latter could be a label for remembering and the model as a whole.

Finally, *Agency* concerns how initiative and control are distributed between a person and a contextual element. A digital photo frame that would not allow for switching of photos leaves the person as a mere viewer, whereas a more interactive system could put them in control. A device that actively seeks to connect and engage people will lead to a different experience (and perhaps more cued remembering, for better or worse) compared to a more passive system. Several examples were covered in Chapter 6 under the category of ‘challenging expectations.’

Together, these five subcomponents of Interactivity cover five well-known ways of questioning and understanding the world. Namely, when (*time*), where (*place*), what (*clarity*), whom (*agency*), and how (*form*)? This leaves the question of why (i.e., what does it mean?) to the three components of Experience, Self, and Memory.

The process casts remembering as a kind of experience; Namely, a mental event that encompasses emotional aspects, sense-making, meaning, and personal relevance, situated and unique to a particular context. This process aligns with the view we began to illustrate

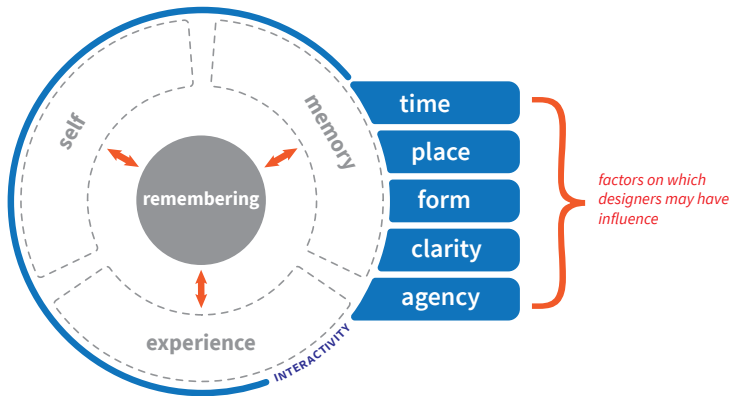


Figure 7.3. The Interactivity component of Figure 7.1 split into five constituent subcomponents, which work together to bridge between the broader context and other components to feed into remembering.

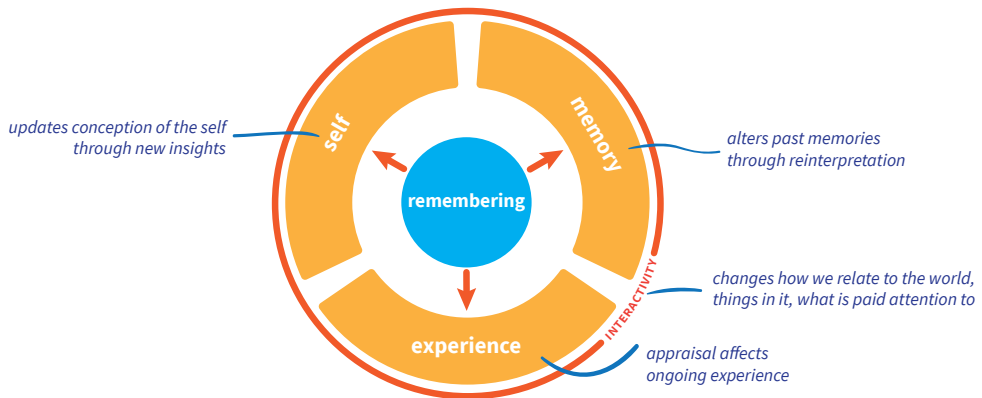


Figure 7.4. In a follow-up step in the remembering process, the resultant experiential qualities flow back into their constituent components. Via the interactivity component, we also consider someone to change their relation to the surroundings. The different colours and arrows indicate this is a specific step in the process, as the direction flows from blue (centre) to orange (outward).

in Chapter 5. It follows that remembering, in turn, affects someone’s ongoing experience (as we worked out at the beginning of this section and visualised in Figure 7.1). Thus, the newly cast experience reflects back on the experience component in our model. This makes sense, also for the other component, because remembering is a process of active interpretation and construction. Thus, in our model, such appraisal towards particular components flows back into these components, as shown in Figure 7.4. Through remembering someone may reconsider their conception of themselves, memories, and how they relate to their surroundings.

The components and subcomponents as sketched in the model are interrelated and should be considered to work together to facilitate and influence remembering. The outcome is negotiated between the components, similar to how collective remembering emerges in a social context (e.g., Halbwachs & Coser, 1992; Q. Wang & Brockmeier, 2002). A key difference is that the present model focuses on individual remembering and omits more socially-oriented factors and interactions for the sake of simplicity. Instead, the model illustrated here is configured such that the subcomponents of Interactivity outline factors on which the design of photo displays may vary. In turn, this means that these factors represent options for designers to exert influence.

This model does not prescribe how exactly a designer can support particular ways of remembering. Nonetheless, the previous chapter reviewed and highlighted a large number of design examples that fit into this design space. For example, Photobox (Odom et al., 2014) deliberately played with the idea of time and agency in its slow cadence of printing photos. Several designs, such as ForgetMeNot (Güldenpfennig & Fitzpatrick, 2011) and Dot (Mols, van den Hoven, & Eggen, 2017), attempted to leverage ambiguity to spark new thoughts on existing material. PhotoMesh (Taylor et al., 2007), Shoebox (Banks & Sellen, 2009), and Museum of Me (Thomas & Briggs, 2015) are a few of the examples that investigated novel forms and placement to support reminiscing. The following section moves this chapter towards another set of conceptual designs by taking a selection of the above factors as its starting point.

7.4 Designing photo display concepts

The model of Figure 7.1 puts emphasis on the dynamic interplay between remembering and how someone relates to themselves and the environment. Our diary study (Chapter 4) emphasised that serendipitous reminiscing is often a consequence of the dynamics between things that catch attention and one's current mindset. It is dynamic because initiation and response are distributed between system and user. For instance, a photo display may cause someone to pay attention to and remember a particular moment of their past. At other times, the person may ignore this call to attention entirely (e.g., when leaving home to catch a bus). Interactive systems could vary in the way attempts are made to take initiative and how any further interactions unfold; systems may take a more passive or active role in trying to stimulate reminiscing. This notion of agency is interesting to study further and forms the first focus of our exploration.

Our second focus is on temporal qualities in the design of innovative photo displays. As we noted in Chapter 6, a majority of designs oriented towards use that is in direct response to user interactions. Notable exceptions included Photobox (Odom et al., 2014) that deliberately replaced instant gratification with a more spread-out pattern of interactions (thereby also addressing issues of agency) and BitLogic (Gulotta et al., 2013),

which introduced a digital fading effect over time. It is therefore helpful to consider yet under-explored issues of time that address, for example, the pacing of image displays and resultant effects on interpretation. Fleeting versus drawn out interactions may alter how people take in and relate to novel photo displays and, more importantly, the presented media.

7.4.1 Finding suitable ideas

Together with the theoretical considerations highlighted in the model, we used the above dimensions (i.e., agency and time) to generate and organise ideas suitable for further exploration. These ideas were generated from a brainstorm session using the dimensions as a starting point, and were combined with a compilation of ideas generated at earlier moments. Eight clusters emerged from this process. The *'social'* cluster represented ideas that prompted people to tell stories, or that would only operate with multiple users. *'Altered'* clustered ideas that intended to change appearance or organisation of images to break with expectations. *'Game'* ideas relied on a challenge, such as a puzzle, or required a user to respond to a prompt before another photo would be shown. *'Conversational'* included ideas that provoked commentary (or had a digital parrot provide this) and ideas that aimed to fit photos with an ongoing conversation. Ideas in the *'do something & get a response'* cluster sought to provoke interactivity through split screens, tangible interfaces, or demanding a destructive act to reveal more photos. *'Random viewing'* ideas gave users limited control of direction, only to instigate a change, instead relying on the randomised display of photos. For example, a genie lamp and spin the bottle device were included. In comparison, *'just viewing'* ideas would display photos but not allow control over its operation. For instance, one idea would cycle through photos but hide this display behind frosted glass, requiring someone to come close to clearly see things. The *'curation'* cluster was dedicated to ideas around the organisation and filtering of personal photos.

Ideas in the conversational cluster were perhaps the most novel, if compared to the work reviewed in the previous chapter. Social ideas have comparable counterparts in the literature. The do & get, random, and just viewing clusters had diverse ideas that were surprising, fun, and in some cases, rather odd. However, to maximise both breadth and depth in our future evaluations, we opted to retain ideas that were distinctive. Thus, from each cluster, ideas were selected for their ability to stand out conceptually against other ideas (including those espoused in prior work, as discussed below), as well as their promise to evoke discussion (according to our subjective interpretation). For example, an idea that proposed that people may paddle their hands in a small tray filled with water to reveal personal media may reveal little else beyond its alternative method of bringing up images. Ideas that were similar to other ideas were combined or one of them was dropped. This process left six ideas that were fleshed out further.

The six selected design concepts were mapped onto a two-dimensional quadrant (Figure 7.5). The horizontal dimension reflects whether a design (rather than the user) takes initiative in the interaction (Passive versus Engaging). The vertical dimension depicts whether the interaction style of the design is of short duration, including rapid changes, or is rather drawn out (Ephemeral versus Slow). These dimensions map onto the ideas around agency and temporality as introduced in the model depicted in Figure 7.1 and further discussed at the start of this section. In addition, basing these dimensions on agency and temporal qualities enabled us to connect the present work with our observations in Chapter 6. Figure 7.5 also maps how the six design concepts that we discuss below relate to prior work. Based on the review in Chapter 6, eleven works

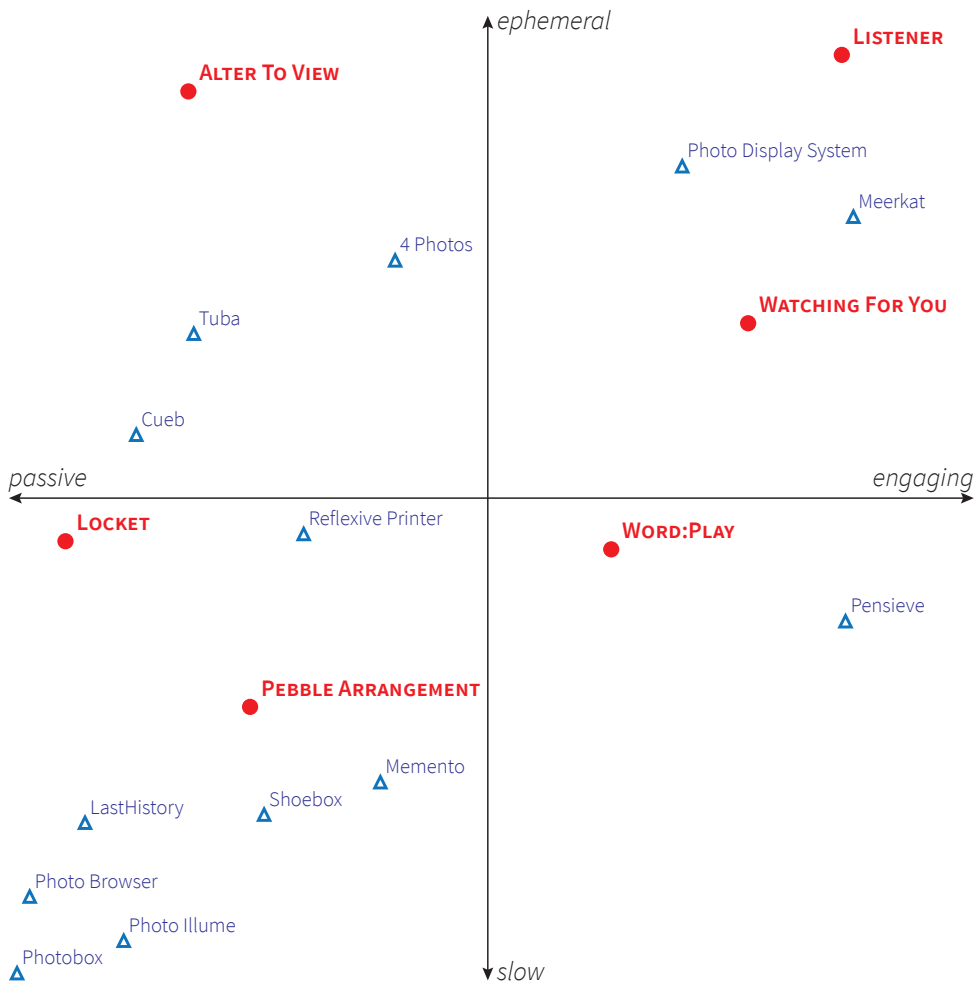


Figure 7.5. Two-dimensional design space that places the six designs discussed in this chapter (red dots) in relation to prior work (blue triangles).

have been included for comparison. Photo Browser (van den Hoven & Eggen, 2003) and Shoebox (Banks & Sellen, 2009) represent 'making the digital present,' Memento (Niemantsverdriet & Versteeg, 2016) and LastHistory (Baur et al., 2010) do the same for the 'exploration of media' category, 4 Photos (O'Hara et al., 2012) and Cueb (Golsteijn & van den Hoven, 2013) for 'social uses of displays,' and Photo Illume (Taylor et al., 2007) for 'passage of time.' The fifth category ('challenging expectations') is most closely related, so five designs were mapped in Figure 7.5: Meerkat and Tuba (Helmes et al., 2011), Photo Display System (Leong et al., 2011), Photobox (Odom et al., 2014), Reflexive Printer (Tsai et al., 2014), and Pensieve (Cosley et al., 2012). Further details on these designs are available in Chapter 6 and Appendix 6.1.

7.4.2 Design concepts

Below, each concept is briefly described along with motivations for inclusion and fit in the design space. These seven designs together represent a diverse range of qualities and were developed to emphasise qualities of interest (such as the ability to initiate photo viewing interactions and reminiscing).

Listener

Listener taps into ongoing conversations and aims to display photos on its circular screen that fits with the speech. Thus, this concept (shown in Figure 7.6) is reactive to its social environment and responds with (hopefully) relevant visual media. As such, it does not interfere with any conversation but merely tries to enhance it. It would also respond if directly spoken to without a conversation partner. The visuals stream outward from the middle (where its microphone is located), resembling waves or tree rings (particularly at the outer edges of the display). The Listener could be used as a tabletop display, hung on a wall, or propped up with a stand like a photo frame. This concept represents a combination of low user control with a system that aims to engage with conversations it listens in on. Personal photos pass by in relatively quick succession. It would be interesting to see how people respond to such exposition, whether they are willing to incorporate this into their conversation, or whether they are keen to explore the device in its own right as it represents a novel window into their personal photo collection.

Wearable Locket

This wearable mini-photo display (Figure 7.7) shows personal media in a very public manner. Similar to jewellery, its use of personal media may reflect on the image one tries to create in the eyes of others. The locket would randomly show an image from one's collection, although it may perhaps be limited to a set of predetermined favourites. It cycles through the images every half an hour to avoid overly fast changes that could distract or leave the wearer without opportunity to evaluate the displayed photos, as it may often be out of view. While this locket is conceptually not very novel, the way it

pushes exposure to personal photos so publicly is. It would be interesting to see how people respond to having to wear this, or from another perspective, respond to someone else wearing this. Which images are deemed (in)appropriate? Another motivation for its inclusion is the fact that the locket is one of a few ideas for non-stationary interactive systems. This sets the concept apart from others and may yield insights into (ill-)fitting situations and places for such systems.

Pebble Arrangement

A square 3x3 grid of personal images with three pebbles on some of the positions, this concept is a passive image viewer (shown in Figure 7.8). Alternate positions of the pebbles cause an alternative set of images to be shown, the pebbles functioning as a physical key. It is possible to choose which images are shown for a particular arrangement. This allows someone to have a set of images at the ready without that collection being obvious to others. This idea stems from an idea for a 'memory first aid kit,' which reflects participants' comments from the first study (Chapter 4) to use certain memorabilia as signifiers of positive personal attributes. These memorabilia may lift one's spirit but need not be in view all the time. While this system is meant to be a passive, decorative element that normally would not attract much attention, it represents the desire to have access to predefined collections. As such, it nicely fills out the bottom-left quadrant of Figure 7.5 (Passive/Slow) and translates findings from the first study into a design concept. The curved shape of the display reflects our intention for Pebble Arrangement to be an interesting thing without actively calling attention to itself.

Word:Play

To be placed in someone's living room or kitchen, Word:Play is a concept stemming from studies that show people may be better helped by ambiguous memory cues to stimulate serendipitous reminiscing (e.g., Hallford & Mellor, 2015). This display shows words in pairs (as shown in Figure 7.9). It does so in the hope these words are evocative, either by themselves or through their combination (in similar vein to forced relationships in idea generation techniques (De Bono, 1993)). If personal photos are shown on the display, this is used as a background behind the words. In addition, the photos are blurred to keep people one step from directly interpreting the image and related memories. Similar to the Augmented Photos by Gldenpfennig and Fitzpatrick (2011), obfuscation may stimulate alternative considerations when viewing the images. When people draw closer to the display, this may reveal the underlying images by reducing the applied blurring effect. This offers some means of interaction and perhaps relief from the question of what the device depicts. Prior work in cognitive psychology suggests that rather than exposing concrete, clear cues of one's past (e.g., personal photos), people may read more into less concrete and yet more evocative cues (as we discussed in §3.5). In addition, presenting cues as questions to frame one's past can be beneficial for reflection and sense making.



Figure 7.6. Listener showcases personal photos in response to ongoing conversational speech (on the left the mock-up, on the right its animated version).



Figure 7.7. A wearable Locket functions as a mini-photo display (on the left the mock-up, on the right its animated version).

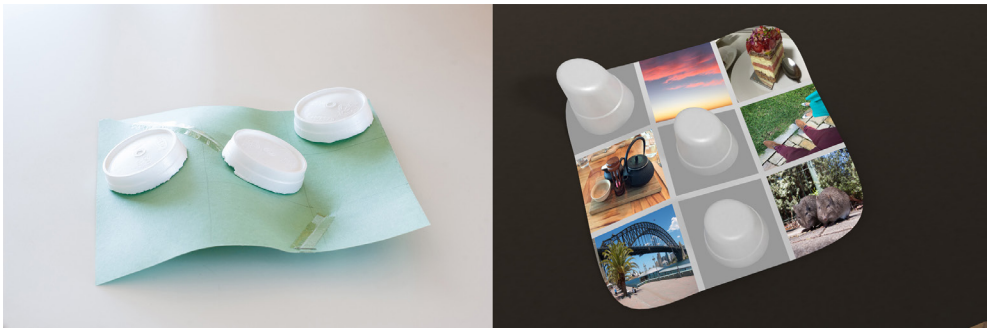


Figure 7.8. Pebble Arrangement offers the concurrent display of small sets of photos, where the arrangement of the tangible pebbles determines which photos are shown (on the left the mock-up, on the right its animated version).

This concept builds on such work by introducing ambiguity and preferring evocation over showing clear photos. In addition, the concept represents a balance between initiating through evocative words and leaving things open for people seeing those words. It fits

nically in the middle of the quadrants in Figure 7.5. There is an ability to interact more directly by coming up close, so it would be of interest to see how people interpret this behaviour and whether they see value in this.

Alter To View

Originally labelled ‘destroy to view,’ this device expects its user to give up something. Viewing an image comes at the cost of not being able to see this image again for some time. Rather than physical destruction, the ‘death’ of an image after viewing comes through its random replacement with another image. It is however possible to select the next image using the interface of the central display (see Figure 7.10). This way, one person can set up images for another person to enjoy as a surprise. How exactly people will derive value from this concept is therefore left open. In contrast to other concepts, *Alter To View* goes against the grain of ubiquitous availability of personal media: at least in normal use, it does not allow for browsing and exploration of content in the traditional sense, as images cannot be seen for longer than a brief moment nor reviewed again unless chance strikes. Whether this is appreciated or not remains to be seen but it is expected to provoke a response in people. Therefore, in its play with agency over one’s personal media, this concept represents good potential for valuable insights.

Watching For You

Why watch all your photos when this device can do it for you? *Watching For You*’s camera-equipped head watches one’s photos and does so by displaying the photos onto its display area (Figure 7.11). This way, it is possible to watch along. New images are brought up once the current ones are watched in enough detail by the device. The split display offers some interaction opportunities as the two images represent a possible choice. The head can move slightly: someone can nudge the device to watch one image more closely than the other by moving the head. Alternatively, this could be accomplished by the use of an onscreen widget that can be dragged to the left or the right. This widget may also offer the possibility of asking some provoking question regarding the images shown. Previous studies have shown that framing one’s reminiscing towards a particular goal can be beneficial (Hallford & Mellor, 2015). Despite minding its own business, it is expected that this concept invokes curiosity. If it is possible to acknowledge a secondary watcher’s presence (that is, someone checking in on the device), this system could potentially lead to reflection on one’s personal media consumption habits. Attempts to engage in additional interactions by offering split-screen choices may further enable this device to get people to think about what they ‘watch along’ with. Depending on one’s desire to interact with it, this concept may be considered engaging or rather passive.

7.5 Evaluation method

We were keen to see what feedback on our designs could tell us about the dimensions of



Figure 7.9. *Word:Play* features a dual-photo display, overlaid with random words, in an attempt for people to consider new connections between what is shown (on the left the mock-up, on the right its animated version).



Figure 7.10. *Alter To View* only reveals personal photos after one of its five screens is tapped. People can pre-set which photos will be shown on the next use (on the left the mock-up, on the right its animated version).

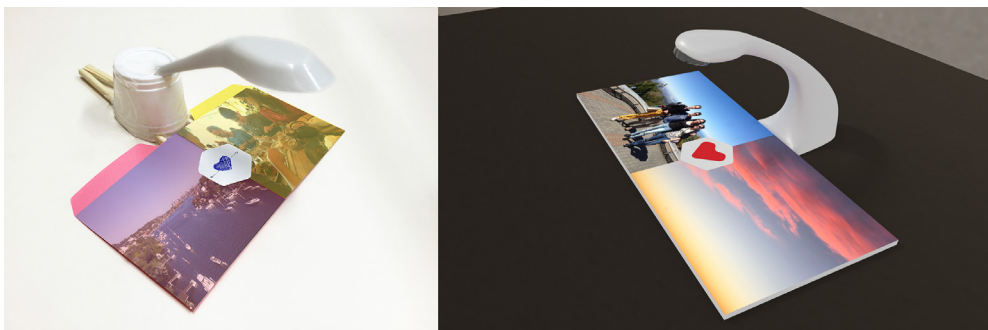


Figure 7.11. *Watching For You* is a robot-camera that watches personal collections two photos at a time (on the left the mock-up, on the right its animated version). It may learn preferences through input from its owners.

agency and time that we seek to explore. To that end, we decided to evaluate the designs through interviews. Interviewees would be shown paper mock-ups and brief videos that serve to inspire discussion. In turn, interviewees would comment on and compare the designs to yield us insights on how well these ideas fit with their desire to review their personal photos and general attitudes towards their personal media. These interviews would thus also shed light on the desired experiences of our participants.

Our methodological approach draws from well-established interaction design research practices on the use of probes and mock-ups in interviews. These probes help to elicit discussion about issues that are otherwise more difficult to envision and reflect on (e.g., Boehner, Vertesi, Sengers, & Dourish, 2007; Mattelmäki, 2006; Tsai, Orth, & van den Hoven, 2017). Mock-ups make the ideas concrete enough for participants to imagine themselves using and interacting with them, without actually being able to. Although some caveats apply when asking people what they would do instead of observing what they actually do, this step is still valuable early in a design process to reveal which directions are more interesting and worthwhile to pursue. It also allows the discussion of ideas that are interesting but are otherwise very niche or technologically complicated.

7.5.1 Participants

Eleven adults participated in the study. They were recruited via personal networks and university notices, via social network posts, emails, in person, and through snowballing. Participants were told the purpose of the study was to learn from their feedback and perspectives towards the design ideas presented to them. To make sure participants would find these ideas relevant, we ensured that respondents were familiar with and active users of digital photos and cameras. All respondents were included to maximise diversity, and they received a small token of appreciation. Participants were aged 21 to 44 ($M=31$ years, $SD=7$), seven were female (60%), and most were affiliated to the University of Technology Sydney as students or staff. All participants were native English speakers or had comparable to native language skills.

7.5.2 Materials

The designs introduced in the previous section were brought into the interviews. These designs were represented through A4 cards with the visual material shown in the figures above, paper mock-ups, and short video clips. We intended to elicit frank commentary on the ideas underlying the designs rather than their appearance. Thus, the mock-ups are relatively simple in appearance and finish to highlight these are not finished designs and can be readily critiqued. Because the designs rely on interactivity, we made it possible to manipulate the mock-ups. For example, several mock-ups feature bull clips that can be used to attach, detach, and move printed images around. These features were used when explaining the designs. However, for a better and more consistent illustration of

interactive aspects, we relied on animations for each design (see Figure 7.12 and Appendix 7.3). These animations employ a semi-realistic style and were animated and exported to roughly thirty-second videos. Such videos allow us to demonstrate and explore potential users' responses to our proposed systems without the need to make these functional otherwise (e.g., Mancini et al., 2010; Markopoulos, 2016; Ylirisku & Buur, 2007). The videos were shown on a 13" laptop and are also [available online for review](#).

7.5.3 Procedure

Participants were invited for an interview held in a quiet space on campus which lasted up to one hour. The researcher asked participants for their consent (see Appendix 7.1 for the consent form) and introduced the topic, namely to discuss everyday practices of reminiscing and to get feedback on how the design ideas fit in. The interview elaborated on current practices before introducing the designs one by one. The order in which the six designs were discussed was randomised between participants as a particular design may

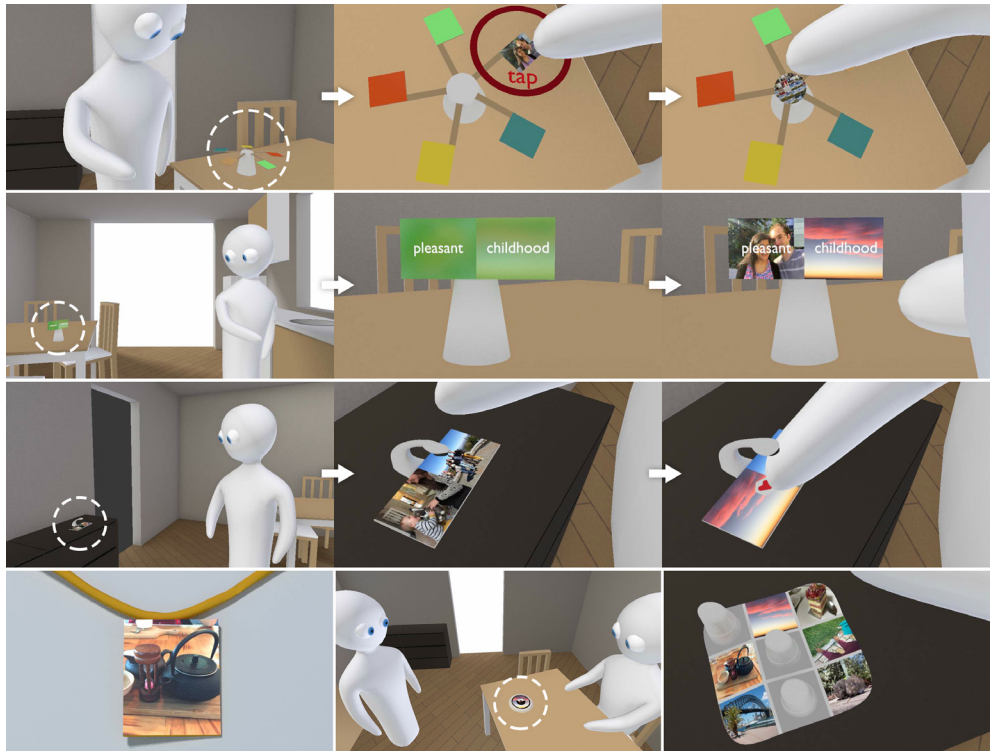


Figure 7.12. Stills from the short animations that illustrate the workings of the designs. From top to bottom: Alter To view, Word:Play, Watching For You, and the bottom row features three stills for Locket, Listener, and Pebble Arrangement. To aid visibility, designs have been circled in some stills.

anchor and influence any further discussion. Randomising the order minimises the effects across all interviews. During the interview, the designs were demonstrated through paper mock-ups and videos of how these designs are supposed to work. The mock-ups served as probes to spark discussion. Comments were elicited to understand how a participant imagined they might use such a device. After each design had been discussed individually, participants were asked to compare and contrast the designs. They were asked to rank the designs in order of their preference and explain their reasoning. Because of the nature of the discussion, the interview followed a semi-structured approach. Appendix 7.2 lists the structure and questions used. Interviews typically lasted for about one hour and were audio recorded.

7.5.4 Analysis

Interview recordings were transcribed before analysis. In a first pass, all relevant quotes were coded for the design they referred to, whether a remark was positive, negative, or spoke to issues of agency. In a second pass, quotes were clustered per design and interpreted into emergent themes (following qualitative thematic analysis principles (Braun & Clarke, 2006)). Both passes were performed by a single coder to ensure immersion into the data and the ideas underpinning the design concepts. This inductive coding led to data reduction as well as the ability to review recurring themes across interviews and designs. These themes were then discussed with others familiar with the work, reviewed, and where necessary, revised. The emergent views on these themes were used as the basis for developing our findings.

7.6 Findings

Our focus was on the potential of photo display designs to engage and deliver value by inspiring serendipitous reminiscing. Following our model, the designs differentiated themselves through the distribution of initiative and time. Our interviews oriented towards particulars of the designs and their fit with participants' desired ways of engaging with their personal collections. We also discussed to what extent it was reasonable for a design to access and display the entirety of their personal photo collections. This enabled us to talk about what is desirable and appropriate to bring up and under what conditions. This section explicates the emergent themes, which include (1) the choice and control over content and device behaviour, (2) the desire to enjoy viewing without the need to interact, (3) the designs' form and place and fit for purpose, and (4) the role of photos in relation to participants' reviewing and reminiscing practices.

7.6.1 Comparing the designs

Before moving towards the main themes, the ranking of the designs according to our participants' preferences provides a glimpse of their overall impressions. Figure 7.13 illustrates these rankings. Even with a small number of participants, the figure reflects

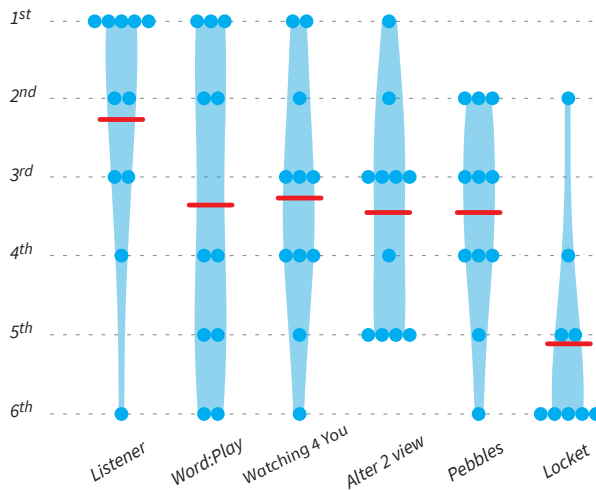


Figure 7.13. Ranking plot of preferences for the six designs. Red lines depict mean ranking order, with blue dots for individual scores, and the lighter blue shapes represent probability density estimations for each design (akin to a violin plot).

the mostly positive views on the Listener design and the mostly negative views on Locket. Other designs are less differentiated on average.

7.6.2 Initiative and control

Revealing personal photos is the first facet we pay attention to, using Locket as an example. Locket displays photos for everyone in the vicinity to see, which led participants to consider it a breach of personal space. Leaving them exposed and likely being made too self-conscious for comfort was exacerbated by the public orientation of the device. While others could see what photo is on display, the wearer of Locket may not. Some participants felt that by wearing Locket, their personal photos would become part of their public appearance. However, they would not be able to manage these photos put onto display. Thus, in coupling this display with traditional means of dress and appearance, it was perceived as highly personal but without the ability to exert control. Relinquishing this kind of control would need to be compensated by benefits that for Locket, participants were hard-pressed to identify. To make the idea work, images put on the device for random rotation would need to face scrutiny beforehand:

“I don’t want strangers to see my photos. (...) When you wear certain clothes, you choose them. They are a reflection of who you are but they are not really revealing [something] about you that is intimate. (...) I guess that photos could work in that way. It’s a form of accessory for others who would not mind for strangers look at that.” (P6).

What the comments on Locket emphasise is that picking from a large collection of photos

is a mismatch when viewership is uncertain. Any imagery shown is likely to reflect on the wearer, who needs to be comfortable with being 'revealed' in this way and not knowing what others may look at.

Listener provides an interesting contrast with Locket. Its ranking shown in Figure 7.13, together with interview commentary, hints that people were intrigued. For this design, the revealing of personal photos in itself was considered far less problematic. First, participants expressed more comfort with the display of their photos in their home presumably to people they know well enough to invite them over. Second, any photos shown were assumed to have relevance. Listener's operation, while without explicit input from those having a conversation nearby, is assumed to derive from the content of this conversation. The resultant stream of photos can be directed in ways that a purely random photo display cannot be. The latter also offers the potential for voice-directed search functionality, which may explain part of the appeal for some participants. This appeal is however not universal. Most participants were sceptical about the potential of the device to distract from a conversation:

"[it] can change the interactions I am having and focus on the device. I'm really against people using phones when I am with them (...) I think that is rude and distracts from the conversation. The conversation is a momentum thing and when something distracts from it, I don't like it," (P3).

To provide a visual companion to a conversation, Listener would need to be present at least in the periphery of attention, where it may capture and divert attention. For this reason, the design appeared unsuitable for more serious kinds of conversation or instances where social relations between conversation partners and any people shown on photos preclude their display. For example, *"if you have friends that have broken up, but you are still friends with both of them (...) You have photos of both sides, and when someone comes over, obviously you don't want photos of the other friend [to appear]," (P2).* In those situations, participants preferred a way for the device to stop listening in.

The design of Word:Play addressed the ability to interact with its photo display at will. Otherwise, images remained blurred. This behaviour was received well by some interviewees, who noted it adds a teasing facet in the way it related to passers-by. Another aspect, the use of two photos side by side and the overlay of randomly selected words in an attempt at inspiring new connections, fared not as well in our participants' opinions. Although this dual display led to questions on its supposed benefits, some saw the appeal in the ability to bring together photos from a similar event or the same people across different events or ages: *"It would show random photos, I am not sure about that... I would find it weird because they don't relate. (...) The words are annoying to me," (P8).* The addition of

words was universally disliked. These words as directions for interpretation felt confusing and ultimately random, in the erratic sense of the word: *“If you could set that up to say ‘oh, this screen just put everything related to my childhood’ and you have a tiny tab of childhood, then it’s good. But words in the middle of the picture that do not relate to the picture, it doesn’t make sense to me.”* (P9).

7.6.3 Value of non-interactive enjoyment

The design of Word:Play withholds a clear and readily viewable image from someone unless they move closer, causing its image blurring effect to diminish. This effect may inspire curiosity to some, to others it proved divisive. By requiring an action first (that is, to move closer to the device), the design cannot let people enjoy its content passively. Depending on its location and the perceived difficulty of reaching closer, the initial appeal of Word:Play may fade quickly. For participants, the ability to view photos with the need for action from their side first appeared more valuable than Word:Play’s blurred default state.

Watching For You attempted to provoke interviewees’ ideas on viewership through its supposed use of a camera robot to watch on their behalf. Responses to this design were mixed but with little enthusiasm. There were a few practical remarks towards its form, as the camera head’s placement may obscure the view and the horizontal orientation of the display would preclude a view from afar. A few participants commented that the use of a camera robot may be ‘cute,’ but at the same time it appears vain to have a device ordained to watch your photos on your behalf: *“A bit funny, a bit spooky but a bit funny as well. But just a bit cute... and maybe a little bit vain as well.”* (P6). The inclusion of a camera proved controversial as participants questioned its necessity and its intrusiveness: *“Why would you have a camera connected to a device? Computer-wise it does not make sense,”* (P9). The idea of having a camera looking at personal things met resistance: *“My girlfriend and I trade photos of each other and store them on my computer. And I don’t want the device to be, say, displaying [those] photos. (...) I don’t think I would be comfortable with that,”* (P3). It brought up connotations of the home as a private space, invasions of privacy, and the often-negative connotations of robots in popular culture¹. What this design seemingly represents to some, in its perceived focus on robot first and the owner’s viewing pleasure second, is that it is antithetical to the personal enjoyment of watching photos. It would add little to their passive enjoyment unless it does more than endlessly watching photos. For instance, the design’s ability to learn about people’s preferences may allow someone to filter their collection on future occasions. If the device would allow for browsing and exploring through such filters, it may deliver additional value. However, its current form

¹We presume negative views towards robots apply especially to one-eyed varieties: *“I’m afraid I can’t decide between these photos, Dave”* (future quote for our design, once it becomes self-aware)

was considered inelegant because ‘training’ the device would require sitting and standing with the device for some time.

The designs discussed so far suggest that passive enjoyment through the peripheral display of photos provides a basic value. Additional interactions would ‘layer’ on top to inspire surprise, discussion, or new interpretations. Alter To View is a case in point where this approach was not adhered to, instead relying on the element of surprise alone. Most of the participants did not believe this approach was desirable, citing its configuration with five small displays mounted on arms as confusing. Several participants sought to find appeal in imagined use with partners or friends for special occasions; However, its use to deliver a surprise seems a task better left to a less complicated setup. Outside of these presumed use cases, the design leaves little to show or draw participants in: *“There is nothing to catch my attention in this one. So, I don’t know whether I would really play with or that it will stay at the corner of a table or desk,”* (P10) and *“Often, you buy these things and they are cool for three months, and then after that you just forget about them. Unless it was often showing photos that I had forgotten about, I would prefer to have an image there all the time,”* (P4). Its central design element required someone to touch a display first to reveal an unexpected photo, only for that photo to vanish soon after. Participants felt this would be an unsatisfying outcome. Also, randomness as a guiding principle behind each ‘reveal’ stands in the way of a more directed mode of exploration, for example, if displays would show content related to another display.

Precisely the idea of sets shown together was driving the design of the Pebble Arrangement. This aspect appealed the strongest to participants: *“I like the idea that it collates pictures, like a story in one panel,”* (P2). Its form underlines its aims as a display piece, although the use of tangible pebbles felt unnecessary to many participants. Also, the idea that the device could be used to reveal valuable sets of photos through the positioning of pebbles did not resonate strongly. Nonetheless, exploring related photos seemed appealing, perhaps because the interactions are fairly low key: *“Oh, when I first saw it, I thought what’s the point of it. Why? But when I saw it in practice, it looks pretty cute and fun. (...) It is again very interactive, engaging, and fun. It’s like a toy. (...) It may be good for visitors other than yourself;”* (P6). Participants felt positive about the opportunity to browse and show collections. Although our initial design supposed that people would create these collections, participants interpreted the design as able to present them with relevant selections based on date, events, people, or specific locations. The ability to bring up such collections without much effort was appealing to participants, compared to the other designs that leave content decisions to chance (at least to a greater extent).

When touching on issues of control over what is shown through the Pebble Arrangement, most participants felt comfortable to adjust merely the current view. What did leave

participants in search of answers is how this design would know, learn, or be given the sets of photos, lest this turns to work to be done by them. Once more, comments on this design brought to the fore that participants expect most of their enjoyment to reside in viewing personal photos rather than extensive interactive exploration, at least where it concerns designs placed in similar situations as we did here.

7.6.4 Form and place

Participants envisioned the concepts to be situated near the kitchen, dining area, living room, or perhaps a hallway. In these spots, the designs would be best placed to be seen by all, such as family, friends, or visitors. While participants saw value in the viewing of personal photos through the use of (some of) the designs, the configuration and size of these design held back the ability to use them for this purpose. From a distance, a horizontal (flat) orientation would render it impossible to see what is displayed. Even if angled properly, the smallish size of most of the designs would not help to make clear what a photo depicts. For this reason, some suggested a display similar to A4 or even A3 paper in size (equivalent to 14" to 20" displays). One participant (P8) preferred to go even larger: *"It would have to be pretty big. I like large paintings and stuff on the wall so I would like it to be like that. (...) In my last place, I had lots of photos up. And not just ordinary size photos but I tend to blow them up bigger. (...) I have landscape photos and I don't feel like that they would work on such a scale."*

The Listener, with its distinctive round shape, seemed an attractive proposition shape-wise, albeit with the caveat that a centrally placed microphone would disrupt the ability to see a photo properly. Its placement close to where conversations take place does come with the risk that it may distract, as we highlighted earlier. For this reason, some participants suggested for the Listener to be hung against a wall like a clock.

7.6.5 Fit with reminiscing practices

Across the findings reported so far, there is an implicit assumption that participants were interested in adopting such a photo display. For several participants, the desire to revisit photos through the proposed designs proved unappealing. For example, P3 stated: *"I don't want to be desensitised of my own photos. And I think that's something that happens when you see it every day."* Other participants expressed this potential for overexposure less directly. Instead, they focused on the value they might derive compared to their current photo usage. The value of keeping photos on a phone, computer, or other means of storage resided in being able to refer back to such images when necessary or inspired to, for example by talking to a friend or some other instigating (often social) factor: *"It would not be an everyday thing that you will look through your photos. But perhaps... I have some family overseas and when you get email from them, they ask you a question and you are thinking of a past event. Then you look at those photos,"* (P9). This puts the photo

displays in an odd position. These designs speak less clearly towards established ways of reminiscing, at least for the people interviewed. The break with conventions of photo use provoked participants to anticipate the kind of value one may derive from having these designs around. For this reason, several participants suggested for the designs to allow exploration of related photos (as we discussed above), if not for the ability to casually come across and think back to some moments of the past without the need for complicated or dedicated ways of accessing domestic photo archives. The latter may limit current use: *“I would like to have more access to [family photos]. I think because they are on my husband’s computer (...) I never use his computer and he does not use mine, so I don’t see them. Occasionally we get them out. It becomes quite involving and interesting and it’s quite family time, but we don’t do that [often],”* (P7). Thus, it appears the unsolicited presentation of one’s personal photos can circumvent some of the barriers for current use of photographs for reminiscing. The designs that aligned with this benefit were regarded more positively (e.g., Listener, Pebble Arrangement) than those that did not (e.g., Alter To View) or the designs that evidently ran against the use of photographs to stimulate and cultivate (and perhaps curate) an idea of the self (e.g., Locket).

Thus, while participants had to tease out and find positive aspects, some of the negative aspects were more readily apparent. The random nature of displaying images without sensitivity to social fit prompted worries over how to avoid this: *“For example, I am dating a guy (...) We don’t want anyone to know about us. So if I start talking to you, or one of our common friends, and a picture of us shows up, I don’t want it to be seen,”* (P9). In principle, looking at such pictures would not be unpleasant, yet it may well be in social situations that naturally arise in everyday life. In combination with the difficulty to predict and filter large collections, some designs fell short in catering to deal with this.

To summarise, our findings show that participants were interested in the proposed designs and use of personal photos. It should be noted that comments on the designs’ details were solicited, not a result of time spent with an interactive prototype. For instance, while one might rationally dispel the concerns about a device (Watching For You) watching personal photos via a camera (that are already known to the device), this shows the value of the method in uncovering surprising and tacit attitudes. Most participants could imagine how the casual display of their photo collection in everyday life may inspire them to give attention to these photos and perhaps reminisce about the depicted events. For this reason, the interviewees preferred the designs to indeed show photos without the need for an initial (and perhaps unnecessary) action from their side. We also explored concerns regarding improper exposure, not just to participants themselves and their immediate family, but more so towards others. Across the various aspects of the designs that were discussed, the need for control stands out. This implies that curation of personal media is a vital component for the success of serendipitous photo displays, as we shall

touch upon in the discussion.

7.7 Discussion

This chapter introduced a model to describe how remembering is facilitated through interactions with a distributed cognitive ecology that surrounds someone. The primary driver for this model was to make explicit in which ways interactions between a remembering individual and interactive photo displays play out. From there, we derived a design space and several design concepts that we used to elicit feedback. We consider the use of the model and subsequent design space successful for our ability to organise ideas. Throughout the eleven interviews, the design ideas were able to generate a sufficient amount of feedback that we seek to fit into the existing literature in this section. Additionally, suggestions for design and future work are laid out.

7.7.1 Limitations of the study

The use of design mock-ups to explain a range of ideas was helpful to provoke discussions with participants. The designs brought out a variety of comments, but less so when the proposed concepts were opposed to participants' ideas on remembering and personal photo practices. However, these use scenarios remain hypothetical and remain a step from actually interacting with such designs, and another step from having the device for a while. We surmise this is certainly the case for use that is non-interactive such as the mere viewing of photos without using a design otherwise. It may have been difficult to anticipate this kind of value, as it would spontaneously arise from what a particular image brings to mind, or the combination of an image and someone's concurrent thoughts, rather than its functionality or a value proposition driven by use (cf. Petrelli et al., 2013). However, there are arguments to support the idea that early prototypes and videos can generate information similar to that of field trials. For instance, Dadlani, Sinitsyn, Fontijn, and Markopoulos (2010) identified comparable issues with video prototypes as they did with field-tested prototypes, suggesting the former is a valuable way to do evaluations ahead of the more involved latter method. Kjeldsov, Skov, Als, and Høegh (2004) came to similar conclusions for the use of mobile interactive systems, provided the lab-based evaluation recreates the use context to some extent.

To help participants imagine the intangible aspects, our descriptions and videos prescribed certain ways of interacting and placing the device in the home. While this was necessary to get the ideas across, it may subtly influence responses. However, by making clear what kind of situations a design aims for, we were able to set the scene and allow participants to respond to these hypothetical scenarios. Doing so enabled the discussions to touch on where the value of a particular design may be and its fit (or lack therefore) with (social) situations and locations.

Because the physical mock-ups and video animations were introduced together (and both depended on verbal explanation by the interviewer), we cannot comment on how each of these influenced participants' responses and which one provoked a stronger response. Still, while the videos could show the proposed design in action, the mock-ups remained present during the interview with the participant such that its appearance was a useful stimulant to the discussion. It also allowed participants to consider and refer back to designs discussed earlier. However, without the videos, we believe the ideas behind the mock-ups may have remained too abstract for fruitful discourse.

7.7.2 Reflections on the model

The model of contextual remembering explicated at the start of this chapter (Figure 7.1) served to clarify the position of interactions with the environment – in particular for things that may cue memories – such that important dimensions of this interactivity could be defined. In turn, these dimensions provided a good starting point for our design explorations. Our intention for the model was indeed to guide design, not to make empirical predictions. Nonetheless, the way participants expressed themselves did align reasonably well with the main elements of the model. An inspection of the data confirmed that personal values (*self*), the past (*memory*), and imagined and desired *experiences* were relevant in the context of *remembering* with or without the proposed designs. Imagined and desired experiences were some of the most frequent comments we received, as was the (un)willingness to reminisce in certain situations. The latter aspect makes a connection with the (desire for) *reliving* category of responses we identified in Chapter 5.

We were most interested in how the interactivity of the designs would affect and fit in with desired experiences. In our design space, we broke this down along the lines of temporality (i.e., ephemeral versus longer-lived) and agency (i.e., taking initiative versus being more passive). It proved the notion of *time* was hard to study via imagined use, as the temporal aspects are hard to infer one's response to. Where our discussions turned towards time, comments often took more towards engagement and the distribution of initiative between device and user over time. Thus, there certainly is room to explore this further through alternative means.

Agency, in various forms, was often at the forefront of our discussions. This element was typically put in the context of participants' current practices. Several designs implied for someone to relinquish control, the interaction with which then comes to rely on trust and transparency in its operation (cf. Schmidt & Herrmann, 2017). For example, the oblique ways in which *Watching For You* uses its camera was at odds with the idea of the home as a private space. Those designs that opted for a more a dialogic approach, as exemplified in *Listener*, fared better in participants' opinions because at each step, a device-initiated action is in response to one's actions. Nonetheless, the flow of personal photos dished up

by Listener remains unpredictable and a potential source of uneasiness and distractions. An ability to shift control was deemed desirable. What remains open for future study is the element of surprise, which might be appreciable and important for people's impressions but is difficult to anticipate in this study's setting.

Clarity was primarily featured as a way of direction (or withholding attention). For example, *Word:Play* in particular incorporated ambiguous characteristics in its display of photos by withholding detail until someone were to move closer. Participants were divided on this aspect, both in terms of its perceived value and the interpretation of their future response to such behaviour by an interactive system. Because participants were unsure about their position on clarity, was the least clearly distinguished element in the model if going by our data. However, this uncertainty may reflect a lack of familiarity and, depending on participants' disposition, a source of curiosity. Thus, based on the comments and our earlier interpretation, clarity still represents a distinct aspect for design to support serendipitous reminiscing.

Notably, participants would speak about the designs in their living environments in terms of what they would give attention to or have their attention be attracted to. One could indeed see overlap with well-known theories of attention (cf. Norman, 1976), which assume some signal (e.g., a photo on display) would be able to 'punch' ahead of competitive percepts through its salience (e.g., physical or interactive features, or in tune with what is on one's mind). It then becomes part of someone's conscious awareness. Distributed cognition assumes all contributing elements can take on some cognitive work. We aligned our model with the latter and framed context as the dynamic means for selecting what is included within the active ecology. Something not given attention to equates to it not being relevant to someone's current appraisal of a situation and their immediate goals.

7.7.3 Reflections on the design concepts

The design concepts each represent specific spots in the design space of agency and time that was illustrated in Figure 7.5. The Listener, for example, represents a highly ephemeral concept that through its display of photos relevant to a conversation attempts to engage the person watching its display. On the opposite end of the spectrum sits Pebble Arrangement, which does not call attention to itself. Instead, it lets a user take the initiative to change the position of its pebbles (and with that, the set of photos shown). *Word:Play* occupied a more central position, although its use of words on top of blurred photographs proved anything but middle-of-the-road with participants, who questioned the value of these words to inspire their thinking and reminiscing.

Our findings indicated that participants were not very enthusiastic about the design

elements we put forward. To some extent, as mentioned above, this may be due to difficulties imagining how the photo displays could be valued assets. Several participants also indicated not to be so keen to put their personal photos on prominent display. The more overt designs were then considered demanding of attention (of themselves, others in the household, and potentially, visitors), with which participants were ill at ease at home. In this regard, it is interesting that a design like Listener was received better than Locket and Alter To View, despite all three being reliant on a random, out-of-user-control process. While this preference was not universal, it does suggest Listener could be valued in ways that the other designs are not. This value could be the (possible tangential) connection of its media with a conversation, or because it is placed closer to where such a conversation is taking place. Similar to Cueb (Golsteijn & van den Hoven, 2013), CaraClock (Uriu et al., 2009), and 4 Photos (O'Hara et al., 2012), this design might provide value in a social context.

Our initial framing of agency as a dimension between engaging and interactive on the one hand and more passive or responsive behaviour of systems on the other hand, seems off. Locket, as we positioned it in Figure 7.5, ought to be passive. Yet, our participants' interpretation is that Locket takes the initiative to show photos to the world without the ability for users to intervention or provide a means for quality control of the photos put on display. Thus, our framing (and by extent the model) would be better served if it reflects agency not just as the distribution of initiative between user and device, but also as initiative towards others not directly interacted with (for example, random passersby who get to look at photos on Locket). This framing validates the strong desire for control. By taking away control, we believe that participants may have felt their agency was reduced. Odom et al. (2014) observed similar initial displeasure of users of Photobox, who over time came to appreciate and anticipate the prints that their system would occasionally generate. Our designs operate on a faster timeframe but, crucially, do so in a more public place in everyday life (i.e., without a lid on top).

Agency could be woven into the designs if more attention is given to curation. Relatedly, it was also the perceived ability to organise and create collections of photos that attracted several of our participants to the Pebble Arrangement. Other designs such as Listener offered no means of control, but participants were quick to suggest possible ways in which they could gain control (e.g., by putting their hand over the microphone or covering the display). Once the overlaid words of Word:Play would be removed (because few were able to see their possible value), what is left is a design that allows someone to control exposure by varying their distance to the system. This particular aspect was considered intriguing but would need implementation to evaluate its effects in use. When designing Watching For You, we considered the horizontal orientation of the display a benefit for similar reasons. Unless someone would stand near to the device and be able to look at the

display, it would not make unnecessary demands on attention. However, as participants argued, this would also negate the ability to look upon the display from a distance. Without that level of engagement, there may be little value left.

What the above insights highlight is the complex interplay of the photo display, interactive behaviour, and agency to arrive at a design's perceived value. *Alter To View* serves as a case in point because it relied on people making the first step to reveal an image that would soon after disappear again. We considered this ephemeral display to be fun, but participants saw little value. This stands in contrast to the design of *Tuba* (Helmes et al., 2011), which required people to lift its display before it would reveal a random piece of personal media. Its evaluation showed people did appreciate the kind of surprise *Tuba* could give, sometimes leaving its display open to keep the media on. *Story Shell* (Moncur et al., 2015) also relied on touch before it would play its audio recordings. Given the possibly rueful memories *Story Shell* may elicit, the decision to require explicit action made sense. It appears when the content is more mundane or otherwise not sensitive, the value resides in showing photos, not in how these photos are hidden.

Helmes et al.'s (2011) other design, *Meerkat*, got mixed evaluations because it seemingly attracted attention but gave little benefit to the users beyond the small photos it showed. *The Listener* may be able to put a more positive spin on this by making itself relevant to social use. However, *Watching For You* (which comes closest conceptually to *Meerkat*) received equally mixed reception. In particular, the curatorial abilities of *Watching For You* received mixed responses. Its effectiveness was questioned; in particular, the need to put in a considerable effort for an uncertain payoff. Despite this, the idea that the system would learn and over time show preferred photos was seen as compelling. Most related work does not combine simple curatorial abilities with the randomised display of personal media, besides abilities to move on to something else (e.g., *Photo Display System* (Leong et al., 2011) incorporated a kind of dice roll).

While there is evidence to reason that the occasional display of one's preferred media can lead to positive outcomes, it is likely that the connection to (serendipitous) reminiscing depends on people's disposition to do so. From there, it may also be the case that those interested in using their photos this way feel that (some of) the design would enable them to do so. As the evaluation of *Pensieve* (Cosley et al., 2012) showed, practices around reminiscing in everyday life did not significantly change due to the system's introduction. Rather, it supported those already inclined to reflect and reminisce.

7.7.4 Suggestions for the design of photo displays

Besides the particulars of the designs, our interviews also discussed reminiscing practices and the role of personal photos in everyday life. The six conceptual designs were used to

stimulate the discussion and find out how technology may support these practices. From our interpretation of the findings several clear suggestions emerge for the design of photo displays that aim to stimulate serendipitous reminiscing.

Provide a basic viewing experience

The viewing of personal photos is often a casual affair that arises from the spontaneous encounter with an image, an event to come to mind, or another cue. In our discussions, those designs that relied on hiding photos until interacted with were reviewed negatively. *Alter To View*, for example, faltered as it was deemed of little value unless explicitly sought out. Instead, a photo display that would offer something to be seen is able to provide a basic value for a viewer. This offers something for the mind to latch onto in the (common) absence of the desire to interact in more explicit ways. In case undesired material would come up, a device may still offer the ability to suppress such materials from current and future viewership. In positive cases, interesting photos could instigate further exploration.

Explore relatedness

Rather than the purely random display of photos, there are underdeveloped opportunities in exploring relatedness between images. This relatedness, whether between the events, people, or certain items shown on photos, facilitates user-initiated exploring of their collections. That is, if an image attracts attention, people may want to follow that lead and browse and view related images. As our participants expressed, one such photo may be the starting point of a more user-driven exploration. Earlier work also observed this tendency to get side-tracked, especially in conversations (Hilliges & Kirk, 2009).

We imagine that a device may offer suggestions for further exploration, perhaps in similar vein to how online platforms recommend other videos to watch, articles to read, etc. To support this kind of use, it would be beneficial for technology to understand what makes an image connect to another. The technology required to obtain a higher level of understanding of the content in a set of photos and potential connections between them is certainly a challenge. If used for the concurrent display of multiple photos, more related images could make a stronger, more meaningful connection together. This idea was the premise behind *CaraClock* (Uriu et al., 2009), which used timestamps and relational knowledge between people depicted on photos to direct its display of photos. In its modest evaluation, the findings suggested the potential value of this approach. Compare this with playing music on shuffle, where serendipity arises from happy coincidences between two otherwise unrelated songs as one is followed by the other (Leong et al., 2012). It would be of interest to investigate further how coincidence and relatedness play out for personal photo displays.

Flexibility to adapt

Photo viewing is often a pleasant activity, but not always fitting for all situations. A device that would continue to display personal materials, blind to its context, may well be inappropriate. Therefore, it would be helpful to consider in the design of such devices the flexibility to adapt to different situations. In its simplest form, a device may offer to limit or dim the display of photos, for example by going 'dark' for a given amount of time. In the case of Listener, holding one's hand over the microphone/display for some time could trigger the device to stop listening for an hour. Pebble Arrangement catered naturally to this idea by offering a multitude of different arrangements. A more advanced solution would have a device remain operational but instead filter out certain photos. Ideally, the latter is done in such a way that it may anticipate the changes in appropriateness based on time or other sensibilities.

In our interviews, we touched on the issue of connecting a display in the home to someone's entire collection of photos. This angle was a proxy for the appropriateness of using a rather large and often 'unsanitised' collection. The flexibility to acknowledge and cater to the presence of undesired material also warrants attention. If suitable curation does not take place ahead of time, it may have to be dealt with through in-the-moment curation, for example by excluding certain photos upon user input.

The suggested flexibility, if not offered through a user interface, may have to rely on rather advanced artificial intelligence to operate without intervention, which – as we hinted at in §4.5.2 – is unlikely to be perfect. Nonetheless, to stimulate remembering means to get it wrong sometimes and this provides the impetus to adapt gracefully.

Explore displays that show multiple photos

Several design concepts that we reviewed in Chapter 6 incorporated the ability to display more than one photo at a time. In our study, we noted positive comments on the ability of collages to combine several photos and tell a story together. Pebble Arrangement offered such an ability, which led to similar positive remarks for being able to see a collection of photos together (each offering context for adjacent ones). On the other hand, the effects of Watching For You's and Word:Play's dual-photo display remain inconclusive.

A design like Word:Play offered keywords and a dual-photo display to suggest new interpretations. Although our inspiration was work that suggested directed reminiscing may be beneficial (Hallford & Mellor, 2015), more so than just reliving the past, participants were sceptical. It may be that the directions offered go against one's own development of alternative perspectives on the past, which likely develop naturally over time (Frohlich et al., 2012). Alternatively, such displays pose no discernible benefit unless the images were connected in a meaningful way. In prior work, Meerkat

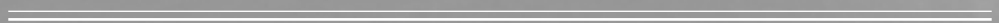
(Helmes et al., 2011) simultaneously offered three random photos, which did not drive deeper interpretation. Because there is potential to pursue interesting combinations, this remains of interest to study further. Future work could investigate what kind of combinations are of interest to pursue. This is content-dependent, which we could not address in this mock-up-based study.

7.8 Conclusions

In the previous chapter, we highlighted the varied ways in which interactivity was expressed and explored for the display of personal photos. In this chapter, the outlines of the connections between remembering and interactive photo displays were drawn clearer and filled in through the model we developed. This model was instrumental in moving forward with six conceptual designs. Using mock-ups and animations, we evaluated the fit of these designs with participants' desired reminiscing and photo use practices. The suggestions laid out in the previous section follow our insights, gained both during the development of the six designs and through subsequent feedback from our participants. Via our study, we sought to further develop in what ways interactivity mediates and supports reminiscing. This interactivity may work best if it is flexible, in tune with a more laid-back and casual approach to encountering one's photos, and when it offers the ability to explore these photos in more detail if so desired. We observed a preferred emphasis on non-interactive viewing preferences, such that the more convoluted concepts were considered less suitable (but still helpful to tease out these preferences).

The study presented here had several limitations, chiefly among them the hypothetical nature of the imagined desirability of seeing photos in the way our designs proposed. The frequency of use and other typical metrics for human-computer interaction do not fit well with the casual, perhaps hands-off approach we seek to investigate. These limitations are however not problematic because the work presented in this chapter is a first, divergent foray into our research-through-design approach. The study allowed us to narrow down and focus the design effort based on the early evaluations, which were sufficient for this goal. The design steps we made in this chapter were of a formative nature and helped us to shape the final prototype for which we seek to collect stronger evidence. In the following study, we take the newly found insights and move into people's homes to deepen our understanding of interactive photo displays and their fit with everyday practices of reminiscing.

Designing and evaluating Phototype



8.1 Introduction to this chapter

In this final results chapter, the design and evaluation of a novel photo display takes centre stage. Through deploying this prototype in the homes of people, we further our insights on designing to support everyday reminiscing. More precisely, this study allows us to consider how the display of one's photo collection on a novel device interacts with established practices and preferences around domestic photography.

The first step towards this study was set in Chapter 6 by surveying the status quo of comparable designs in the literature. From there, Chapter 7 built a theoretical basis and then developed and evaluated several conceptual designs. The insights gleaned from that evaluation provided a starting point for the prototype design discussed in this chapter. However, the previous study lacked external validity due to the conceptual nature of the concept prototypes. For the present study, we resolved this by constructing a working device that could be placed in the homes of participants. This study remains committed to the domestic environment in the vein of prior work, which thereby provides us with a frame of reference (per Chapter 6).

Through the deployment and evaluation of a prototype system, we aim to shed further light on the recommendations set out at the end of Chapter 7. We indicated the likely value of someone being able to see their photos without the explicit need for interaction with a device. The removal of typical barriers (such as photos being 'out of the way' of daily use or consideration) may prove beneficial and desirable, as indicated by a multitude of prior works (e.g., Heshmat et al., 2017; O'Hara et al., 2012; Zargham et al., 2015). This direction also builds on earlier studies involving 'glanceable displays' in the home. For example, studies on digital family calendars (Neustaedter, Brush, & Greenberg, 2007) and messaging systems (O'Hara et al., 2005) have shown that families value the ease with which they can walk by and glance at a display's content.

One of the design suggestions in Chapter 7 called for the exploration of multi-photo displays. Having multiple personal photos available for viewing at once may provide a better sense of connections between the photos and possibly interesting juxtapositions. Such connections – serendipitous or otherwise – are of interest because exploring personal media that are related could spark curiosity and provide positive experiences. A third consideration going into this study pertains to an ability for people to make their preferences known to a system such that an interactive system may adapt to these preferences. For this aspect, we also lean on earlier ideas on agency (as distributed between people and systems), such as embodied by the Watching For You concept. First discussed in §7.4.2, Watching For You allows people to adjust the head of a photo-browsing robot to steer it towards preferred photos. Finally, we considered the passage of time as another relevant parameter for the design of the prototype, especially if time

itself is a key determinant of the system's interactive behaviour. The latter also distributes control over the system away from people, such that the eventual system interactions remain (at least in part) less predictable. Thereby, this can possibly lead to serendipitous encounters (alike several designs reviewed in Chapter 6 (e.g., Cosley et al., 2012; Helmes et al., 2011; Leong et al., 2011; Odom et al., 2014)).

Similar to the other studies presented in this thesis, this study maintains a keen interest in people's remembering experience. Accordingly, this chapter lays out the implementation of a photo display prototype device that we named Phototype. We discuss the methodological particulars of the explorative study before turning to the findings. These findings make clear that while Phototype's interactive elements did not kindle all participants with great enthusiasm, the device was able to invoke reminiscing and bring a degree of joy to participants' experiences.

8.2 Implementing the prototype

We continued the design directions laid out in Chapter 7. More precisely, we opted to explore involuntary browsing as a means to inspire serendipity in unanticipated encounters. This kind of browsing, as we explained in §3.5 following the arguments of André et al. (2009) and De Bruijn and Spence (2008), concerns someone glancing at a thing (in this case, an interactive photo display) to intentionally or unintentionally get cued. Thus, the conceptual direction remains closest to the Watching For You and Word:Play designs discussed in the previous chapter as we shall discuss in this section.

Our initial plans called for the use of two prototypes, each of which would be deployed with participants for some time and then swapped with the other device to allow for comparisons post-deployment. Restrictions on both time and technical options called for the integration of two prototypes into one platform. Because the conceptual work at the basis of these prototypes (that is, the designs of Chapter 7) all used the display of visual material as their basis of operation, the design gravitated towards the use of a two-dimensional (LCD) display. To enable two interactive designs on the same platform, we used a relatively conventional design (see Figures 8.1 and 8.4). Phototype is characterised by its 7" touchscreen display, wrapped in a bright red casing. The prototype system included two modes, DualDisplay and PhotoSoup, which are further detailed below. The device switches between these modes roughly every 3.5 hours. This duration varies randomly by up to $\pm 25\%$ to avoid repeating the same pattern from day to day.

8.2.1 DualDisplay mode

This mode shows two photos side-by-side (see Figure 8.2). These photos get replaced every half a minute. Images shown on the left and right are not replaced together. Instead, the one image swaps around the halfway point of the other image's viewing time. When



Figure 8.1. The Phototype device, showing (in clockwise order) the DualDisplay mode, the PhotoSoup mode, its back, and placed on a dresser table.

someone moves closer to the device, a dividing line is revealed between the photos. When reaching even closer, a widget appears on top of the line. Using the touchscreen, someone may move the widget and with that, both images to the left or right. This widget provides a way to indicate a preference for one image over the other. If one image is moved near the edge of the display and the user lets go, this image gets replaced with another one. If no choice is made (i.e., the dividing line is not far enough to the edges when released), both images resetttle on their original position and the regular shuffle procedure continues. Swiping an image away in this manner constitutes ranking one over the other. Internally, this is represented by adjusting a rating for an image either up or down (by ± 0.2 each swipe, with 0 being neutral). While someone is interacting with two images, these do not get replaced until a brief moment of downtime has passed.

When a new image is required for display, this image will be chosen at random. However, its rating determines whether this choice is picked or declared invalid (requiring another random draw). The higher an image's rating, the higher the likelihood of this image getting used and shown onscreen. On average, an image with the highest possible rating of +1 has an 83% chance of being selected, whereas an image with the lowest rating of -1 has only a 17% chance (i.e., $0.5 \pm \frac{1}{3} \times \text{rating}$). Note that it would take a minimum of five swipes in favour or against an image to have it reach the maximum ratings. Also, images

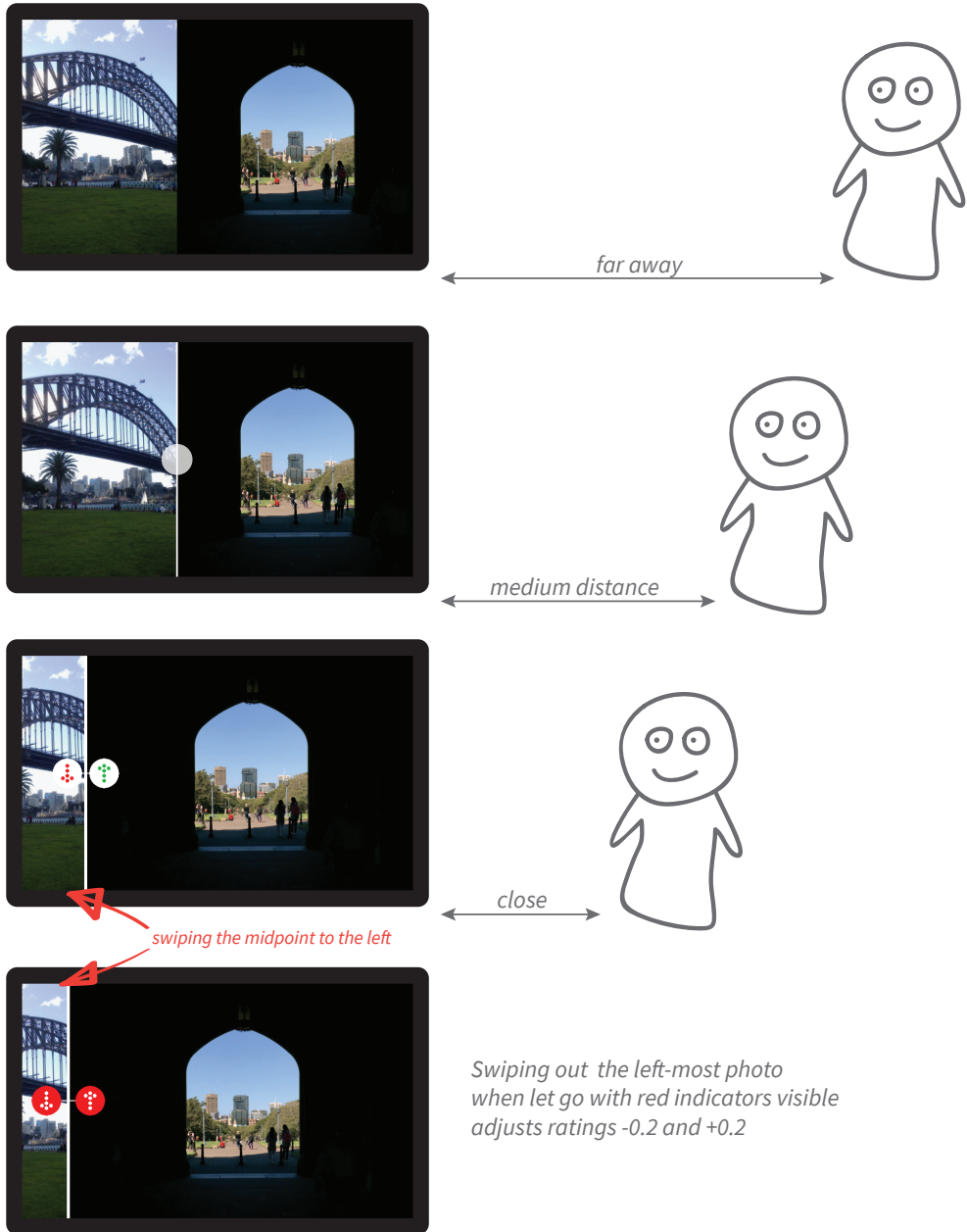


Figure 8.2. As people approach, DualDisplay reveals user interface elements to encourage interaction. When moving the middle line around using the touchscreen, cropped parts can be revealed and less preferred photos swiped away entirely. Note that even in the top image, the middle line is off-centre: this reflects the higher ratings of the right image over the left image, as the former is given more space by design.

shown recently are excluded and cannot be shown again until some time has passed.

DualDisplay is an amalgamation of several ideas. Most clearly, it builds on Watching For You introduced in Chapter 7. Compared to that concept, it omits the robotic camera and instead orients the display upward to allow for easier viewing from a distance. It retains the idea from Word:Play that someone moving in closer influences the content shown. Its expected appeal rests with the ability to make preferences known in a way that is both easy to learn and easy to do. By making the line appear when someone moves in closer (using the distance sensor), this person may be encouraged to come even closer and interact with DualDisplay. Over time (and given enough input through swiping) this mode should gravitate towards showing the preferred images in its collection without entirely leaving less desirable images in the dark. Based on anecdotal evidence obtained during development, this is indeed what happens over time. This approach assumes that preferences are relatively stable over time. While such stability is unlikely for a long period of time given the available research on attitude change (Petty & Briñol, 2010), for our timeframe of use (i.e., several weeks) this assumption may hold.

Recent work by a postgraduate student I helped supervise also considered the choice between two photos as a curatorial dilemma (Zürn et al., manuscript under preparation). In summary, people were reluctant to choose between two photos depicting others they cared about. For example, a choice between one's dog and one's boyfriend proved difficult as both represent meaningful relationships to them. However, in the case of DualDisplay, it is not necessary to choose. If left to its own, this mode simply continues to shuffle through and display a photo collection.

The display of two images together that are likely unrelated may sometimes create unexpected but interesting combinations. These kinds of emergent situations are at the heart of serendipitous encounters and may well prove attractive to people. Of interest is whether people pick up on such serendipitous cues and whether they indeed find interest in this. Based on the use of the Photo Display System, Leong et al. (2011) hinted at the possibilities in this direction.

8.2.2 PhotoSoup mode

The PhotoSoup mode derives its name from its visual appearance (see Figure 8.3). Personal photos are shown as circles floating around the screen, superficially resembling pasta in a bowl of soup. The movements are relatively slow, and the images tend to gravitate towards each other, without overlapping. If an image floats out of the screen, it gets replaced by another image. This ensures no images 'exist' off-screen and introduces a reasonable refresh rate. When someone approaches, images get slightly larger to make it easier to see them. However, the key feature of PhotoSoup is that every half an hour a new

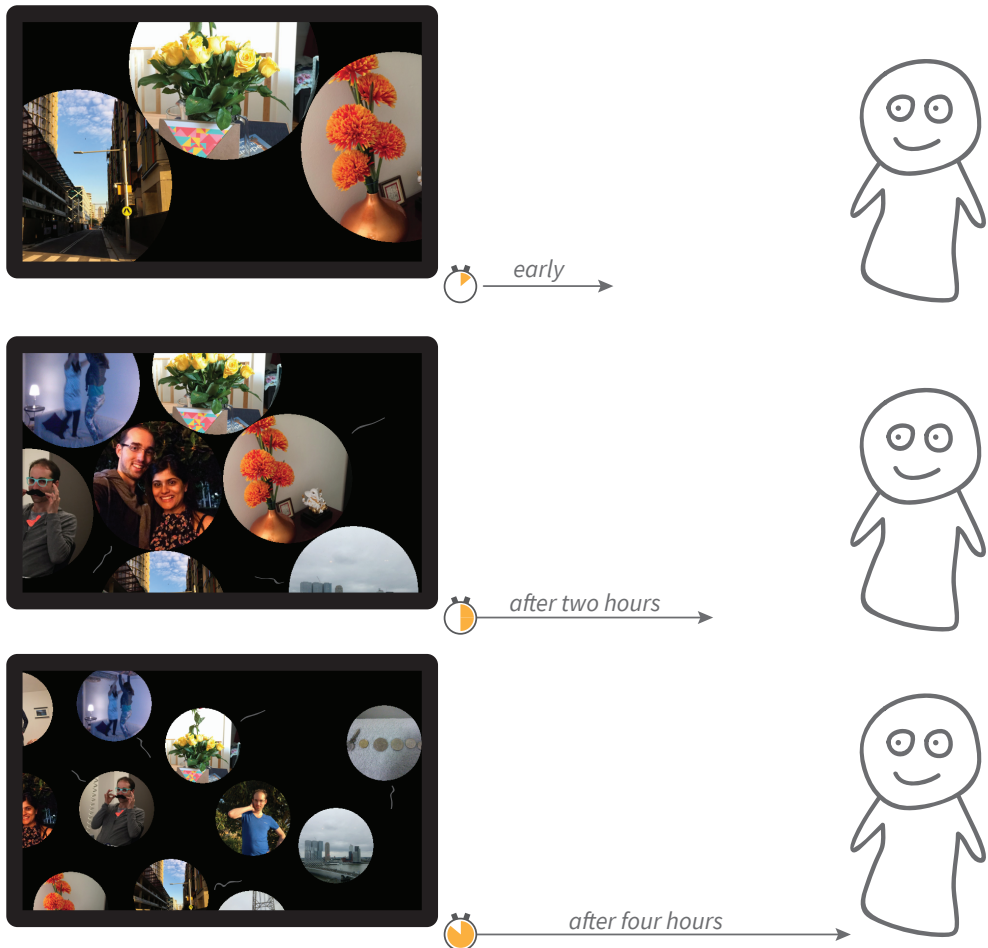


Figure 8.3. PhotoSoup has photos moving around, with a new image being added every half an hour. When someone moves closer to the device, images become larger to ease viewing (not depicted here).

image is added into the mix. This causes all images to shrink in size to make space for the new arrival. Given enough time and thus enough new images, the circles get rather small. Someone can go up to the display and drag and swipe circles out of the screen, which causes the remaining images to regain a larger size. The minimum number of images at any given time is two, with eleven being the maximum after which no new images are added. Swiping images away also influences their rating as with DualDisplay, although the rating is only adjusted by -0.1 . Remaining images see an increase in their rating equal to $+0.1$ divided by the number of images left. This ensures a proportional effect on ratings.

Key to the PhotoSoup mode is that it reduces the speed of interactions. The introduction

of new images is deliberately slow, such that the typical way to enjoy this mode is to let it play out over time. Alternatively, swiping away images until only two are left will introduce new images if the second last image is also swiped out. At that point, this mode behaves similarly to DualDisplay. Nonetheless, it makes a play for a more temporally elongated style of interaction. It certainly does not approach the temporal span of Photobox (Odom et al., 2014) or even Pensieve (Cosley et al., 2012), but it moves at a noticeably lower pace than most applications for viewing photo-collections of which we are aware. We opted for this design to incorporate both the aspect of time and the idea of relating to the device by moving towards or away from it. Without having to use the display, this natural way of relating to one's environment could be supported. Feedback received on the Word:Play concept introduced in Chapter 7 strengthen the idea that revealing photos as one moves closer could be an interesting area to explore. However, while PhotoSoup allows people to interact with the device without delay, it does delay gratification by not replenishing the image pool until time has passed. It was expected that this might prompt commentary from participants. Therefore, our aims with this mode were to explore if the above aspects are appreciated and whether these contribute positively or negatively to serendipitous encounters with personal photos in everyday life.

8.2.3 Form and materiality of Phototype

The design of Phototype followed its function closely, such that the casing traces a minimal outline over the components mounted behind the 7" multitouch display. This casing is made of 3D printed polyamide, polished and dyed a bright red so that the device stands out during its few weeks in someone's home. The open casing enabled airflow. A Raspberry Pi 3 computer powered the software written in Python. An ultrasonic distance sensor was mounted on top of the device to allow it to sense the proximity of people in front of the display, which drives some of the interactive behaviour outlined above. Appendix 8.3 covers additional technical details. All 3D models and source code are also open and available online².

Getting photos onto Phototype

A simple web-based interface was implemented to ease the process of getting photos from one's current storage medium onto the device. Once Phototype is connected to a home network via WiFi, one can log onto a webpage using any device and drag-and-drop images onto the webpage (as illustrated in Figure 8.5). This follows conventional mechanisms of other contemporary services where people may upload photos (e.g., Facebook, Dropbox, Google Drive). The device uses a simple web server to handle any uploads. In its current state, accessing the upload webpage requires a user to be aware of the device's IP-address

²Phototype source code and other technical details are available online via <https://github.com/dvangennip/Phototype>.

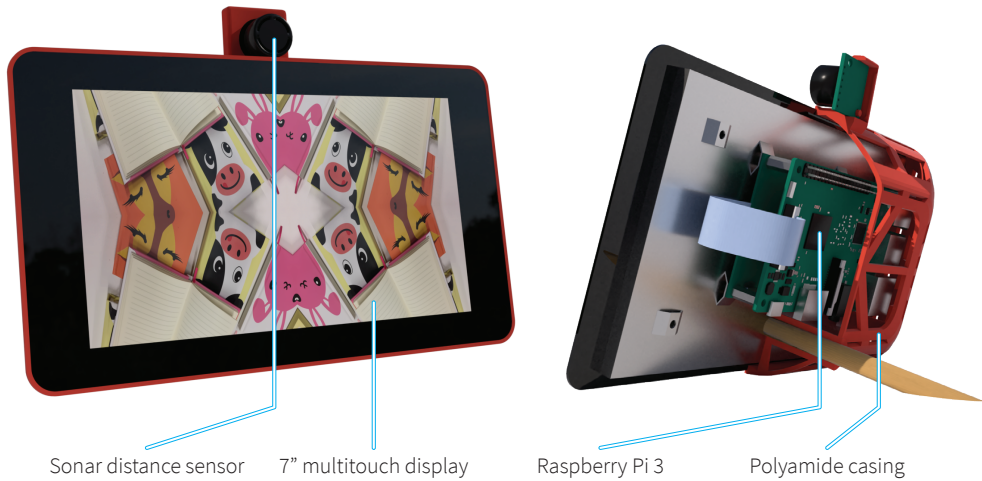


Figure 8.4. A technical overview of Phototype, identifying the main components.

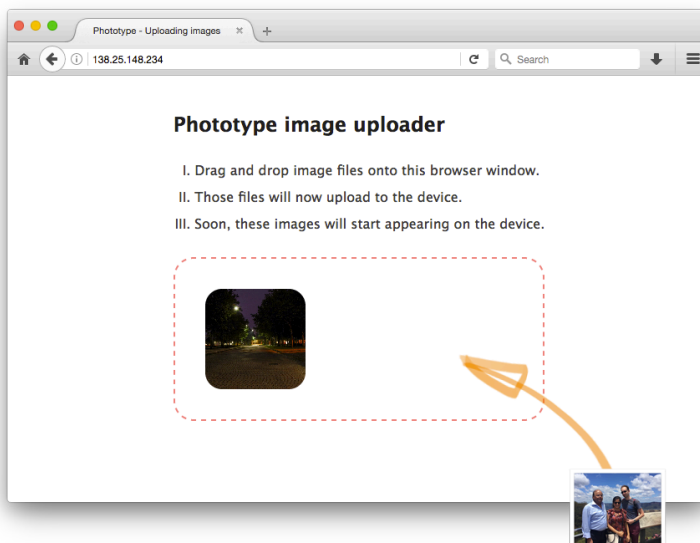


Figure 8.5. Screenshot of the web-based drag-and-drop interface used to upload photos onto the device.

within the network and to have the device that is uploading to be on the same network. This IP-address is shown on a status screen. Uploaded images are downsized to reduce storage needs and speed up their processing once available to the modes described above.

8.3 Deployment and study method

Phototype was deployed in the homes of eleven participants for a minimum of three weeks (see Table 8.1). While care was taken to make the device as reliable and user-

friendly as possible, it still is an experimental device. More precisely, it is a technology probe that aims to “*find out about the unknown (and) to hopefully return with useful or interesting data,*” (Hutchinson et al., 2003, p. 18). In this study, the unknown is how people will respond to the particulars of Phototype’s features and the place of digital photos in everyday life. The deployment period of three weeks was a compromise between the necessary commitment from participants’ (and their families) on the one hand and on the other, our desire to move past any novelty effects such that we may see if and how the device becomes embedded in daily practices. These considerations echo those of similar deployments (cf. Judge & Neustaedter, 2014).

8.3.1 Participants

Eleven adults participated in the study. They were recruited via personal networks and university notices, via social network posts, emails, in person, and through snowballing. Participants were told the purpose of the study would be to evaluate their views on and experiences with a prototype device placed in their home. In addition, we mentioned this device would display their photos. Because of the considerable time investment, we decided to give potential participants a reasonable amount of information to decide whether participation would suit them. The intention was to include all respondents to maximise diversity. Those eleven adults who invited us into their homes were aged 28 to 72 ($M=43$ years, $SD=13$), six were female (55%) (see also Table 8.1). All participants were native English speakers or had comparable to native English language skills. Educational levels were high with several having a PhD, a likely outcome of our method of acquiring participants. All participants received a small token of appreciation.

Table 8.1. Overview of participants, the number of photos kept on Phototype, and its location. The last line denotes mean values.

P#	Gender	Age	Household	Days	Photos	Location
1	F	49	2 adults, 1 child	21	641	Living room, on dresser
2	F	45	1 adult	29	189	Living room, on low table
3	M	31	1 adult	25	563	Studio room, on corner of desk
4	F	35	2 adults, 3 children	33	424	Kitchen, on top of water filter
5	F	54	2 adults	32	617	Living room / kitchen, on dresser
6	M	35	1 adult	29	422	Studio room, on corner of desk
7	M	29	2 adults	31	40	Living room, on table next to TV
8	M	28	1 adult	32	38	Studio room, on corner of desk
9	M	72	2 adults	21	390	Study room, on corner of desk
10	F	38	2 adults, 2 children	22	334	Hallway, on dresser
11	F	53	1 adult	28	23	Studio, on dresser next to desk
M	55% F	43	1.5 adult, 0.5 children	27.5	335	

8.3.2 Materials

Five Phototype devices were built, all completely identical. Thus, five participants could have a device at home in parallel with each other. This sped up data acquisition. All deployments took place between February and June 2017. Along with the Phototype device, participants were given a one-page manual explaining the primary functions of the device and practical information about the study (included in Appendix 8.2). A small diary was offered to keep notes if they desired to do so (Figure 8.6). These notes were meant as input for the interviews and were not recorded or discussed further.

8.3.3 Procedure

One researcher would meet with the participant at their home. During this first meeting, the researcher would introduce Phototype and explain that we aim to evaluate their experience of having the device at their home. After obtaining consent (see Appendix 8.1 for the consent form), most time would be spent on setting up the device. In particular, connecting Phototype to a participant's WiFi home network required expert knowledge. Afterwards, the researcher explained the uploading process and helped with uploading photos to the device. Typically, this step required the participant to bring out their laptop or use a desktop computer or smartphone to find digital photos to upload. While photos were uploading (and a minimum were available for use), the device would begin its functions. This provided the researcher with the opportunity to demonstrate the two modes and interactive features.

Once the setup completed, participants were free to choose a suitable place for the device, provided the power adapter could reach a wall plug. We also requested that the device would be put in a place they either spend time in on most days or a spot they walk by reasonably often. Participants were instructed to use the device as they saw fit but to try and spend at least a minute every day interacting with it to get a feel for its features. While aiming for an ecologically valid in-the-wild approach, we also wished to ensure our participants would have some minimal exposure to and interaction with the device. Before leaving, the researcher ensured the participant had signed a consent form and was handed a short manual (Appendix 8.2) and a diary for recording any observations during their time with Phototype (see Figure 8.5). The device itself would also log usage data: the number of photos uploaded, which mode was active, any user interactions, and changes in an image's rating. Phototype would remain at the participant's home for three weeks. This duration was chosen anticipating it would reveal significant issues and allow the development of some habituation towards the device, while still allowing us to deploy with enough participants within the limited timeframe available for data collection.

After this period, the researcher would return to the participant's home for a final interview. This semi-structured interview focused on the experience with the device,



Figure 8.6. Participants were given a small diary to make notes during the three weeks they had Phototype in their home.

positive and negative aspects, and general considerations around the use of digital photos for remembering. Appendix 8.4 lists the structure and questions of the interview. During the conversation, participants were able to use the device to demonstrate anything of interest. Interviews lasted between 30 to 75 minutes and were audio recorded. After the interview, participants were asked whether they consented to the use of their uploaded photos for later analysis. The device would be taken back by the researcher and its data transferred so that the device would be reused by another participant.

8.3.4 Analysis

We base our findings on both the interview data and log files extracted from the Phototypes. The log files were used to plot activity graphs for each participant (see Figure 8.8 in the next section) and to identify images of interest (e.g., those with a high or low rating). Interview recordings were transcribed before analysis. We used a coding strategy that combined open coding (Corbin & Strauss, 2008) with codes relevant to the research questions. For example, we decided to code any references to either mode to ease our discussion of these aspects of interest. This approach corresponds to thematic analysis (Braun & Clarke, 2006). Recurring themes emerged from the interviews, and diverse views on these themes were used as the basis for further analysis and laying out the findings in the next section.

8.4 Findings

The treatment of our findings starts with information on the duration, the kinds of photos participants uploaded, and usage patterns. This is followed by a more in-depth examination of experiences with the different modes and emerging themes across reflections on serendipitous remembering influenced by the device.

Placement of Phototype was typically in the living room or, if participants lived in a studio, on a desk where they would spend considerable time. Figure 8.7 gives an example,

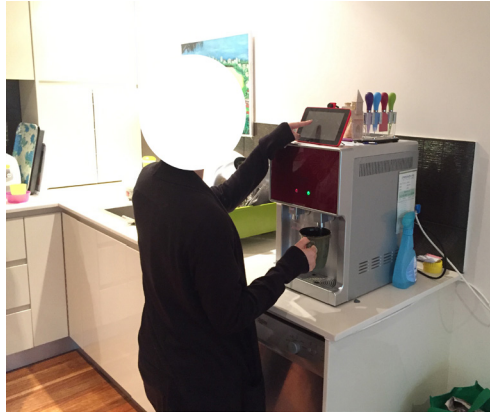


Figure 8.7. An impression of Phototype in the home of a participant. It was placed in the kitchen on top of a frequently used water filtering machine.

while Table 8.1 lists locations for all participants. The rationale behind these placements stemmed from a desire to keep it available for viewing (something we stressed in our introduction) and participants' knowledge of typical use of spaces in their home. This way, attention could drift towards the device now and then: *"When I spot it, it's when I walk past. To get anywhere in the house you have to walk past there [a dresser in a hallway],"* (P10). A similar deliberation grounded the choice of photos uploaded onto Phototype, as participants took into account the perceived use and exposure to its photo display. This process favoured photos that represented family members and pets over, for example, photos with primarily visual appeal such as landscapes and memorable places. We return to these preferences later in this section.

8.4.1 Active usage patterns

The actual deployments lasted from 21 days up to 33 days ($M=28$ days) as can be seen in Table 8.1. These variations reflect pragmatical issues around scheduling the post-deployment interviews rather than intentional variations of the schedule. One participant (P6) kept the device for another week after the interview, as the interview took place outside his home, and we agreed to collect the device later. This explains the long deployment period for P6 in Figure 8.8.

Figure 8.8 visualises participants' activities with Phototype. It should be noted that these are activities that the device could record (i.e., touchscreen use, merely seeing or looking at the device could not be recorded). Proximity tracking data was not recorded because of privacy concerns. Across all participants, it is clear that initial curiosity led to high levels of interactions (as depicted by the dense clustering of interactivity markers in the graph). This initial enthusiasm dropped off after the first day. For several participants (i.e., 1, 6, and 9), their activities show a marked drop-off that reveals only occasional interactions

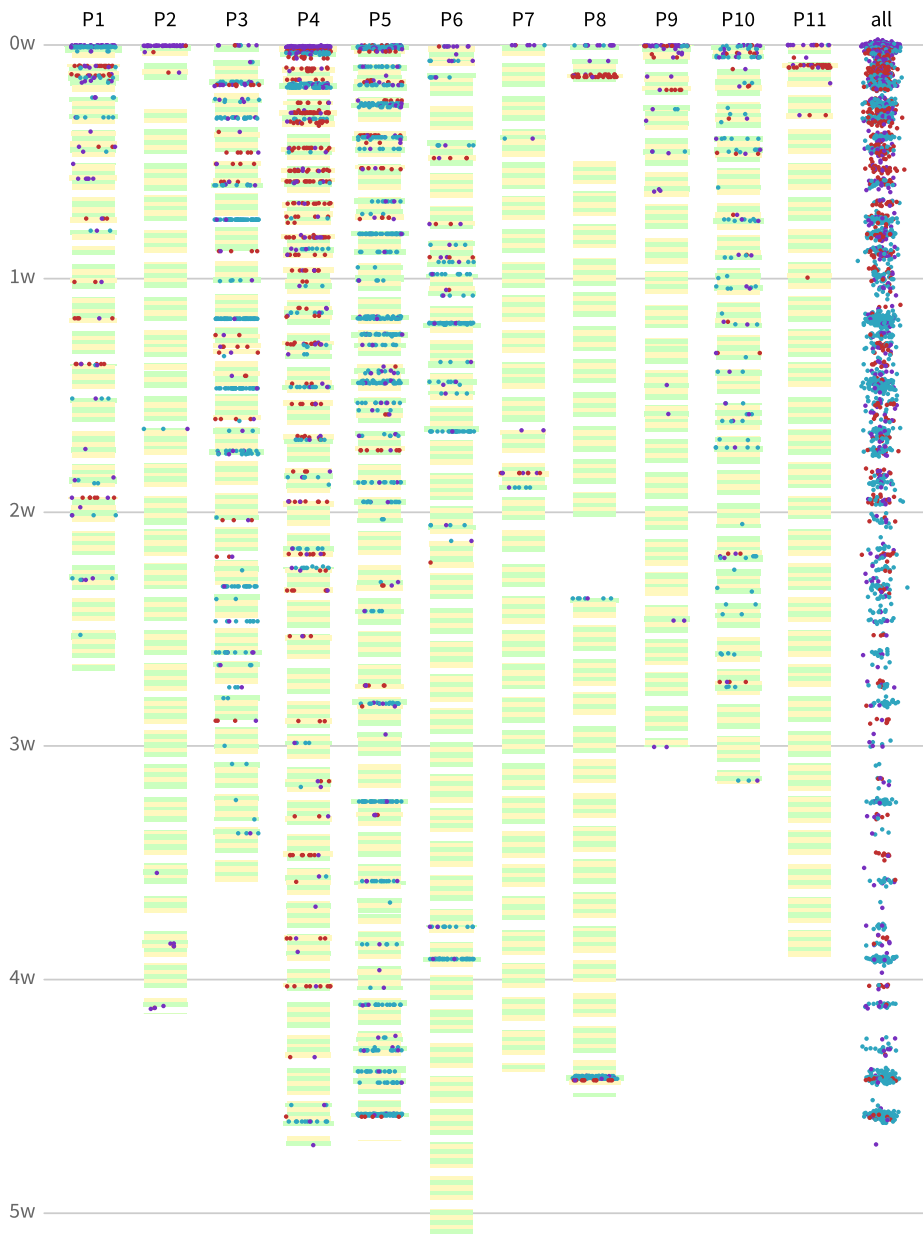


Figure 8.8. Activity graph based on log file data. Each column shows the activities per participant, with all timelines lined up to start at 0. The green (DualDisplay) and yellow (PhotoSoup) bars represent when a mode was active. No bars are drawn at nighttime, such that day/night cycles are apparent. Coloured dots indicate activity: blue (choosing between two images in DualDisplay), red (swiping away an image in PhotoSoup), with other activities shown in purple. The last column gives an aggregate of activities across all participants.

with the device over the remainder of the deployment. Some participants (notably, 4 and 5) explained they liked interacting with the device and continued to do so even after several weeks passed (albeit with reduced frequency and intensity). Conversely, several participants (i.e., 2, 7, and 8) barely interacted, instead preferring a more passive approach to the device. In the case of P8, it is evident the device was switched off for a few days on two occasions. P8 stated a need to use the wall plug occupied by Phototype during those times.

There is a marked difference between the two modes regarding participants' engagement. Most of them interacted with DualDisplay at least somewhat (shown through blue dots in Figure 8.8), whereas they gave up on PhotoSoup (red dots) sooner. As we discuss below, it appears this mode presented more work, was more cumbersome to operate, and in its outcomes less satisfying. P4 was the only participant to favour PhotoSoup over DualDisplay, at least in terms of her proclivity to interact with it. Other participants, such as P9 and P10, barely interacted with PhotoSoup but did so with DualDisplay. Participants 3 and 5 also kept interacting with the latter while stopping to do so with the former.

When participants did interact with either mode, this was likely to happen in the evening or around midday. Most of our participants would be away from home during the day. The interactions were typically clustered in bursts rather than a singular swipe or touch, as indicated in Figure 8.8. Based on our participants' descriptions of their interactions, these bursts were typically motivated by a desire to interact with their photos for a little while. This would continue until they found something of interest that they were happy to keep onscreen. At that point, they would move on and stop interacting. This finding suggests that a selection befitting such use (i.e., viewing, rather than exploring) may reduce the need to interact, and as a corollary, that the frequency of interactions is not a measure of success.

The location of Phototype likely had some influence on the patterns described here. Those who kept the device in a more accessible spot (e.g., P1, P3, P4, P5, P10) were more likely to interact compared to those who had the device in sight but, for example, on a low table (P2, P7, P11). However, this pattern does not hold up for those participants who had the device on their desk, often next to a computer that was in frequent use (P3, P6, P7, P8). In fact, this placement seems to lower the chances of participants interacting with Phototype. Despite the device being within easy reach, people may focus their attention elsewhere. Being in a mindset for work could keep distractions at bay, such that Phototype sees less overt use during those times.

8.4.2 Experiences with DualDisplay and PhotoSoup

With its two images side by side, DualDisplay proved the most enticing to interact with

for participants. They liked the fact that photos were relatively large and therefore easily recognised, even from a distance. Among the participants who interacted with the device, this mode offered the most satisfaction.

The ability to move both images to reveal hidden parts was used infrequently and only by a few participants: “[Just] so I could see the whole picture. Quite often they were landscape pictures (...) I was trying to slide it back the other way, so that I could see the whole of the other one,” (P9). Sliding further (to make one photo go away and a new one appear) was used more often. Participants responded to the choice between two photos in similar ways to the earlier study by Zürn et al. (manuscript in preparation). When they considered an image displeasing (e.g., bad quality or a copy of paperwork that is no longer of value), it was appealing to take up on the proposed choice to swipe. However, when two photos were not that easy to differentiate, participants found such a choice harder. As P5 said, “it showed me a photo of me and my two nieces, my brother and two nieces and me as a child, my niece as a child and so on, so... sometimes [when] I had choices like that, it was hard to choose and I like both the photos.” The process of swiping away less preferred photos would continue until both sides presented photos that were hard to choose between: “Sometimes both pictures are valuable to me... I don’t want to go left or right and I just want to have a look,” (P3). At that point, the interactions would cease because waiting for either photo to change by itself (after about fifteen seconds) would exhaust people’s interest. Interactions with the device were often fleeting and done when passing by, or in the case of P4, when getting a drink (see Figure 8.6).

For those not interacting, the photo display was enjoyed passively: “I just liked it as it was and I enjoyed the randomness. I enjoyed not knowing what I am getting. Like I said, I didn’t hate anything, I just didn’t hate even the crappy [photos],” (P2). This participant put great emphasis on being able to appreciate the smaller and imperfect aspects of life for what it is or was, without the desire to sculpt this into something else. Because the absence of participants’ interventions had few consequences, they could enjoy DualDisplay as it slowly shuffled through photos.

This stands in contrast to PhotoSoup in which, if left alone, circular images would shrink to a small size as additional images were added. These ‘bubbles’ (in the words of participants) were harder to recognise and enjoy: “I found that when there are a lot of circles, that was downright frustrating because you couldn’t see enough and quite often I would change the mode. I enjoyed it more with the other. Partly [because] the small ones, it’s difficult to see the details and also because of the shape, it chopped a lot of the edges of a lot of pictures off. If I had the choice, I would have turned it off,” (P9). Nonetheless, some appreciated it for what it was, such as P1: “Across the room I might see the flash of yellow and that was my daughter’s school uniform. I know what it was, so I would go and expand it. [My daughter] was quite intrigued

that you could push the circles away, the ones you didn't like. She likes the movement, the ability to do that." And P4: "I like the bubbles but obviously there was a purpose behind the bubbles and if I was not there for a while, there will be more bubbles and I have to move around to see... If it was constantly like that, the size would be an issue, I think. Too small."

Performance issues also plagued PhotoSoup. The technical need to draw and resize multiple photos onscreen would impede the fluidity of the interface, such that moving images around the display was choppy at times. This affected participants' willingness to interact with this mode.

However, the difference between the modes that seemed to matter most was the size of the photos onscreen and consequently, the ease with which these could be looked at: *"[DualDisplay] gave me time to focus on a picture whereas the bubbles were like a screensaver, but you have to move your eyes. So I will give preference to the two static pictures,"* (P6). The gentle movement of PhotoSoup proved divisive: *"At first, it irritated me and then I got used to it and it was weird that I saw they were bunching up together... It was very weird watching it. I don't know, you can be distracted a bit,"* (P11).

8.4.3 Positive influence of Phototype

So far, this section has expounded on differences and negative aspects, yet most participants argued in favour of having Phototype in their homes. This praise often tied in with being able to reminisce: *"There is a couple of shots of the two boys [grandchildren] just when they were born. It brought back memories... How fascinated we were (laughs). It was really nice to remember and seeing images of different stages since they were born,"* (P9). P7 echoed this sentiment: *"Ah, it's a fun feeling [having the device]. Yeh! That's something you usually don't do, that you go through photos all the time and the history of how you looked... I started working on losing weight [recently]. By looking at myself like a few years ago, it was encouraging me to lose."* The experiences these participants describe tie in with our aims to support serendipitous reminiscing in everyday life. Phototype's dynamic display of photos accommodated such occurrences: *"I love the changes, seeing these little things popping up here and there. Because that keeps you very interested, it's not like a still photo frame. I often still don't notice my still photos after a while, and they are simply there. I go there and I see them, but I don't actually see them,"* (P2). In a few instances, seeing particular photos also prompted participants to re-evaluate their relationships to those shown: *"I was upset with my wife for a few days. I was not planning to talk to her and those pictures helped me to take the initiative and I spoke to her every day. So this was all about emotions... Whenever I found the time, I kept swiping the pictures to see them all. My family was in those pictures. The random representation of those pictures was good,"* (P6).

Encounters such as those described above clearly have serendipitous properties, as these

were unexpected and surprisingly effective in nudging someone's mood. The narration of these encounters also echoed characteristics of involuntarily cued memories like those collected in the diary study (Chapter 1). That is to say; participants reminisced about the relevant photo, the events that surrounded its capture, and the social relationships depicted (which were generally in play, as we detail below). In keeping with the characteristics that we laid out in §3.8, these moments were enjoyable, relatively short-lived, and offered a brief detour from one's ongoing business, without being overly remarkable in their own right. As a consequence, it did require some probing by the interviewer to tease out exemplary moments.

Although several participants commented on the random choices the device made in displaying their photos, few made meaningful connections between photos on display at the same time. Such a juxtaposition (whether in shape, colour, or people shown together), if noticed, appears to stand out. This led one participant to question if the device was capable of bringing similar photos together, as she seemed to enjoy seeing such connections (for instance, her nieces on one side and her husband's on the other). The emphasis of DualDisplay in particular on choosing one photo or leaving both photos steered our discussions towards those mechanics and comparative motivations, which could have clouded a more open approach to finding commonalities or interesting contrasts between two photos. Nonetheless, all participants responded positively to the variety of their photos on display. Those who uploaded a smaller set of photos expressed a desire to add more if they were to redo the same period.

8.4.4 Choice of photos

The kind of photos uploaded and the subsequent experiences matched fairly well for most of the participants. As stated before, the selection and uploading of photos was a conscious process that took into account what people felt was desirable to view and show. Typically, this resulted in an emphasis on photos of personal events (like holidays) and family, including pets. Friends were less likely to be featured, and this certainly was the case for photos depicting nice vistas, landmarks, or other material aspects. For example, P6 noted that: *"I can say that pictures of my family members were more valuable (...) compared to landscapes or the other things where my family members were not present. Most of the pictures were of my family members standing in front of a landscape, so [for example] we visited some hilly area. It was not only the picture of my father horse riding, [but] it also took me back to that tour we made."* One participant (P8) stood out for his preference of aesthetically pleasing imagery (often shot by himself with some effort) over photos of people or events close to him: *"What I basically noticed is that although family is dear to a certain extent, these things are actually closer because I like them, I have a special attachment to them."* P2 made similar arguments around photos of details in nature (e.g., flowers, a beetle, moss) that she was able to enjoy out of appreciation for the variety of life finding

its way. Nevertheless, the strongest draw to her proved to be her cat, of which she has accumulated a large collection of photos, a selection of which made it onto Phototype.

Given the tendency of photos uploaded onto the device to match with well-established motivations for domestic photo use, it stands to reason that similar motivations underlie our participants' selection process. In §6.2, three kinds of motivations for photo (re) use were listed (Frohlich et al., 2012): as social prompts, serendipitous cues for everyday reminiscing, and to reminisce about specific events in a more deliberate fashion. Our findings have so far given several examples of the latter two functions, but there were fewer instances of Phototype inspiring social uses. Children of participants would inquire about photos they saw (especially if this featured them at a younger age) and we recorded several examples of participants contacting and even sending a screenshot of Phototype to a partner because of something that caught their attention. As a social prompt to occasional visitors, Phototype invited some questions as to its purpose but less about the actual content that was shown. This paucity did not stop participants from considering what is appropriate to show in their homes, citing frustration with, for example, the inability to make certain photos disappear permanently (e.g., a photo of bills, or a baby taking a bath) as these images also have little perceived value for everyday display within the family.

8.4.5 Control over the photos shown

Thus, despite the appreciation for the serendipitous display of their photos, participants expressed a desire for additional control over what gets shown. Phototype offered simple means to get rid of a particular photo momentarily (i.e., by swiping it away in either mode), but the action would only reduce the likelihood of another encounter, not hide it permanently (which would be a welcome feature to add). This highlights a limit of Phototype's simple curation system based on relative ratings because images cannot be removed permanently. Another limitation is the required quantity of rating actions per image. None of the participants dedicated a large amount of time to this activity, as it was primarily seen as an extra interactive thing to do; to reveal another image by making others go away: *"[My daughter] was quite interested in it at first, and I think after a while she was just happy to look at the pictures rather than touching it,"* (P1).

People noted that the initial set of (typically a few hundred) photos were becoming stale after a few weeks, such that refreshing or adding new material would be welcome. However, shaping such a growing selection through the current rating system was deemed not to scale well: *"I think that with the swipe options, I think it definitely is useful... But for any given person, there are a full set of photos up there [points to laptop], and if I put all my photos into [Phototype], it will be 100+ thousand photos, and it will become meaningless pretty quickly,"* (P5). This effect would be exacerbated by the inclusion of duplicate photos

(i.e., multiple captures of the same moment), which we anecdotally observed among our participants' uploaded sets. If a photo is rated, such ratings do not apply to any duplicates. However (and we are speculating here), it could be possible to apply ratings also to similar photos (e.g., those from a similar trip) and thus use few interactions to collect information that is applicable to a larger collection.

Because most of the participants uploaded photos based on a pre-existing organisation (e.g., a folder on a hard drive), any imperfections of that organisation transfer to Phototype. A smaller number of our participants was more deliberate in selecting their photos for uploading, which can cost a significant amount of time (up to 1.5 hours in one case). This step may in itself be enjoyable as it could spark reminiscing or it may be regarded as a chore hindering Phototype's adoption. Our initial design concept called for the availability of a large database, likely through the automatic downloading of (or connection with) one's photo storage medium. That approach would sidestep the uploading process but open up questions about whether all those images fit Phototype's use case.

The prototype introduced a different way of viewing one's photos into the domestic environment. Several participants remarked that they were surprised about liking what it did, offering access to their photos in a way that differed from occasionally looking into a hard drive folder or looking for a photo on one's phone. Although the adoption and continued use of the interactive features were low, the ability to enjoy this device through occasional glances was appreciated. Several participants considered whether they would see value in a regular electronic photo frame (none of the participants had owned such a device at any point): *"I think I have to go and buy one, an electronic photo frame. Didn't know what I was missing out on! (laughs)"* (P1). If participants could keep using Phototype, perhaps with modifications, their responses proposed changes centred on the photographic content. Typical suggestions were to add more photos and achieve a better balance and selection of uploaded photos (e.g., representing a wider range of time), and to have the ability to pause the device for some time to reduce distractions. Finally, practically all participants considered the 7" display of Phototype too small for its envisioned purpose, namely the casual viewing of domestic photographs. Similar to our participants in Chapter 7, the preferred display size would be around 14" to 22".

8.5 Discussion

We sought to evaluate how an interactive system could support reminiscing in everyday life through the display of personal photos. Our study involved the deployment of Phototype, an interactive photo frame-like device, in the homes of eleven participants. We noted the value that participants found in being able to glance at the photos that they had uploaded at the beginning of the study. The kind of photos that people had

added and appreciated to see during the weeks they had the device align with earlier work on domestic photography (e.g., Chalfen, 1987; Sarvas & Frohlich, 2011), and primarily featured meaningful moments and social relationships, such as with family and friends.

However, the interactive features of DualDisplay and PhotoSoup saw a lower than expected uptake. In this section, we reflect on the design parameters that may have given rise to these findings and relate this to the literature, before making suggestions for future (design) research.

8.5.1 Reflections on the study

Deploying the prototypes for several weeks allowed us to let participants adjust to the device. Eleven participants proved a large enough cohort to establish recurring patterns. In fact, their experiences showed strong similarities despite differences in uptake, the kind of photos uploaded, and household composition. In this sense, our approach was successful. Nonetheless, the observed engagement dropped off early, such that a longer deployment period would be unlikely to aid significant further insights without changes to our design. Any deployment requires considerable commitment from those involved such that any longer period needs additional compensation (cf. Heshmat et al., 2017). A longer-term commitment would also need to consider means to add new photos in a way that is accessible and convenient to the participants and their families. In its current fashion, uploading to Phototype benefits from a researcher's assistance.

Phototype had some technical shortcomings. These shortcomings pertain to the PhotoSoup mode's tendency to add images (and shrink all those on-screen to give space to new arrivals) such that visibility became an issue, at least from a distance. While this was intended so that people may be motivated to use the screen to swipe away the less desirable photos, these interactions were rather cumbersome due to the somewhat unresponsive interface. The computational intensity of the PhotoSoup mode made it slow to respond to touch input. Another technical approach may resolve these issues (see also relevant comments in Appendix 8.3), along with improvements to signal potential user actions in the interface. This could have made people keener to interact with PhotoSoup in particular.

A more conceptual limitation concerns the inability to comment on user engagement in ways that did not require interacting with Phototype. While our participants gave insight into their experiences of seeing their photos, reflecting on these, and making a note of this to other members of the household, we cannot evaluate this in ways other than through interpreting such interview statements. Even if we could, frequency and even quality of use are both imperfect indicators of the perceived value that our participants saw in Phototype. As Petrelli et al. (2013) remark: “[*Evaluating technology effectiveness*

through the frequency of use] does not hold for photo mementos that are emotionally intense but seldom accessed,” (p. 334). Even if the cueing of personal memories takes place in an involuntary (and hopefully serendipitous) manner, a response is methodologically challenging to study. This notion also underlies the ideas on Remembering Experience developed in Chapter 5.

8.5.2 Contributions of this study

The contributions of this study concern insights on remembering and desired experiences, the choice and control over photos for glanceable photo displays, and considerations on the role of interactive elements of such displays. This subsection reflects on the findings and compares these to the literature.

Reminiscing and desired experiences

The overall impression of participants was moderately positive. It is an improvement over the somewhat negative tone of the earlier study (Chapter 7), which perhaps saw participants orient towards aspects they did not like. Those designs could also have pushed beyond boundaries that Phototype does not, or seeing an actual device with one's photographs is simply a more enjoyable experience. Several people expressed mild surprise at the positive experiences they had gained through Phototype at their place, signalling that at least for this cohort the experience was (somewhat) new. Indeed, most participants reported at least several positive experiences from having the device, even if their enjoyment stemmed from a mostly passive use (that is, viewing photos rather than interacting with their photos).

Therefore, we may surmise that serendipitous encounters were at the heart of the enjoyment of Phototype, but this leans towards the recognition of one's past rather than the surprise at a novel realisation or unfamiliar moment. The latter may be a result of the initial selection process not including unfamiliar photographs. Thus, encounters with photos were less likely to be unexpected. These images were likely somewhat known and then seen frequently over the next few weeks (especially for those with few photos on the device). Serendipity, at least as it manifested itself in this study, was thus less an unanticipated encounter that led to a sudden realisation (as Andel (1994) defines serendipity) than that it was a brief, meaningful moment amid other happenings (similar to Leong et al.'s (2011) view on serendipity).

We did not request participants to note when and why Phototype would cue them to reminisce (as we did in the first study reported in Chapter 4) to retain a semblance of regular, everyday use of Phototype. Nonetheless, all participants could relate to multiple moments when Phototype did inspire such reminiscing. This gives reason to believe the system was capable of providing a form of 'ready reminiscence,' which is afforded

to those objects that are present and ready to bring to one's consciousness the kind of event, person, or other notion it represents (Kirk & Sellen, 2010, p. 30). It is possible such readiness was transient as photos came and went, but in being an ever-developing artefact, it does beg attention rather than move into the background entirely. Indeed, a few participants alluded to such a process taking place. A key takeaway is the notion that Phototype afforded digital things (i.e., personal photos) presence in the home. This conclusion reflects participants' arguments as to why they enjoyed having Phototype.

Although we cannot make conclusive comments towards the frequency of cued reminiscing, it appears that when it happened, the quality of these encounters makes a case for the design of Phototype. It did inspire reminiscing using personal photos, typically in moments of downtime, when passing by, or upon coming home. This accords with our observations in Chapter 4 that reminiscing often happens when the mind is free to wander, unoccupied with other demanding tasks. At such moments, Phototype was afforded to move into someone's peripheral awareness for some time before it being relegated once more (in line with characteristics of peripheral interaction (Bakker et al., 2014)).

Glanceable viewing experience

The prime takeaway from the present study is the idea that people preferred and found value in seeing their photos on display. The nature of these encounters was through short, glancing moments, and thus dependent on the device's place in the home. It being placed in a central location, preferably easily glanced at multiple times of the day, stands it in the best possible position for its aims. This notion also reflects our findings from the diary study (Chapter 4) in that repetition may be a contributing component for meaningful memory cues, as repeated observation allows for the development of meaning (cf. Petrelli et al., 2008). However, Frohlich et al.'s (2012) work on re-encounters with forgotten images suggests that cues for reminiscing may become less effective if shown too often. The cadence of such repetition is thus a trade-off for designers to consider. Complicating such decisions may be that people might prefer to see certain images often, while the theoretical insight on involuntary cueing and serendipitous reminiscing suggests a slower rate of repetition could invoke a more insightful experience.

A passive, glanceable interface sits on one end of a design space for photo displays, with a highly interactive experience on the other. The latter end, apart from exploring one's collection in some way, would also lean closer to media management and curatorial activities. Showing photos to instigate reminiscing leans firmly to the former side of the spectrum. Despite our design intentions to support further connections with photos-as-cues through the inclusion of interactive features, participants rather relied on Phototype's passive qualities. This desire, to glance at personal photos and move

on (something we dubbed a passive viewing experience in Chapter 7), was not well served by PhotoSoup in the eyes of the participants (due to the small size of images, the subtle movement of which also proved divisive). Therefore, the obstruction of the desired viewing experience and the consequent dislike of PhotoSoup supports the earlier suggestion (expressed in Chapter 7) to provide a good basic viewing experience.

Reflection on modes

Nearly all participants expressed a strong preference for the DualDisplay mode over the ‘floating bubbles’ mode of PhotoSoup. Notably, the rather small size when many photos were onscreen made each image difficult to observe when walking by or giving the device a cursory glance. Interactions with this mode were also frustrating to people, due to the device having trouble to keep up with touch input. Technical improvements may relieve this issue but cannot take away the core issue that people felt little appeal to the way this mode operated. DualDisplay did not suffer such issues in the view of participants. However, its side-by-side display of photos did not inspire people to consider interesting combinations. Responses to Meerkat (Helmes et al., 2011) were comparable, its evaluation failing to invoke a clear a positive response to multi-photo displays. Here, the supposed value was more ambivalent, perhaps because the screen size was considerably larger than for Meerkat (and with that, the size per photo on display). In contrast with either design, the multiple images shown concurrently through 4streams (Zargham et al., 2015) did inspire positive comments. The latter is likely a result of 4streams giving somewhat current insight into the lives of different family members, thus affording a social use to each quadrant of its display. DualDisplay did not effectively distinguish between the left and right side by meaning, depicted period, people, or otherwise.

With PhotoSoup, we attempted to study the passage of time as a means of influence on the photo display. Our findings suggest that seeing more photos at once can be desirable (at least to some) if their size remains reasonably visible, although participants made no connection to this being a result of the passage of time. Despite direct comments in this direction, the lacklustre reception of PhotoSoup gives rise to the idea that its slow accretion of images was not preferred. However, the aforementioned technical limitations could also explain this response. Therefore, we lack the evidence to make strong claims regarding this conceptual underpinning of PhotoSoup.

Role of interactive features for Phototype’s form factor

Interactions with the prototype were less frequent than expected. This hints at a different idea of the device’s value proposition. The value rests with seeing photos (and reminiscing that stems from this), rather than rating these photos, or exploration of one’s collection. This is in line with our focus on the cueing of memories rather than curation. The first aspect (viewing) was however hard to measure as the device is not aware if and when

someone looks at it. The second aspect (rating) suffered because its results were not immediately apparent and remained subtle. The third aspect (exploration) may benefit from the inclusion of some leads to related content in the user interface, rather than a random shuffle (as implemented here) without a particular direction or user control over such a direction.

However, the low uptake of the interactive features begs the question of the value of their inclusion. For example, for Tuba (Helmes et al., 2011), the simple reveal action (lifting the device up) invoked curiosity (see §3.7.5 and Figure 3.4). For Story Shell (Moncur et al., 2015 see also §6.4.4 and Figure 6.6), the necessity of touch adds to the connection it aims to establish. For the present form factor of Phototype, interactive features added little. In contrast to the above examples, no interactions were strictly necessary to have the device do something, which may explain why participants were less inclined to interact with Phototype. This brings us to question whether there is merit in these features if these do not inform or inspire practices around reminiscing beyond the basic viewing experience that we highlighted earlier. Moreover, given that interactive features did little to contribute to reminiscing practices, we question the opportunities for future interaction design work on similar photo displays. If not through interactive features, how may interaction design research develop new value in this niche?

The answer to this is likely different dependent on various interaction scenarios. We reason that the form and location of Phototype – while good for glancing – is less suited to prolonged use scenarios. If exploring a photo collection is the goal, sitting down with a device (e.g., a laptop or tablet) or having a larger screen (e.g., a tabletop interface as in Hilliges & Kirk, 2009) are more comfortable options compared to the typical way Phototype was positioned. Phototype was placed similarly to how one would place a photo frame, perhaps instilling similar notions regarding its function in the home. If so, this may imply the similar appearance to a non-interactive thing may have imbued Phototype with similar practices of use and deriving value. This is similar to many other recent conceptual designs (e.g., Helmes et al., 2011; Jansen et al., 2013; Petrelli et al., 2013; Taylor et al., 2007; Zargham et al., 2015). If new insights for future design work are the prime motivation for future research, then concepts are welcome that conceptually move further away from established practices around domestic photo displays.

A direction with potential for such differentiation is, as we argued first in Chapter 7, the inclusion of abilities to explore a personal photo collection. However, as we stated above, this may require rethinking how and where people interact with such a system to the point that it may no longer perform as a serendipitous, glanceable photo display. This dovetails with the observation in Chapter 6 that reminiscing-oriented designs tend to be different from those oriented towards interactivity.

Choice of photos

With one exception, all participants felt that photos of themselves, close family, and friends fitted best with Phototype. This is not surprising, considering the wealth of prior work establishing similar trends of the home as a place to display and confirm family relations (e.g., Chalfen, 1987; Csikszentmihalyi & Rochberg-Halton, 1981; Sarvas & Frohlich, 2011). However, the deliberate process that underpins the choices for framed photos in the home cannot be upheld for digital things due to the larger quantity of photos people deemed suitable to upload.

The positive response to encounters with their uploaded photos was thwarted by unsuitable images. This could include any photographs that did not appeal to valued connections with other people or valued moments in one's personal past (e.g., photos taken for practical reasons). A suggestion we put forth is that opportunities are made available at the capturing stage to sideline such photos. For example, when capturing photos of some notes using one's smartphone, it may be possible to prevent such photos from ending up in the regular stream of personal photos. This way these images do not intermingle at a later stage (whether it is Phototype or another means of photo display for reminiscing).

Another pertinent management burden was the presence of duplicate photos (i.e., depicting a similar moment, captured in quick succession). Digital photography affords easy, successive capturing at a cost that presents itself at a later stage. Phototype (like many alternatives) does not cater well to duplicate photos, for example through 'condensing' into one representative photograph or otherwise. This pragmatic concern has been given little attention in recent interaction design literature. Earlier work did address this (Graham, Garcia-Molina, Paepcke, & Winograd, 2002; Marshall et al., 2006; Platt, Czerwinski, & Field, 2003) and indeed photo-oriented software from major vendors (e.g., by Microsoft, Google, and Apple) are starting to embrace clustering mechanisms. A means to manage this better for serendipitous photo displays is welcome, as this category's perceived value leans on photographic content and presumably less so on its ability to manage said content.

Control over photos

To provide some control over the (otherwise random) photo display process, we implemented a simple ratings-based form of curation in Phototype. By swiping away photos, people could increase the likelihood of desirable photos showing up and vice versa for undesirable photos. Nonetheless, these features saw little use. There are several reasons for this. First and foremost, participants uploaded a limited number of photos, which were selected for this purpose. Some uploaded whole folders they found suitable, others picked individual images to add. This means a process of selection had already

taken place, reducing the need for any curatorial decisions afterwards. Second, the way the system implemented curation was rather subtle in its consequences: any photo's rating would drop a little but never result in an image disappearing altogether. These ratings were not directly observable to the user, such that they only get to see the consequences at a later point (as some photos will appear more often and some others less). Making a photo go away entirely (e.g., because it showed some work documents) could not be accomplished. This reduced the overall appeal of the photo display.

Future work could consider the inclusion of a larger, perhaps less filtered set of photos to evaluate these options from a different starting point. However, despite encouragements in this direction, our current participants preferred a more deliberate process due to the prototype's domestic nature. It had to function in what Kirk and Sellen (Kirk & Sellen, 2010) called a negotiated space between members of a household and be suitable for occasional glances by visitors. Here, we can draw a parallel to Meerkat (Helmes et al., 2011) that offered little in the way of control over its photographic content and gave rise to some misgivings as to its random display thereof. Pearl (Jansen et al., 2013), on the other hand, did garner positive comments regarding the ability to make some images more central (i.e., more important) relative to surrounding images. Here, in particular for DualDisplay, the issue was not so much that the interactive rating feature was underappreciated (most participants gave it a go at first), but instead that its outcome lacked appeal and could be made more explicit.

While the ability to mark photos that show up on the device as welcome or unwelcome was considered valuable in principle, so was the ability to add new photographs as time passes to keep the display 'fresh.' If such photos are added, rather than replacing photos already available, this increases the size of the collection on Phototype. With too many photos, rating may prove meaningless if such choices 'drown' in a sea of unrated photos. The aforementioned duplicates issue is exacerbated as rating one among several duplicates does little to teach the system about the others. Thus, the means to exert control as featured in Phototype are limited without further improvements.

8.5.3 Suggestions for the design of photo displays

Using our findings and the above reflections as inspiration, we outline several suggestions for future work on the design of serendipitous photo displays. The brief nature of interactions with photo displays like Phototype (such as a quick glance, a flick of a photo towards the edge of the screen) demand an equally brief and effective response. This emphasises rather lightweight user interfaces that evade the kind of cumbersomeness that people experienced with PhotoSoup.

Explore beyond established practices

Future research may explore outside established practices with photo displays. In the present study, participants' choices in photographic material seem to replicate well-studied practices of domestic photo use. This is perhaps not unexpected as Phototype mimics a photo frame in important ways. Participants perceived the device as a photo frame with additional features rather than a new kind of product. Both Photobox (Odom et al., 2014) and Reflexive Printer (Tsai et al., 2014) serve as examples of designs that set themselves apart from preconceived notions of what a photo display could be to gain novel insights. Thus – while we suggest ways to improve upon the path taken in this study further below – another avenue for future research is to consider novel designs to study underlying values and motivations in ways that overcome established ways of relating to photo displays. Such a suggestion is perhaps not novel in itself but serves to emphasise an alternative way in which interaction design research provides valuable insight on this topic.

Notwithstanding the above suggestion, there is space for new insights in studying established practices. None of the participants had owned a digital photo frame before. Because they believed the primary value to be in seeing their photos, it may be possible to study a longer timeframe (without the need for prototypes) by interviewing those who own and have lived with such digital photo frames.

Optimise user experience around the display of photos

Because of the emphasis of passive over interactive use, the steps before such usage is possible are given extra importance. With this comes additional pressure on the curatorial decisions when selecting and uploading photos. It stands to reason that problematic facets at this stage reverberate at a later point. Therefore, the selection and uploading phases ought to be given more weight as part of the whole photo display user experience. As we noted, the value rests on the ability to provide positive or serendipitous encounters, which suffers from low-quality photographic content. Thus, we reason that to realise the potential value we deem present in Phototype and devices of similar ilk, additional attention is welcome for the 'onboarding' and maintenance steps. This aims to preserve both initial and long-term enjoyment because the perceived value rests in the content more so than in the interactive features that build on it. Similarly, our findings call for the ability to enact a more 'permanent' verdict on individual photos, if its content and display in the domestic sphere are ill-aligned. The absence of such means in Phototype prolonged known issues around digital photo collections (e.g., Whittaker et al., 2010) and reduces the overall value of the collection on display.

Paradoxically, the suggestion to emphasise the role of curatorial decisions before putting the display up runs against recent claims that such decisions ought to happen in the

moment of use. For instance, Broekhuijsen et al. (2017a) and Van House (2009) reason that in the case of co-located photo talk any photographic input to such social moments is highly dependent on this context, because the photos are considered to be in service of the conversation. Ergo, interactive systems ought to facilitate such in-the-moment photo display needs. Broekhuijsen et al. (ibid.) note that searching for a particular photo takes time and concentration, both of which detract from the photo talk it aims to support. Despite clear parallels in the motivations for photo use underlying both foci, the present study reasons towards prior curatorial efforts. The everyday, serendipitous encounters we envision and recorded here benefit from prior efforts towards desirable photos for viewing and reminiscing. As such, the use is in response to involuntary cues, rather than actively incorporating suitable photos into one's conversation. Nevertheless, stronger tools for in-the-moment control, such as hiding undesired photos and tagging favourite photos, are welcome improvements to Phototype as per our findings.

The previous chapter raised the point of automated support through machine learning, which we deem an under-explored but potentially useful area for future explorations in this regard. If taking this route, depending on the distribution of control between system and user, interactions with the system would be best described as guiding the automated process of bringing out the best in someone's collection of photos (cf. Schmidt & Herrmann, 2017).

A different but related approach would be to optimise the user experience of photo displays by catering to varying levels of interaction. Abowd and Mynatt (2000) discussed explicit and implicit user-system interactions in their work on everyday computing. Whereas explicit interactions require the user to devote time and attention, implicit interactions attempt to lift user input from what people do (that is, actions that are not with the system of interest). To reduce encumbering people, designers could seek ways to support implicit interactions, for example, to inform when a system should 'mute' itself or when provoking interactions would disrupt the process of reminiscing (e.g., if someone's focus is on one image). Thus, in reference to the peripheral interaction paradigm (Bakker et al., 2014), photo displays could incorporate varying levels of control depending on user engagement. This could mean to rely on implicit input when no attention is given to a system, allow someone to quickly give input without devoting much attention, up to more involved interactions when so desired. This approach ties in with our call for a glanceable viewing experience.

Insights for design for remembering

Our focus in this chapter has been practical and remained close to the design and evaluation of Phototype. Still, the study yielded several insights that apply more generally to the design to support remembering. In the next and final chapter, we shall relate our

findings further to the design for serendipitous reminiscing. However, this subsection calls attention to two core contributions.

The foremost finding is that people see the benefit in reviewing their digital photos in ways other than via a personal device (such as a laptop or phone), for which photo use may be driven by a goal or by photos' organisational structure (e.g., looking through a folder, with some folders reviewed often and others gathering the digital equivalent of dust). Still, this insight came as somewhat of a surprise; people had expected to like it less than they did, which suggests first-hand experience may be necessary to realise whether one derives value from an interactive system that aims to support remembering.

Our findings with Phototype illustrate that people's experiences with the design depend on the ability to connect with the uploaded photos. When these potential cues fall short of the ability to invoke personal meaning, the general design falls short too. What this implies is that reminiscing, and serendipitous reminiscing in particular, depends on people being able to read something of personal relevance in their encounter with a thing (be it a kitchen utensil, a souvenir, or an interactive photo frame). Phototype may be able to deliver such relevant cues, but these are fleeting given its propensity to cycle through photos. With larger collections, it may take a considerable amount of time before a photo returns and can continue to build on its relevance (if still applicable). As Sellen and Whittaker (2010) argued, an interactive system's value resides in its perceived usefulness for reminiscing, an argument that Phototype underlines. However, we did not record instances of unpleasant moments due the involuntary cueing, as we did with the diary study (Chapter 4). This is likely due to the pre-selection when uploading photos, such that future work on design for remembering could deliberately encourage larger, unfiltered selections to study the effects of the perceived value of a design's ability to positively contribute to (serendipitous) remembering in everyday life.

8.6 Conclusions

In this chapter, we focused on the design and evaluation of Phototype. Phototype was developed to continue the study of reminiscing in everyday life, in particular where and how it may be supported by novel technologies. Thus, the study presented in this chapter sought to bring out how an interactive photo display inspires and affects reminiscing. After we deployed devices for three to five weeks at eleven participants' homes, the findings illustrate that Phototype was able to inspire serendipitous encounters with personal photos. These encounters, while not very frequent, often led to brief instances of reminiscing in a similar vein to the diary study of Chapter 4 and established literature on involuntary remembering (e.g., Berntsen, 2009). This kind of reminiscing left people with positive feelings about seeing their photos, such that we may conclude there is room for technology like Phototype to support positive experiences. From the recounting of their

experiences and particularly what participants deemed valuable, the ability to casually consider and reinterpret one's past and relations with others stood out. This finding again meshes well with prevailing ideas on the functions of memory (as reviewed in Chapter 3) and outcomes of the three earlier studies presented in this thesis. This motivation also drove the selection of photos for inclusion on the prototype display.

Phototype's interactive features were used less often than we had expected. When these features were used, participants felt the quality of their experience could be improved upon. Notwithstanding some technical pains, this paints a picture of the experienced value from the photo display. Indeed, this value appears to reside in the ability to situate personal photos in the everyday (domestic) environment, ready for inclusion into one's awareness. The different placements of Phototype and patterns of use give a tentative indication but would require follow-up studies to tease out more clearly where and when Phototype drifts into focus. Thus, we conclude that this study underlines the value of serendipitous encounters with personal photos and that the display of such media can support reminiscing and occasional photo talk. This comes with some caveats. Our findings highlight the importance of the photo selection process itself as a proxy for the later enjoyment of serendipitous encounters (whether done by the user or, if possible, through automatic means). Thus, while in-the-moment (dis)agreement with depicted photographic material could be expressed in ways similar to those explored in Phototype, this was deemed insufficiently powerful to adapt the display's behaviour to contextual demands. For instance, swiping away images that people prefer not to show to visitors implies these images are also less likely to return later for private consumption. Here, an ability to silence the device while having visitors over would be considered helpful. It appears too much of an overhead, at the least where it concerns the use for involuntary cueing. When further exploration of photos was sought, Phototype could also not deliver in full due to the random nature of its photo display process. Instead, more meaningful connections could provide cues for exploration and connect the presented dots. We have briefly alluded to the desire for variable levels of control to better cater to varying use cases. Finally, we surmise the form factor of Phototype brought up perceptions of its value as comparable to existing photo frames, such that a break with these conventions in future work may inspire different views and practices.

The study of Phototype addressed the core research questions of this thesis as first laid out in §1.4 and touched upon in this section. The final chapter addresses these questions and the presented evidence throughout the thesis more thoroughly to establish contributions, recommendations, and insights into the design for serendipitous reminiscing.

*In Conclusion: Interaction Design
for Serendipitous Reminiscing*

9

9.1 Introduction to this chapter

Over the course of time, people adopt different perspectives towards the events of their life. Doing so allows people to reframe their past in a way that is beneficial to one's present and future self (Conway, 2005). Things, like personal photos or souvenirs, that are able to tell a part of one's autobiographical story face a similar process of reframing in relation to one's identity. Encounters with such things are both opportunities to revisit their story, or as was the case for the cyclist in the introduction to this thesis (§1.1), something to avoid so as to maintain the earlier framing. It is however easy to avoid one particular, well-advertised road in France. This is different for things that are closer to one's everyday environment, such as personal possessions and things in one's immediate living sphere. These things, when encountered, can bring up the past in ways both predictable and unexpected. Encounters may be predictable because people have seen, heard, or felt that thing before. For example, a digital photo used as desktop wallpaper on one's computer is likely familiar to the point of going unnoticed. However, if some time has passed, or if upon seeing something one makes a sudden realisation, the encounter may well stand out. With digital possessions becoming more numerous and more ubiquitous in our everyday lives, the chances of such unanticipated encounters increase.

In line with the views of van Dijck (2007) on digital ubiquity, this thesis has argued that personal memory-related things are unavoidable and encountered frequently, which alters our relationship to these things in important ways. Rather than raise concern, the view was adopted that such encounters can lead to positive instances of casual reminiscing on one's past. To this end, we proposed the term serendipitous reminiscing to capture instances of reminiscing that momentarily occupy one's mind before other activities take over once more. This is not to deny the potentially negative and harmful effects that reminiscing could have (as attested by a large body of literature on, for example, ruminating (cf. Webster, Bohlmeijer, & Westerhof, 2010)); Rather, we opted to focus on encounters with things that are likely to result in neutral to positive outcomes.

For the research presented in this thesis, we chose to pay particular attention to digital things as reminders of the past. Specifically, we focused on digital photos both because of their ubiquity in most people's lives and because of the relevance to the ever-widening body of literature that addresses issues that large collections of digital photos bring up (a.o., Sarvas & Frohlich, 2011; Schwarz, 2014; van Dijck, 2007; Van House, 2011; Whittaker, Bergman, & Clough, 2010). The question underlying this work concerns how we could deal with large amounts of personal photos such that these may contribute to meaningful experiences. The challenge here is that the vast magnitude of one's collection may render individual images meaningless. Such meaning is derived from their use for reminiscing. We took particular interest in the casual, everyday nature in which reminiscing may manifest itself. This thesis developed the idea of serendipitous

reminiscing to outline the kind of spontaneous encounters so easily afforded to physical things but (without technological intervention) out of reach to digital photos.

Through a review of the literature, Chapter 3 framed serendipitous reminiscing as responsive to context, in service of a personal or relational goal, and dependent on the perceived shift of one's perspective on the matter cued by the encounter. The diary study in Chapter 4 qualified the experiences of involuntary cued remembering in everyday life, of which some encounters may indeed be serendipitous. A key element of serendipity is the realisation – whether through a gradual drift of one's attention or a more sudden leap of thought (e.g., Ansel, 1994; André, Schraefel, Teevan, & Dumais, 2009) – that changes (perhaps subtly) how one thinks and feels about a thing, a photo, or an event from one's past. This effect gives meaning to the experience of serendipity. Chapter 5 aimed to formulate how remembering and experience are intertwined such that we may speak of remembered and remembering experiences. We continued with research-through-design by reviewing prior design work (Chapter 6) and developing new concepts. Several concepts for interactive systems that could initiate serendipitous encounters with digital photos were developed and evaluated in Chapter 7. The use of mock-ups allowed us to study perceptions towards such technology. The final study reported in Chapter 8 deployed an interactive prototype in the homes of participants to see how technology could feasibly bring about serendipitous reminiscing in the everyday domestic environment.

In this chapter, we aim to generalise insights from earlier chapters and to provide new insights on how serendipitous reminiscing can be facilitated in interaction design. This chapter also highlights the contributions of the thesis and indicates directions for future research. Where possible, we have italicised the main contributions and conclusions.

9.2 Answers to research questions

The research presented in this thesis studied reminiscing in everyday life. Across four studies, we explored practices, preferences, and (desired) experiences for reminiscing through the use of interactive systems. This focus on serendipitous reminiscing explored casual encounters with digital photos as a meaningful way of interacting with the past. The central research interest concerned the understanding of how personal memories relate to digital media that represent such memories. The angle chosen for our investigations was the exploration of encounters with personal digital photos that would lead to reminiscing. We expressed the research interests in four research questions that each address a facet of serendipitous reminiscing in everyday life. Through a discussion of our insights below, we express how the presented research contributes to defining and understanding the everyday situations in which serendipitous reminiscing takes place.

9.2.1 RQ1 – When and how do people relate to external memory cues in everyday life for the purposes of reminiscing?

People relate to external memory cues in diverse, sometimes idiosyncratic ways. Our diary study (Chapter 4) showed that, while cued remembering is not a deliberate process, surrounding oneself with things that may cue often is. Memory cues, in particular in the domestic sphere, are not merely a source for memory, these are also and foremost an expression of one's past and identity. Still, a notable category of cues is not meant as a token for the past. Instead, its continued use has imbued it with significance (e.g., kitchen tools gifted by parents). Such significance may not be apparent until someone makes a sudden leap of thought; the otherwise innocuous but repeated encounters made that thing meaningful. Food is a prime example of something that can bring up a diverse array of personal, social, and identity-related connotations. While physical objects were dominant across diaries, participants related less commonly to photos and other digital items. In the remainder of this section, we seek to clarify and interpret the above synopsis.

In Chapter 3, we described that *reminiscing is adopted flexibly in response to personal needs and desires*. What this conveys is that reminiscing is a motivated activity. As a form of autobiographical storytelling and self-talk, reminiscing is in part a means for people to self-regulate their wellbeing. More specifically, reminiscing helps to put the past, present, and (imagined) future into perspective. It helps people to feel better, reduce boredom, or in a more negative sense, it allows people to ruminate over past actions. In addition, the storytelling aspect enables bonding with others.

Although reminiscing is motivated and regulated by personal needs and desires, it is invoked by thoughts and other cues. This extends to the inclusion of and sensitivity to things external to the mind that may cue reminiscing on associated personal memories. It is this process of association that makes something a cue to remember. As such, *the question of how people relate to cues in everyday life cannot be separated from the associations they make*. For example, when busy a potential cue may be ignored, but at a later time, it may invoke a memory. For this reason, we employed diaries for the study reported in Chapter 4 to canvas when and how people relate to things that involuntarily cue memories and the cued memories themselves.

The meaning ascribed to certain things (such as framed photos in the home) is not directly related to these things' ability to involuntarily cue memories. Instead, such meaning is available by virtue of the object being in that place, signifying its autotopographical role (González, 1995; Petrelli, Whittaker, & Brockmeier, 2008) to portray the household's identity to visitors or upon devoting attention to it. By being readily visible and always there (for example, in one's living room), the ability to command attention and inspire

spontaneous reminiscing seems to diminish as it ‘simply is’ without question. When not relevant to someone’s current state of mind and interests, such objects fade into the background. Thus, the meaningful relation to this kind of thing stands in contrast to the kind of sudden realisation inherent to serendipitous reminiscing. What this means is that framed photos may be suited to a different, more deliberate kind of reminiscing rather than the serendipitously invoked kind that relies on unexpected input. Indeed, amid the many kinds of physical objects that cued memories, we noted only a few photographs and digital things.

Our interviews following the diaries (Chapter 4) made clear that *the things that cued memories were not as important as what people remembered and how that made them feel*. The value of a spontaneous, possibly serendipitous moment depends on the thoughts that come up and consequently, the emotions one may experience. In other words, it is about the meaningful moment itself that comes out of the encounter. This meaning may come through delight, a sudden realisation, or reconnecting with something that one may not have considered for some time.

The perceived meaning when reminiscing depends on what someone brings to the encounter, perhaps more so than any meaning-embodied-by-the-thing. The evaluation of Phototype reiterated this insight, which also aligns with similar conclusions by Kirk and Sellen (2010) and Petrelli, Bowen, and Whittaker (2013). This is an important finding that has several implications, as we discuss here and in the next two sections.

With more personal meaning already invested by the owner in a particular cue, cued memories are less likely to be sudden or surprising. Thus, while the underlying process to come to personal meaning may follow different paths (i.e., through involuntary means such as serendipitous encounters (e.g., Cosley, Sosik, Schultz, Peesapati, & Lee, 2012; Leong, Harper, & Regan, 2011) or more deliberate attention, such as photo talk (e.g., Crabtree, Rodden, & Mariani, 2004; Frohlich, Kuchinsky, Pering, Don, & Ariss, 2002)), for the reminiscing itself it need not matter. The design studies (Chapters 7 and 8) certainly entertained a more spontaneous pathway with the randomised display of photos but Chapter 4 tuned in to those (often personal) things that have more layered and accrued meaning. This led us to several considerations for interactive systems that opt for a serendipitous approach to inspire future meaningful moments.

Interactive systems using involuntary cues, such as by showing digital photos, run into several challenges. Chief among these is a sensitivity to opportune moments, as people may sometimes be more open to reminiscing than at other times. *The meaning of a particular thing to someone is difficult to ‘know’ for a system as it is idiosyncratic*; it is dependent on prior meaning and what someone brings to the moment of cueing. As we

argued in Chapter 4, learning about this idiosyncrasy may happen through sensing (e.g., is someone deeply engaged in another activity?) or through feedback. Using feedback as we aimed to do through the rating system of Phototype (Chapter 8) allows people to indicate their preferences, but not the perceived meaning that informs such preferences. It is here that systems run into limitations, as we discuss in more detail further below (§9.4).

Instead, designers may opt to let a system play an active role in the process of something becoming meaningful. We realised through the diaries and subsequent interviews (Chapter 4) that *repeated exposure to and engagement with a particular thing develops a meaningful relationship*. For novel designs, it may be possible to inspire moments of reminiscing that over time contribute to similar developments.

Participants were partial to photos of close family and friends, and to a much lesser extent photos that portrayed holidays or visually pleasing scenes. We observed in Chapter 8 that the selection process of photos and the eventual experiences with the prototype favoured particular kinds of photos. Rationales behind these preferences echo prior work on domestic photography (e.g., Chalfen, 1998; K. Rodden & Wood, 2003; Sarvas & Frohlich, 2011), including the desire to portray family relations and reinforce positive attributes. While our data is limited, it appears that these choices follow established practices around domestic photography despite the altered intentions embodied by Phototype. Namely, these intentions were aimed at inspiring casual reminiscence through the display of a varied collection of photos, rather than remaining within the strong confines set out by preconceptions on what domestic photography is for. It seems our design intentions did not break the mould of what imagery people desire to relate to for occasional reminiscence in everyday life. To a certain extent, this may be because people selected and uploaded photos before they spent significant time with Phototype, such that a change in their understanding of its best use (and subsequent alterations to the collection it displays) was not yet incorporated. This provides a route for future research on the development of long-term practices around interactive photo displays. More precisely, *future work can ensure that collections of photos are plentiful or refresh at certain moments*, such that participants' upfront knowledge of the photographic material is reduced. Other authors have also experimented with third-party cues for similar reasons (e.g., André, Sellen, Schraefel, & Wood, 2011; Gulotta, Sciuto, Kelliher, & Forlizzi, 2015).

To conclude our insights on how people relate to external memory cues for reminiscing, we claim that the value of such cues for reminiscing resides not in merely having them, but in their usefulness for inspiring self-talk, storytelling, and other purposes that we identified for reminiscing (Chapter 3). This realisation challenges the value of (for example) photos that we have but have no use for: photos that remain unseen or if seen, are unappreciated. Yet, some of these photos may be under-appreciated. The way

technology enables photos' use in reminiscing practices is what counts, rather than how immersive a particular technology lets us replay a past event. If people derive little meaning from an encounter, their experience falls flat. This is an important point for the development of new forms of digital and augmented visualisation, as we believe the real immersion and reminiscing happens through the creation of a narrative around the cues for remembering.

9.2.2 RQ2 – Can remembering be defined as a kind of experience, such that it may be qualified for the purposes of design?

We consider that *remembering is a kind of experience*. We affirm that it is fruitful for interaction designers to think about remembering in similar ways as is already done for experience. In Chapter 5, we proposed that remembering holds similarities with the idea of user experience (as it is defined by a.o. Forlizzi & Ford, 2000; Hassenzahl, 2010; Wright, McCarthy, & Meekison, 2003). Both remembering and experience are constructs emergent from multiple elements (e.g., many aspects make up one's overall experience, just as several episodic elements make up a memory of an event or period). Several studies, specifically the diary study (Chapter 4) and the deployment of Phototype (Chapter 8), do support the idea that remembering can be discussed in similar terms as a regular experience would be. The way participants discussed their instances of remembering held close similarities to how people would discuss their experiences, although the remembered experience and the experience while the remembering took place were somewhat entangled.

In Chapter 5 we opted to better understand the relation between remembering and experience better. The chapter touched on how the two constructs are alike and formulated remembering as a particular kind of experience, namely *the set of effects that is initiated during the situated recall of a personal past episode*. This set of effects can be complex and rich, involving mental images, feelings, and thoughts, affected by its situatedness such as mood, use of media, physical and social context. However, while we put forth this definition based on our theoretical discussion of the matter, we opted to focus the empirical efforts in Chapter 5 on the *remembered experience, which we defined as the experience one remembers having had at some point in the past* (Chapter 5). Because designing for a positive user experience is a common aim and the focus of considerable design research (e.g., Desmet & Pohlmeier, 2013; Hassenzahl & Tractinsky, 2006; Norman, 2004), the study reported in Chapter 5 set out to deconstruct participants' remembered experience of past events.

Using repertory grids to compare and contrast past experiences, we derived a classification scheme along with a numerically derived clustering that can be used to map and contrast remembered experiences. This reductionist approach to the phenomenology

of remembering as experience emphasises the past experience. It qualifies this remembered experience and gives less attention to the reminiscing or encounter that gave rise to the remembered experience and where the subsequent meaning may reside. Elsewhere in the thesis, *we emphasise that meaningful reminiscing is more than the sum of its parts*, such that the evidence reported in Chapter 5 could not adequately describe such experiences in a comprehensive way to be directly useful to design.

Instead, the realisation that a partial understanding of reminiscing and its experience insufficiently prescribes considerations for design suggested a different approach in later chapters. The research-through-design approach taken treated experience as something integral to the use of interactive systems and, by extent, reminiscing that may come about as a result of such interactions. The two design studies (Chapters 7 and 8), as well as the review of prior design work (Chapter 6), adopted a more holistic approach to the user experience and with this, leans closer to established practices in the field of Interaction Design. This signals there is space to harmonise the efforts in Chapter 5 with the requirements of design work and its evaluation of the user experience of remembering.

Based on the other studies presented in this thesis, we note that *the creation of new meaning is where the real value of reminiscing lies*. Specifically, with the diary study (Chapter 4), we corroborated earlier work on domestic practices around personal memories and the desire to signify and relive these. The evidence also reinforced the notion that, *while the aim of reminiscing is to provide a consistent narrative of the self and regulate one's wellbeing, this happens through one's ongoing experience*. As we have argued earlier in this thesis (Chapter 3), spontaneous reminiscing becomes serendipitous through the recognition of a meaningful moment. Whether such a moment stems from a sudden realisation or the delight or dismay from an unanticipated re-encounter with something of one's past counts less than that the moment is experienced. This means for designers who aim to support remembering, the emphasis ought to be on this experience while reminiscing and generation of meaning takes place. Consequently, this is also the area where interactive systems can make their mark towards improving and supporting this experience.

9.2.3 RQ3 – How can serendipitous reminiscing be characterised and which considerations apply when designing and evaluating this kind of reminiscing?

Here, we address our characterisation of serendipitous reminiscing. Section 9.3 is dedicated to the second, design-oriented part of this research question. Using the literature as guidance, we defined serendipitous reminiscing as the *'casual recollection and reliving of past experiences, for enjoyment, restorative, and social purposes, brought about by chance encounters with things that remind of one's past.'* This definition was put forth in Chapter 3 along with a number of its characteristics. These we repeat here.

Serendipitous reminiscing is associative. It is taken up effortlessly, in response to cues. Such cues may be taken from technology and other impulses that inspire, facilitate, and scaffold memory, or because earlier and ongoing thoughts primed someone to notice such cues. *Reminiscing happens in service of personally relevant goals.* It is therefore subject to (and malleable to) our current understanding of the world. *Reminiscing happens within the context of other activities.* Interruptions that instigate reminiscing are likely, that is, these interruptions may form a source of inspiration for reminiscing. This latter aspect is corroborated by the diary study (Chapter 4), in which we observed that involuntary cueing and subsequent reminiscing is particularly likely in the context of activities that are well known and repetitive (such as cleaning, cooking, and cycling). *Such reminiscing is both remarkable and unremarkable:* Episodes are often short-lived, may feature in a later conversation, but are likely unremarkable enough to leave a lasting impression. Still, at that time it may be remarkable in its ability to influence one's ongoing experience and mood (the effects of which may linger).

Finally, we reasoned that for serendipitous encounters, it matters whether people can come to a new realisation about the event considered. What someone brings to the encounter in terms of their knowledge and perspective is as important as the encounter itself. Thus, the above characteristics emphasise that *a (sudden) development of one's perspective towards a thing or personal memory is a key aspect of serendipity.* In line with Leong et al. (2011; 2008), who reframed the necessity of a 'leap of thought' towards the invocation of delight for encounters with digital media, *our characterisation on serendipitous reminiscing remains open to encounters that are meaningful but not necessarily unexpected.* Indeed, we concluded from the diary study (Chapter 4) that involuntary cueing by things observed in participants' everyday environment did satisfy the context-dependent, associative characteristics but were not unexpected. Examples include domestic objects such as framed photographs placed in one's living room or objects that are in everyday use. Despite a continued, perhaps long-lasting presence, these things can inspire casual reminiscing that has most characteristics in common with serendipitous reminiscing as we have described it. At home, surrounded by many familiar things, this may be the most likely kind of serendipitous reminiscing that could happen.

For the above reasons, we consider that serendipitous reminiscing is spontaneous in its influence on someone's attention and experience and can bring new thoughts to mind. *Serendipity lays in the ability to connect the known with something else to yield insight, surprise, and perhaps delight.* This does not require an unexpected stimulus; rather, it requires someone to make an unforeseen but relevant connection. From the perspective of an interactive system, where it seems to trade on luck to kindle serendipity with its display of personal media, this may just as well be premeditated: luck can use a helping hand. Such premeditation would rely on (tentative) insight into what may bring about

delight or deeper considerations of one's past.

Despite the call for serendipity, caveats apply. The diaries (Chapter 4) and the feedback on several design concepts (Chapter 7) that relied on surprise make clear that reliance on subverting expectations is risky; it goes against how people express and relate to meaningful things. Similar to what was discussed earlier in response to RQ1, *unanticipated cueing through personal photos or other things may be unwelcome*. What may inspire delight the one moment, could instil dismay at another time, or simply leave one cold. Cueing, even if involuntary, depends on personal relevance, thus what aspects of the environment someone considers relevant. This depends on current context and what in this context stands out. Fairly mundane things that are always there can also stand out, if relatable to someone's frame of mind (Chapter 4).

The above argument suggests that *having a meaningful experience is an alternative criterion for success for serendipitous reminiscing* because just surprise itself or the requirement of a 'leap of thought' is unlikely to satisfy all relevant cases in everyday life. This is particularly true if encounters are more frequent and thus less unexpected. For the design of interactive systems, this suggests a reduced reliance on the unanticipated element and more on inspiring meaningful moments when reminiscing.

The research-through-design approach adopted for the final studies (Chapters 7 and 8) took the above characteristics into account. As a basis for developing design concepts, Chapter 7 developed a model for interactive photo displays. In this model, we emphasised the relational aspect of serendipitous reminiscing, thus that its value lies in how well it connects aspects of the self, personal memories, the interactions, and the subsequent experience. Underlying the resultant design concepts in Chapters 7 and 8 is the aim to let people (re-)encounter digital photos in their collection. Through (repeated) viewing of these digital things, the design concepts may inspire people to arrive at a similar meaning as ascribed to physical things that can be placed in one's everyday living environment.

Evaluating serendipitous reminiscing was not directly possible in the third study (Chapter 7) due to its setup, although participants were able to express their expectations. This included strong concerns against designs reliant on surprise instead of a continued display of personal photos. Because dependency on surprise alone seemed unfavourable, we sought to alleviate these issues for the deployment of Phototype (Chapter 8) by always showing personal photos in the hopes that their presence could invoke reminiscing. The field experiences with Phototype (Chapter 8) also showed that it was *difficult to observe and qualify the occurrence of serendipity*. To some extent, this may be attributed to the fact that participants had pre-selected and were thus somewhat familiar with the uploaded photos. Nonetheless, people reported having several positive encounters that resulted in

momentary reminiscing or storytelling. It thus appears, despite the constraints imposed by the research context, that the prototype was able to inspire spontaneous reminiscing using digital photos. Also, these moments – alike the involuntary cueing studied before (Chapter 4) – were able to bring forth meaningful experiences. In correspondence with our argument here, *the kind of serendipitous encounters evoked through Phototype favoured the recognition of known moments*. Such rediscovery may inspire emotional responses precisely because it builds on prior meaning attached to these photos (echoing Frohlich, Wall, & Kiddle, 2012). This meaning may indeed become noticeable while, for example, framed photos do not elicit a similar response due to their everyday ubiquity and recession into the background of attention (as we concluded in Chapter 4).

Thus, to recapitulate, serendipitous reminiscing gives an opportunity for people to consider personal relevance in response to a chance encounter with evidence of their past. Because it is fleeting and contextual, its further study should also cater to in-the-moment reporting. This would be similar to our diary study, as we shall discuss amid suggestions for future work in §9.4.1. Although we also discuss a number of ways in which technology may support reminiscing in the next paragraphs, additional insight is welcome to understand what makes certain moments serendipitous (and how personal media play into this). Stronger insights into how serendipity is elicited could inform the design of serendipitous technologies, including but not limited to the presentation of personal media that enable such serendipitous moments to occur. We believe that the characteristics we set out in Chapter 3 are reflected in the data of our final design study, but follow-up studies could further explicate how people determine personal relevance of shown media and create personal meaning. These two aspects are key to making a personally relevant realisation, which itself is key to serendipity.

9.2.4 RQ4 – How may interactive technology support serendipitous reminiscing through the use of personal digital photo collections?

Here, we reflect on insights gained that are pertinent to how technology influences and evokes serendipitous reminiscing. This precedes our outline of design considerations in the following section. So far, we concluded that serendipitous reminiscing is characterised by unanticipated encounters with things that remind of one's past. These encounters may result in people experiencing a meaningful moment. A key assumption for this thesis has been the notion that technology may inspire such encounters if done right.

The diary study on involuntarily cued remembering (Chapter 4) suggested that *digital photos are underrepresented among involuntary memory cues*. The notable exception was images on social media (e.g., Facebook), perhaps because people have limited control over what they will see once they log on (which seems part of the appeal of such media).

Like earlier work on digital photo collection management (e.g., Crabtree et al., 2004; Whittaker et al., 2010), this notion challenges the assumption that having (digital) photos is sufficient for reminiscing to occur. Instead, work is needed to bring these to people's attention.

To better understand how technologies may do so, the second half of the thesis explored several approaches to the design of interactive systems for serendipitous reminiscing. Alike many prior design efforts (Chapter 6), we opted to use digital photos given the strong tradition of using photos for reminiscing and portrayal of social relations.

Serendipitous reminiscing is strongly dependent on the ability to relate any (digital) things to one's current context or situation in life. Thus, the implication for design is that a technology's ability to fit in with contextual factors is valuable to invoke serendipity. However, as we shall discuss below, there is insufficient sensitivity to context among current designs (including our work here), such that we were reliant on a randomised process to pick digital photos to display. We give further pause to this concern later on (§9.3.4) because it is challenging to assess the content of photographs (or other personal media) and match this to the context in which such a display technology may find itself. This issue is compounded by the fact that serendipitous reminiscing is a fairly rare occurrence (we were unable to assert exactly how rare in our last study).

People's experiences with the display of personal photos depend on the ability to connect with the material put on display. Based on a critical review of other designs for remembering (Chapter 6) and the empirical insights we gained through our research-through-design (Chapters 7 and 8), we reiterate that an interactive system's value resides in its usefulness for reminiscing (cf. Sellen & Whittaker, 2010). This usefulness is ultimately determined by its content (the photographs) and the presentation thereof. While we focus on the latter in our design studies, the preferences of participants suggest a closer look at the photo selection process is warranted. Some photos are more valuable than others for revisiting as we outlined in response to RQ1 (e.g., social photos of family and friends, rather than locations). This conclusion is expected and similar to earlier work on domestic photo framing (e.g., Chalfen, 1987; Petrelli et al., 2013; Sarvas & Frohlich, 2011).

Regarding presentation, a key difference with physical things is the relative abundance of digital photos, so that new methods of utilising this ubiquity are required. *Our findings led us to conclude that guidance towards interesting photos or connections between photos ought to be higher in priority.* Phototype, showing at least two photos at once at any time, did however little to prompt people to consider potential connections between them. Thus, this is either something people are not interested in, or our current attempts have been unsuccessful in stimulating people to make these connections. This could be teased out

further with alternative design variations.

An interactive photo display is always part of the domestic environment. We focused on presenting personal photos at home. This means such a technological intervention is also made a part of a larger curatorial effort to portray one's (family) identity. The latter brings along specific contextual concerns that any designer of novel technologies has to content with. Based on our participants' responses, we conclude that *it is important for a system to remain flexible to changing demands.* To illustrate this, many of the conversations with participants in Chapter 7 concerned the appropriateness of displaying one's personal photos in a shared or social space, such as the living room. The ability to adapt functionality and content to changing context is, so we believe, crucial to interactive photo displays as beneficial and appropriate technology in the domestic environment. Simple means may, for example, include the ability to turn it off at least temporarily or to restrict the collection of photos on display to something amenable to a situation. This is however rather personal; some considered it an important issue, others felt that visitors entered their private space and would not be invited if that was deemed to cause discomfort.

We sought to investigate photo displays that aim to stimulate serendipitous reminiscing along two dimensions, namely in how both device and user negotiate agency and, secondly, temporal qualities. Using mock-ups to evaluate conceptual design ideas (Chapter 7), we concluded that participants preferred to glance at a photo display and be able to see something of interest, rather than unlock some surprise through their actions. Thus, to stimulate serendipity, we believe *it is commendable to make an interactive system easy to get into, without complications that make it less approachable.* For example, the designs that would always show photos were considered more favourable than those that did not. It seems this is because it matches prior expectations of what a domestic display should do. The two modes of Phototype that we evaluated over several weeks of domestic use gave rise to similar insights. The smaller photos-as-circles we used for the PhotoSoup mode were often ignored as the device ran afoul of the need for a glanceable viewing experience. Without the initial ability to raise attention, subsequent enjoyment of one's photos and the possibility for serendipitous reminiscing is diminished.

In the next section, we outline several considerations for design more concretely, followed by a discussion of limitations of the present work and suggestions for future work towards inspiring serendipitous reminiscing.

9.3 Considerations for design to support serendipitous reminiscing

This thesis covered studies on the particulars of involuntary cueing, remembering as experience, prior design work, and an iterative research-through-design process culminating in the deployment of a prototype for an interactive photo display. Every chapter discussed its finding in relation to the literature and the other work in this thesis. Here, we generalise our findings across the thesis and indicate in which way the findings contribute to the literature. Five considerations are introduced that we deem relevant to design practice and research around remembering in the context of everyday life. Each consideration will be clarified and discussed in terms of its implications for people's practices, for those interested in the design for serendipitous reminiscing, and where relevant, for methodological matters.

9.3.1 Encounters with personal photos in everyday life are welcome

The premise of this thesis rests with the idea that people care about personal media that represent their past. We also assumed that it would be appreciated to re-encounter these personal media such as digital photos. For this reason, we studied involuntary cueing of personal memories in everyday life. The recorded involuntary encounters were mostly rendered in a positive light. This is not surprising as people surround themselves with markers of a positive past (e.g., Csikszentmihalyi & Rochberg-Halton, 1981; Petrelli et al., 2008). Similar patterns also occurred for those cues that came into play away from the domestic environment. We gather that people tend to frame reminders of the past as either a neutral or positive aspect of everyday life. In the neutral case, it may be ignored in favour of other things, whereas in the positive case it could lead to a brief moment of reminiscing.

In the design studies, we moved to bring personal digital photos into everyday life, so that these photos may be appreciated and used to reminisce. A key takeaway from the deployment of Phototype (Chapter 8) is that on the whole, *the display of personal photos was perceived in a positive light*. Initial responses to the design mock-ups (Chapter 7) were ambivalent, but when deployed, our participants told of moments where the photos prompted them to consider their past. Sometimes, the value seen in these encounters came as a surprise, which suggests that the value of serendipitous reminiscing is not immediately apparent. It may take first-hand experience with photo displays such as Phototype to realise its value. We consider this value to be the ability to inspire serendipitous reminiscing and consequently, the opportunity to connect with one's past without the need for intention or effort from the observer of the photo display. Still, people's difficulty in anticipating this value means that designers face a challenge to overcome this initial hurdle. *We suggest that designers of interactive photo displays consider*

additional attractive qualities in their designs to spur initial interest. For example, to some participants, the swiping actions of Phototype's DualDisplay mode (Chapter 8) offered such an attraction.

As laid out in Chapter 1, a large number of people face an over-abundance of digital photos as the costs of capturing and storage have come down. Yet, the desire and ease to archive and curate these ever-growing collections has not kept in step with the volume, such that digital photos may be under-appreciated (e.g., Frohlich et al., 2002; Kirk, Sellen, Rother, & Wood, 2006; Petrelli & Whittaker, 2010). *Our evidence emboldens the idea that people may appreciate more frequent encounters with personal photos otherwise left unseen.*

For such an appreciation to happen, it is vital that someone can derive meaning from the encounter with a photo or set of photos. This meaning may be a short-lived positive feeling, instigating a brief conversation, or a deeper engagement. However, as Chapter 4 laid out, a photo (or other media) is not automatically valuable simply because we have it. This includes technically imperfect photos, duplicates, and photos that refer to events deemed insignificant. We believe that while this view is in itself not controversial, it is not acted upon consistently. Many less valuable photos remain in people's collections as that is simply the lowest effort option. As a consequence, these photos would be shown by photo displays and render such a device less able to elicit a meaningful response. A complicating factor is that photos that are currently rather mundane may in the future epitomise a meaningful past. Predicting such concealed value would prove rather challenging. Even so, our findings on involuntary cueing – along with prior research on domestic photography (e.g., Crabtree et al., 2004; Whittaker et al., 2010) – suggests that *photos depicting social relations, stand-out events such birthdays and other celebrations, along with imagery representing the lived environment, are more likely to gain value.*

Just as not all photos are appreciated or valuable, not all means to bring photos into everyday life are suitable. Some of the design mock-ups illustrated these issues clearly and were met with negative commentary (Chapter 7). Specifically, those designs that did not offer an always available viewing experience did not fare well. As such, we recommend that designs do not rely solely on a surprise factor. While serendipity is in effect surprising, it requires someone to make a connection with something. Without such a thing, the chances for serendipitous reminiscing are reduced.

Our conclusion is that the value of a photo display lies in the ability to enable people to have casual encounters with evidence of their past, such that people gain a positive experience. These encounters may happen in serendipitous fashion, via more deliberate interactions, or without the need for prior user intervention. We can see creative ways to acknowledge this consideration in future design work while maintaining additional value through

interactivity to surpass the passive digital photo frame. We outline several directions in the next section. Such explorations will allow deeper insights on how encounters with personal photos in everyday life contribute to positive experiences.

9.3.2 Reminiscing is a personal experience

Throughout this thesis we have highlighted the relation between reminiscing and experience. In our studies and many other works on memory and design for remembering, reflecting on one's past is deemed a (usually) healthy activity that gives rise to positive side effects. *We have also made a point of illustrating that remembering is in itself a kind of experience*, similar to how washing a car or spending time with friends are experiences. One may be duller than the other but both invoke feelings, relate to higher level life goals, and beget new thoughts that in some way connect to the events as they transpire. Such thoughts could move away from hands-on activities that require little cognitive effort (e.g., washing up dishes), or beget someone to find personal meaning in their present experience.

As we argued in Chapter 5, *personal meaning is constructed in an ongoing fashion as people go about their lives*. Aspects that are deemed relevant are considered, those not pertaining to someone's thoughts and state of mind are left in the background of everyday life. For instance, a static photo frame may not garner much attention on a day-to-day basis as it is entrenched in the domestic environment. If one day a family member shown on the frame passes away, this photo may feel relevant and be contemplated, perhaps to find solace. What is relevant at one moment may no longer be so the next.

Any thing that brings up the past also influences someone's present experience. A thing produces meaning and shapes someone's present and near future experience, which is – perhaps only momentarily so – swayed by reminiscing about the past events brought to attention. This use of things for the generation of meaning is personal. It is idiosyncratic and therefore difficult to 'see' meaning in a similar way for those not in the know. After all, it is about what someone brings to the material and how meaning is perceived and assigned to things (Kirk & Sellen, 2010). As a consequence, this challenges technological systems to anticipate potential meaning, contextual relevance, and what the display of a particular photo may affect an individual if memories are indeed cued. Earlier, we discussed several pointers from our studies as to which kind of personal photos are more likely to arouse appreciation, although we ought to remark that such likelihoods are just that: reasonable assumptions that may at times fall flat for a variety of reasons. This ought to invite designers to consider other means of managing matching system capabilities with people's desired experiences.

For design to support reminiscing, it must consider how it aims to relate to someone's

experiences and to what extent the designers of interactive systems deem themselves comfortable influencing this. As interactive systems assert influence, these systems (and by extent, their designers) also gain responsibility towards someone's experience. The study documented in Chapter 7 made clear people prefer their boundaries to be respected. As we shall discuss for the last consideration further below, in being a potentially powerful influence on someone's experience, it also requires empathy for these experiences. For this reason, we suggest that an interactive system ought to readily adapt to people's (experiential) responses. While this link is crucial (as several of the negative examples in Chapter 7 laid bare), exactly how a system may do this is a direction ripe for future attention (as we discuss in the next section).

Finally, we consider that a strong understanding of the connection between remembering, experience, and the evocation of serendipity is fundamental for future design efforts. This motivated the second study that attempted to qualify remembered experiences (Chapter 5). We have given preliminary handles for designers to understand the kind of experiences that evolve from reminiscing. While more work would be required to apply the outcomes to design practice (see also §9.4.1), we believe a more thorough appreciation of remembering-as-experience is helpful to guide the design of interactive systems that can adapt to those whom such designs seek to influence. The design studies that followed reinforce this notion because in their evaluation, the focus during the post-deployment interviews was primarily on how people felt the device nudged their experiences through the display of personal photos.

9.3.3 Photo displays are part of a wider context

We have established that remembering happens in context and that this context informs and shapes someone's ongoing experience. Based on our findings, we also observed that there may be a place for interactive photo displays to support reminiscing in the context of everyday life. It is in this context that the display performs its work as an influencing factor, amid many other elements that vie for attention. Within the distributed cognitive ecologies that make up our everyday environments, the key factor is how particular elements contribute to and complement our thinking.

The foremost implication that we may derive from this is the acknowledgement that the display of photos is in service of other goals. *Showing photos is not the goal; it is a means to elicit encounters with personal media that inspire someone to appreciate their past and reminisce.* In turn, reminiscing is itself a means to accomplish a number of functions to regulate wellbeing, which includes mood regulation, finding one's purpose in life, socialise, and deal with adverse thoughts (Bluck & Levine, 1998; Harris, Rasmussen, & Berntsen, 2014; Webster et al., 2010).

One ramification is that when a photo display is used to stimulate reminiscing and reflection on one's past, it is not about what is shown by this system, it is not about what is done with this system, but rather, it is about how people incorporate it into their thinking and everyday practices. This influence is what gives an interactive system its value. *The point of the system is to support and complement reflective processes that are already latent, which through the right cues may be brought to the surface.* Serendipity often stems from an inference that was seemingly out of reach before, and yet only required something of tangential relevance to come to the fore (Andel, 1994; Merton & Barber, 2004). This relation, the tangential relevance, is what matters over the purely factual content of any photo put on display.

Therefore, *the design of interactive photo displays ought to focus on the elicitation of meaning.* The meaning invested and the meaning taken from things relative to their context is what counts to influence serendipity and, by extent, reminiscing. To make this suggestion more concrete, we connect back to the introduction of this thesis, in which we discussed thing theory (Brown, 2001). It is by asserting their thingness that objects, whether physical or mediated (as with digital photos), exert influence on the thinking process. This thingness conversely depends on the relationship fostered between the subject (person) and the object itself. We also considered that relationships between things might evolve into multiple elements ascertaining some amount of influence on the thinking process (that is, like a distributed cognitive ecology (Hutchins, 2010)). Ideally, this happens in a way that complements thinking (supportive) or is able to steer it into new directions (suggestive).

The guiding principle for the design of interactive systems begets a focus on supportive and suggestive abilities. We exemplify these directions briefly. Supportive abilities complement the current context by adding onto it. For example, the Listener concept (Chapter 7) was designed to augment ongoing conversations with photos relevant to the current topic. In contrast, Watching For You (Chapter 7) and Phototype (Chapter 8) intend to sway someone's interest by steadily introducing new material. Suggestive abilities thus require a greater emphasis on the contribution a system could make to the (evolving) context of its use, rather than an emphasis on particular ways of showing photos, transitions, and other practical interface details. The design studies documented in Chapters 7 and 8 did concern themselves with some of these practical elements as we set out to explore this suggestive area. However, these studies did little in the way of exhibiting explicit intentions as to the kind of thinking these wanted to influence, and instead left this 'reading into' of meaning mostly to the observer. It may be possible to take a more directive stance, as done with for example Pensieve (Cosley et al., 2012), which prompted questions to users to steer their thoughts. Still, Pensieve's design randomised the selection of cues for reminiscing.

We believe it may be helpful to direct the selection of things to show (e.g., digital photos) to link the past with the current situation, whether such a link is based on date, season, colours, people present, or other contextual factors. The guiding principle is that a system becomes contextually aware. Then it may be able to build on this knowledge to underline its role, namely to inspire serendipitous reminiscing. While this subsection considered a conceptual approach to let designs take the initiative in eliciting serendipitous encounters, the following consideration further addresses such guidance from a more practical, content-oriented perspective.

9.3.4 The value of photo displays depends on the photos

We realised during the design studies that for photo displays to succeed at influencing people and inspiring reminiscing, the answer lies in the photos shown. While acquiring the ‘right’ photos is primarily a user-led endeavour, designers of interactive systems may strive to help people get the most out of their device. A system can suggest or otherwise cater to a good balance of its source material. Namely, a good mix of familiar, meaningful images together with some unfamiliar, perhaps forgotten photos that could be meaningful goes a long way to ensure the presence of an interactive photo display is making a valuable contribution to the domestic environment. Conversely, as we surmised in our discussion of Phototype (Chapter 8), photo displays may not work well without some attention devoted to the collection on show.

To support our argument, let us step back to the nature of reminiscing. Reminiscing is a focus on the past with the intention to reflect, relate to oneself and others, find meaning in one’s past and present, and do so in a manner that brings forth affective qualities (e.g., Harris et al., 2014; Webster, 2003). *The extent to which reminiscing allows for the realisation or generation of meaning rests with the ability to find such meaning, either in oneself or something external to the self.* Serendipitous reminiscing as we have defined it in this thesis (Chapters 1 and 3) expects that meaning is realised by the involuntary observation of some marker of the past (e.g., a souvenir, a photo, an old piece of clothing). In that moment of realisation, meaning is further cultivated so that subsequent encounters with that same thing (or something closely related) build on prior developments. This connection between a thing and personal memories relies on that thing to indeed be a thing. Following Brown (2001), asserting thingness is a quality of those objects that, if observed, exude meaning that is readily incorporated into one’s thinking.

This realisation ought to motivate designers to consider how photo displays support the curatorial process. *If we frame photographs as enablers of serendipity, how does an interactive system help in getting the ‘right’ photos to display?* As we laid out above, the ability to establish a meaningful connection depends on how relevant a thing is and on how salient its premise is (that is, perhaps unanticipated but interesting nonetheless). We believe that

interactive photo displays have an important role to play in the selection of materials that could foster a connection.

An important first step for designers is to resolve the tension around photo selection because the success of a photo display system depends on this selection process. This tension comes as two competing motivations collide. First, as we concluded from the design studies and the discussion of design mock-ups in particular (Chapter 7), people are reserved about the kind of photos they feel are desirable to have on display. This finding builds on well-established practices around domestic photo framing (e.g., Sarvas & Frohlich, 2011; Slater, 1995). This framing is a deeply social act and is perhaps risk-averse. Paradoxically, it is in this risk, the unanticipated, that serendipitous reminiscing would manifest itself. Fixed photo frames that reside in the background of everyday life may not satisfy the first criterion (i.e., being novel and noteworthy), and many digital photos are unlikely to meet the latter – that is, being interesting and relevant enough to move into the centre of attention, even if momentarily. In addition, the requisite curatorial process is dreaded as has been previously established (e.g., K. Rodden & Wood, 2003; Whittaker et al., 2010). Irrelevant or not truly meaningful cues are a mere distraction, whereas those that fit the above criteria would indeed foster a more positive response. In the remainder of this subsection, we reflect on several design directions for reducing the tension between strongly ‘prescribed’ domestic photography practices and the need for more dynamic, unanticipated encounters to stimulate serendipity.

In Phototype (Chapter 8), we sought to reduce this tension by introducing simple curatorial interactions (e.g., swiping away undesired photos) as a good way to evaluate people’s desire to use such tools. It did, however, fall short of our expectations. Perhaps we did not provide the right tools that people desired (such as more permanent ways to hide photos), or it was the omission of strong support mechanisms during the initial selection and uploading phase. These things may improve as people revisit the uploaded collections when deployments last longer and require a refresh or addition of the available photos on display. Still, *the low uptake of interactive features in Phototype prompts the view that people tend to prefer the device to display photos and not rely on management-heavy or interactivity-dependent ways to engage with the system.* Providing what we dubbed a basic viewing experience (Chapters 7 and 8) is key to both serendipity and reminiscing. This does, however, require a reframing of its ‘use,’ which we initially envisioned as something involving more intensive user-system interactions.

Recognising the position photo displays may take in practices of reminiscing puts further emphasis on the initial process of selecting photos that will be on display later. Although meaning may be cultivated to develop over time, this would require some emotional investment that not every digital photo is worthy of. Many photos are not as valuable

as we think these will be at the moment of their capture (Whittaker et al., 2010). Taking this diversity in the meaningfulness of digital photos into account, whether via user feedback or some machine learning mechanism, is likely hard. As suggested earlier, what people read into a photograph may only be tangential to its actual content, such that understanding this connection between a photo and related memories on the basis of the photo alone may be incomplete (and thus hard to automate or leave to someone or something else). It represents a formidable challenge for the design of new interactive technologies. Our exploration of the matter has given some preliminary insights into what may or may not work, but there is certainly much ground left to cover. Indeed, the literature on domestic photography suggests several heuristics for personal importance based on familial relations and friendships (Sarvas & Frohlich, 2011), events during typically important and formative years (e.g., around the reminiscence bump (Rathbone, Moulin, & Conway, 2008)), collecting practices (Marshall, Bly, & Brun-Cottan, 2006; Watkins, Sellen, & Lindley, 2015), and perhaps (if means for visual recognition would be employed) the detection and entrance of new people and places into someone's life. Some low-hanging fruit would be the exclusion of duplicate photos (e.g., Platt, Czerwinski, & Field, 2003) along with removing various technical mishaps (e.g., blurry photos).

Because curation has noted drawbacks, we also suggest another viewpoint that future research may consider. *Instead of trying to forge concrete links between photos and emergent reminiscing, it can be worthwhile to leave room for ambiguity so that people may fill in the gaps as they see fit.* Such ambiguity (in the vein of Gaver and collaborators (Gaver, Sengers, Kerridge, Kaye, & Bowers, 2007; Sengers & Gaver, 2006) and Benford et al. (e.g., Benford et al., 2003)) is an alternative way to trigger serendipity rather than via randomness or careful curation. Similar to randomness, ambiguity is open-ended and relies on people making an appropriate connection, but it differs in the sense that interpretation is required to make sense. In creating clarity for oneself about the ambiguous system (or what it aims to portray), serendipity may occur. Ambiguous systems may still run into the problems that we identified for randomised display, included undesired encounters. However, as we touch upon in the final consideration, the perceived meaning of one's past and thereby the desirability of cues related to this past is ever evolving.

9.3.5 Involuntary cueing can be undesired

In several places across this thesis, *the observation was made that some photos (like other things) can be disturbing, not fitting the present context, or be unwelcome in other ways.* An example is the scarf first mentioned in Chapter 4, because it provoked a strong emotional response where it used to signify a different, positive relationship. Similarly, photos of now deceased relatives would have seen a change in significance since their capture. For this reason, the final consideration for design appeals to graceful adaptation.

In those situations where a design's aims and effects are at odds, it ought to be possible for either party (a system and its user) to recover from earlier missteps. Earlier in this section, we made a case for the guidance towards interesting photos (or other media), hereby allocating some curatorial agency to a technological system. We have argued that interactive systems that aim to support reminiscing ought to play into the context of their use, be it in exhibited behaviour or the selection of personal media from a larger collection. With that comes a responsibility of the system's designer to acknowledge and handle mishaps.

As we saw in Chapter 4 when discussing involuntary cueing, interactive systems may have to refrain from showing photos or otherwise curb the technological ability to do so if it turns out doing so has adverse effects. For example, a photo depicting a nice holiday trip together with an ex-partner may be rather unfortunate if a new date is coming over. Computing systems may not be able to decipher and understand photos as contextually (in)appropriate cues. This should be reflected in the interaction design. To illustrate this, consider the swiping actions included in the DualDisplay mode of Phototype (Chapter 8). While the idea to remove photos from view was sound, its implementation made sure such photos featured less often but would not disappear forever. Nonetheless, certain photos would certainly be hidden if this were possible (e.g., bills or other photos of short-lived utility). A more robust system could cater to the underlying (lack of) appreciation for such photos in a more granular fashion. At this time, the swiping fell short.

It is likely future systems that attempt to be 'smart' in assessing the fit of photos with a particular moment remain with a simplified view of its place in relation to the context. It is unlikely technological means develop significantly (at the least in the foreseeable future) for interactive systems to truly grasp what meaning people may read into particular personal photos and consequently, how relevant or evocative these materials are.

When a system inevitably fails, we believe it must do so gracefully. By this we mean that a device must be open to the possibility that it is wrong and allow those to be unpleasantly taken with the system to reduce, retreat, or reset its interactive behaviour. The responses to some of the design mock-ups (Chapter 7) made it clear that a bad neighbour is worse than no neighbour, hereby playing to the concerns of Schwarz on the ubiquity of personal media in everyday life (2014).

Several solutions present themselves, such as a straightforward off or mute function, but more adaptive approaches are harder. This would be hard for two reasons. First, it requires a not insignificant amount of knowledge on machine learning paradigms that is likely not among the skillsets of most interaction designers. Second, it presents methodological and ethical issues for its study. If future research requires the evaluation of how well an interactive photo display can adapt to perceived discomfort, it walks a fine line between

introducing such discomfort and not being able to reach methodological validity. This is because an ecologically valid study requires a real situation with real cues that could make someone uncomfortable, which invites ethical concerns. A study would have to reduce such discomfort and accept the limits this imposes for answering research questions.

In conclusion, *we believe that to fail gracefully is to adapt appropriately*. Whether such adaptation is automatic through sensing and computational insight or through interaction design principles that allow people to make their desires known remains an important question that future research can address.

With our insights summarised and translated into the above five considerations, we have made clear how the research reported in this thesis contributes to research and design practice. These considerations should be interpreted to guide the interested reader than be prescriptive. We continue with outlining several limitations to the present work and areas where future work on the design for serendipitous reminiscing can make its mark.

9.4 Directions for future work

In this thesis, we observed that things can involuntarily cue personal memories and invoke reminiscing. We developed a number of design concepts to promote the use of personal photos to inspire serendipitous reminiscing. The final study affirmed that such moments occur amid people's everyday activities and that these moments can result in brief but positive experiences. The design concepts contributed to our understanding of how interactive systems can support remembering. Below, we address limitations along with several ways in which future research can build on the studies presented here.

9.4.1 Reminiscing and the relation to experience

We believe a deeper understanding of remembering as experience can guide the design of interactive systems that support people to think about their past, reflect, or share stories.

We have made the connection between experience as an ongoing phenomenon – which encapsulates feelings, situatedness, and a sense of meaning (e.g., Hassenzahl & Tractinsky, 2006; Hekkert, 2006; McCarthy & Wright, 2004) – and in relation to this, remembering. We have argued that remembering can bring up aspects of emotion, relatedness, and meaning, mimicking the essence of experience. To that end, the repertory grid study (Chapter 5) sought to establish a phenomenological view on remembered experiences. Participants were asked to deconstruct a small number of events from their past to arrive at meaningful constructs that give insight into their experiences. It is possible that these retrospectives were influenced by later thoughts on the topic since it transpired, as indicated by theories on the constructive nature of memory (e.g., Conway, 2005; Schacter, 2012) and the pervasive role of context (e.g., Suchman, 2007). However, for the purposes of our research, this is not immediately problematic. First, because we

were interested in descriptions of experience: the description of a somewhat altered experience still suited the goals for the repertory grid study itself. Second, someone's experience is always a product of both one's internal world and influences outside of it, such that attempts to capture and bottle an experience in the absence of such contextual factors are unavailing.

An epistemological concern with the repertory grid study involves its deconstructive phenomenological approach. By picking apart the particulars of someone's remembered experience, the study opted for a more controlled recollection in lieu of contextual factors. This is a conceptual departure from the other studies, which operated on the basis that meaning rests in (inter)actions in context, a view in accordance with Dourish (2001; 2013) and others (Abowd & Mynatt, 2000; e.g., Suchman, 2007). While evaluating remembered experiences in isolation, we realised that it proved challenging to translate our findings to insights for design (which would cater to the complexity of everyday context). *This means there is room to reconcile these two different paths to understand how remembering and experience relate.*

The bridge between our incursions into remembering as a phenomenological event and the design for serendipitous reminiscing is, in our understanding, the narrative that people construct. As a design invites attention via its display of a photo, it would lead to the development of a narrative. People create this to interpret the story of the depicted moment, related moments and the period more generally, as well as how it informs the larger narrative of the self and the relation to others. In this process meaning is developed that could reflect back on the particular photo (or any other kind of media) on display. *Thus, to better understand this cycle, interaction designers could look into this creation of a narrative.* Our fourth study primarily captured a retrospective, and the diary study captured a summary of the serendipitously developed narrative. Future work could aim to capture 'in the moment' narratives, either through recorded stories, probes, or a participatory approach through which richer narratives flow between users of interactive displays and designers. This would help to link particulars of a design with the developing narrative and experiences. This suggestion is empathically not a deconstructive process like we followed in Chapter 5 but rather, it serves to bridge the distance between participants' experiences and understanding of designers.

9.4.2 Inspiring reminiscing in everyday life

The work presented here has contributed to the understanding of involuntary memory cueing in everyday life. In Chapter 4, diaries illustrated the circumstances of this kind of remembering, the kind of things and situations that bring these moments to the fore, and how people derived meaning from (sometimes serendipitous) encounters with reminders of their past. And in the final study, the use of Phototype allowed participants

to encounter a subset of their personal photo collection for similar purposes. Based on the post-deployment interviews, we concluded that the use of Phototype indeed inspired occasional reminiscing. But the limited data that we were able to collect during the deployment could not give a more detailed assessment of the circumstances, feelings, and other experiential qualities in the moment of the encounters.

In-depth explorations of serendipitous encounters may shed additional light on how, when, and why Phototype and other interactive personal media displays are paid attention to. The deployment reported in Chapter 8 omitted such investigations for we opted to make people's time with Phototype as authentic as was reasonably possible. For example, future work building on this line of inquiry may request members of a household to record notable moments in which the prototype played a role (akin to the diaries of our first study). Second, and likely more contentious in terms of participant approval, the device itself could record more data and track gaze as a proxy for attention. Together, this may shed more light on the ways in which interactive photo displays support reminiscing in everyday life.

It is important to consider that a photo display like those that we reviewed, proposed, and evaluated (Chapters 6, 7, and 8) do more work than simply elicit involuntary cueing or offer ways to explore one's photo collection. These photos and their displays have value on their own. These assert a place in the domestic sphere for the events and people depicted (e.g., Chalfen, 1998; Csikszentmihalyi & Rochberg-Halton, 1981). This environment has been crafted and negotiated by the inhabitants to represent both identity and other motivations of personal comfort, as advocated by (among others) Kirk and Sellen (2010) and Petrelli et al. (2008). Furthermore, changes to this negotiated space by the introduction of, for example, Phototype beget new considerations of how such a thing fits into existing domestic practices. Keightley and Pickering (2014) use this notion to motivate further explorations of how new means of remembering through photography relate to established patterns of use. It may certainly be that the three to five weeks afforded to Phototype were insufficient for long-standing practices to adapt and incorporate this technology. Both Fawns (2017, p. 193) and van Dijck (2008) call for attention to these complex transformations of practices, both in the short and long term. Using Phototype, we were able to discern the initial take-up and gather reflections on its functioning and perceived usefulness. Investigations towards the longer term would benefit from several changes to Phototype itself (as we documented in Chapter 8). *Thus, future explorations may concern themselves with the prototype's place in the domestic sphere and in relation to longer standing family practices around reminiscing, storytelling, the role of each individual household member's past to the family unit, and how Phototype or another interactive system slots into this dynamic.*

With regard to the last point on familial relations, Kirk and Sellen (2010) have argued for the home as a ‘negotiated space’ between family members. Phototype and similar domestic systems could benefit from the design for a larger unit of users rather than the mostly individual focus we have taken. A straightforward way to broaden the focus would be to include other household members in the participation process, both during the initial phases and at the end. This ensures more voices are heard.

The above arguments also reinforce the choices made regarding Phototype’s deployment duration. The study set out to evaluate several of the conceptual qualities we identified through the use of mock-ups (Chapter 7) and provided necessary conceptual continuation into the domestic field. At the same, ‘sizing up’ this study through additional time or extra participants is unlikely to have rendered our present conclusions in a different light. However, provided a number of changes are made, Phototype may yet be useful for follow-up studies. For example, stronger curatorial control and an overhaul of the PhotoSoup mode will allow Phototype to better stimulate serendipitous reminiscing.

In the design studies, we focused on digital photos as cues for reminiscing. For this reason, our conclusions apply primarily to photographs and similarly visual things. *It is reasonable to think that our suggestions also have merit for other media, including audio, text, and perhaps (digital) souvenirs.* However, audio and video would require more time and attention from people when walking by, reducing the ability to garner spontaneous attention when someone walks by. Text may be too small if it is to be read from a modest distance (where we saw Phototype find most of its ‘use’). Thus, we reckon that each kind of media likely has its own optimum display system. It would however be interesting to see if a serendipitous audio ‘display’ with similar properties to Phototype fares differently, and if so, in which ways, as it can tell us about the various properties for serendipitous media displays.

9.4.3 Exploring the sense of photo use

While this thesis has expounded on the idea that getting in contact with photographic evidence of our past can be a positive experience, we acknowledge its limits. A greater reliance on technology-mediated cues for remembering may sometimes be detrimental, as it can prevent people from truly remembering their past experiences (Singer & Conway, 2014). On the other hand, a lack of such cues may also be undesirable because it causes people to miss out on opportunities to reminisce and get in touch with their past. We believe that interactive systems, like other elements that make up someone’s distributed cognitive ecology, should strive to supplement the remembering process. Rather than replacing the need to make sense of particular photos or cues, these should be presented for consideration. It may then be taken up if deemed interesting or relevant, or ignored as other matters take priority. As Sutton explains (2010), things external to the mind

need not mimic or supplant functions of the mind, rather these should seek to extend and complement our cognitive abilities. This holds that *systems that aim to complement autobiographical remembering should explore the ways in which remembering makes connections between the past and photographic evidence*, so that it may allow for the display and exploration of hopefully relevant photographic material.

Randomised selection of photos for display, the approach we adopted for the design studies (Chapters 7 and 8), perhaps fell short on presenting photos that are in some way relevant or meaningful to someone's current thoughts and experience. While the guiding idea behind serendipity is precisely the value of unexpected encounters, its advocates (such as Ansel, 1994; Merton & Barber, 2004) also put forth the notion that without at least some tangential relevance, encounters may be insignificant and fail to persuade further consideration. *In which ways interactive photo displays may tune into tangential relevance is open for further exploration*. It is however a theme roaming underneath the surface of many studies (as we noted in Chapter 6), including the present work. We give some pointers below based on our findings to lead the way for future work in this area.

One realisation from the diary study (Chapter 4) is that people's sensitivity to particular cues, such as photographs, is highly context-dependent in ways that will be hard to grasp for those not in the know. This difficulty certainly extends to technological agents that attempt a similar understanding. However, while perfection is not on the cards, insights may be gained from the application of machine learning methods to gauge the value and appropriateness of showing certain categories of photos in particular situations. Given the volume of digital photos that people acquire and the relative disinterest to sort this manually (K. Rodden & Wood, 2003; Whittaker et al., 2010), *future explorations may have to rely on technological means to find things of relevance in the content of people's digital collections*. These explorations could proffer insights into the depth of the issue and perhaps qualify the level of difficulty in making interactive photo displays adaptive to the variant nature of reminiscing in an everyday context. Along this avenue, we also see opportunities to explore the evocation of serendipity through better control over the frequency of exposure to certain (types of) photos, time delays, perhaps even the measurement of time glanced at particular photos as a proxy for the viewer's interest.

Taken together, if a photo display can successfully tune into the aforementioned behavioural data, it may enable such an interactive system to walk the line between personal relevance on the one hand and the unanticipated on the other. Doing so, a device can ensure sufficient defamiliarisation with a particular (collection of) digital media to make it appear fresh (in line with Frohlich et al. (2012) and Leong et al. (2011)) and, ideally, a welcome encounter with the past. It would allow, as Frohlich et al. (2012, p. 738) propose, for a 'creative attempt to make sense' to occur that goes beyond the

reconstruction of a memory of the past.

9.4.4 Exploring the role of interactivity

Finally, we opt to briefly describe a concern flowing from the design direction we have pursued and which, if followed through, implicates reduced opportunities for interaction design.

Phototype saw a lower than expected uptake of its interactive features. It is likely this was due to its particular implementation, however, *if Phototype's low uptake is indicative of a larger trend it would suggest that interactive features have little appeal for this particular form factor*. Thus, further research into the design for this particular design niche would seem less promising. Perhaps the approach taken in the design of Phototype (and the earlier concepts it built on) was too careful and refrained from extravert attempts to engage. In contrast, the design of Meerkat (Helmes, O'Hara, Villar, & Taylor, 2011) was more audacious but still dependent on someone taking the time to give it attention. Both designs have in common that they are small in size. A bolder move would be to increase the size (as some suggested to us in Chapter 8) and thereby make a photo display more prominent. Doing so would conversely increase the chance to miss the mark and spark annoyance rather than serendipity.

The studies in this thesis have qualified in broad strokes what kind of imagery people prefer to see (e.g., family and friends), although the diary study (Chapter 4) also made clear that a much wider variety of things is welcome to cue personal memories. Thus, a restriction of materials does not necessarily lead to increased chances for serendipitous encounters. In fact, this may be counter-productive. Serendipity is likely to result from the observation of something that is at least somewhat unfamiliar to the extent that someone must feel the desire to re-examine it such that new thoughts on the matter may emerge. *This suggests that interactive systems face a trade-off in the kind of materials shown*. A selection that includes many meaningless or out-of-place images may feel too 'random' and fail to fulfil the traditional role of domestic photography (e.g., Chalfen, 1987; Sarvas & Frohlich, 2011), while a too narrow selection of known and desirable photos may fail to surprise or provide 'food for thought.'

Notwithstanding the possibilities of the niche discussed above, *there is plenty of space to improve people's experiences with interactive photo displays*. The dynamics of selecting photos for display, the way these photos are shown, and the ways in which people will be able to interact and perhaps explore related materials remains under-researched, in particular where it concerns the efficacy and experience of reminiscing. There is a need for an empathy-driven design process to make sure interactive systems support reminiscing and in turn, our ability to reflect, share stories, and manage our wellbeing.

9.5 Closing remarks

This thesis opened with the story of professional cyclist Carlos Sastre, who upon returning to the place where he sealed his Tour de France victory, opted not to ride and re-encounter every twist and turn of his memories. Instead, he felt better to leave his memories of that day as they were. In many pieces of fiction, cycling is used as a metaphor for life itself (e.g., *The Rider* by Tim Krabbé (1978)). Often, the message is that in life, like cycling, one must pedal ever onward for there is no respite. The present, much like the road beneath one's wheels, zips by and becomes the past. Even if the path loops around and revisits the same places, these have been transformed by all that the rider has seen since, unlikely to be rendered in the same light as before. Similarly, personal digital media are also interpreted in a different light as time goes on. The perceived meaning of these media is not static.

This thesis sought to explore how personal digital photos may be used more prominently to support people to casually reminisce in everyday life. We did so by focusing our investigations around what we called serendipitous reminiscing, a combination of involuntarily cueing of memories with photos that could inspire brief moments of thinking back on one's past. This serves both to delight and to help people to manage their wellbeing. The research concludes that the display of digital photos can indeed inspire brief moments of reminiscing related to the photographic content. This represents a valuable purpose for a type of digital media that people are keen to collect but otherwise unsure of how to give a proper use to afterwards, which tends to lead to under-appreciation of these digital media. Our insights contribute to the understanding of serendipitous reminiscing and how designers of interactive systems can address the inherent challenges. Although these findings are encouraging, we envision that future work can take this further to complement our understanding on the place that personal digital photos take in everyday life, in relation to interactive displays, and how these complement our ability to reason about ourselves in the past, present, and future.

Bibliography

- Abowd, G. D., & Mynatt, E. D. (2000). Charting past, present, and future research in ubiquitous computing. *Transactions on Computer-Human Interaction (TOCHI)*, 7(1), 29–58.
- Aipperspach, R., Hooker, B., & Woodruff, A. (2008). The heterogeneous home (pp. 222–231). Presented at the 10th international conference on Ubiquitous Computing, Seoul, Korea: ACM. <http://doi.org/10.1145/1409635.1409666>
- Alba, J. W., & Hasher, L. (1983). Is memory schematic? *Psychological Bulletin*, 93(2), 203–231. <http://doi.org/10.1037/0033-2909.93.2.203>
- Andel, P. V. (1994). Anatomy of the Unsought Finding. Serendipity: Origin, History, Domains, Traditions, Appearances, Patterns and Programmability. *The British Journal for the Philosophy of Science*, 45(2), 631–648. <http://doi.org/10.1093/bjps/45.2.631>
- Anderson, R. J. (1994). Representations and requirements: the value of ethnography in system design. *Human-Computer Interaction*, 9(3), 151–182. http://doi.org/10.1207/s15327051hci0902_1
- André, P., Schraefel, M. C., Teevan, J., & Dumais, S. T. (2009). Discovery is never by chance: designing for (un)serendipity (pp. 305–314). Presented at the 7th ACM conference on Creativity and Cognition, Berkeley, California, USA: ACM. <http://doi.org/10.1145/1640233.1640279>
- André, P., Sellen, A. J., Schraefel, M. C., & Wood, K. R. (2011). Making public media personal: nostalgia and reminiscence in the office (pp. 351–360). Presented at the 25th BCS Conference on Human-Computer Interaction 2011, Newcastle-upon-Tyne, UK: British Computer Society.
- Archer, B. (1995). The nature of research. *CoDesign*, 2(11), 6–13.
- Aron, A. P., Aron, E. N., Tudor, M., & Nelson, G. (1991). Close Relationships as Including Other in the Self. *Journal of Personality and Social Psychology*, 60(2), 241–253. <http://doi.org/10.1037/0022-3514.60.2.241>
- Baddeley, A. D. (1999). Essentials of human memory. Hove, England: Psychology Press/Taylor & Francis (UK).
- Bakker, S., van den Hoven, E., & Eggen, B. (2011). Knowing by ear: leveraging human attention abilities in interaction design. *Journal on Multimodal User Interfaces*, 5(3-4), 197–209. <http://doi.org/10.1007/s12193-011-0062-8>
- Bakker, S., van den Hoven, E., & Eggen, B. (2014). Peripheral interaction: characteristics and considerations. *Personal and Ubiquitous Computing*, 19(1), 239–254. <http://doi.org/10.1007/s00779-014-0775-2>
- Balabanović, M., Chu, L. L., & Wolff, G. J. (2000). Storytelling with digital photographs (pp. 564–571). Presented at the 18th SIGCHI conference on Human Factors in Computing Systems, The Hague, NL: ACM. <http://doi.org/10.1145/332040.332505>
- Ball, C. T., Mace, J. H., & Corona, H. (2007). Cues to the Gusts of Memory. In J. H. Mace (Ed.), *Involuntary Memory* (pp. 113–126).
- Banks, R., & Sellen, A. J. (2009). Shoebox: mixing storage and display of digital images in the home. Presented at the 3rd International Conference on Tangible and Embedded Interaction, ACM. <http://doi.org/10.1145/1517664.1517678>
- Banks, R., Kirk, D. S., & Sellen, A. J. (2012). A Design Perspective on Three Technology Heirlooms. *Human-Computer Interaction*, 27, 63–91. <http://doi.org/10.1080/07370024.2012.656042>
- Bannon, L. J. (2006). Forgetting as a feature, not a bug: the duality of memory and implications for ubiquitous computing. *CoDesign*, 2(1), 3–15. <http://doi.org/10.1080/15710880600608230>
- Baumer, E. P. S. (2015). Reflective Informatics: Conceptual Dimensions for Designing Technologies of Reflection (pp. 585–594). Presented at the 33rd Annual ACM Conference on Human-Computing Systems, Seoul, Korea: ACM. <http://doi.org/10.1145/2702123.2702234>
- Baur, D., Seiffert, F., Sedlmair, M., & Boring, S. (2010). The Streams of Our Lives: Visualizing Listening Histories in Context. *IEEE Transactions on Visualization and Computer Graphics*, 16(6), 1119–1128. <http://doi.org/10.1109/TVCG.2010.206>
- Belk, R. W. (1990). The Role of Possessions in Constructing and Maintaining a Sense of Past. *Advances in Consumer Research*, 17, 669–676.
- Bell, C. G., & Gemmell, J. (2009). Total Recall. New York: Dutton Books.
- Benford, S., Anastasi, R., Flintham, M., Drozd, A., Crabtree, A., Greenhalgh, C., et al. (2003). Coping with uncertainty in a location-based game. *IEEE Pervasive Computing*, 2(3), 34–41. <http://doi.org/10.1109/MPRV.2003.1228525>
- Berntsen, D. (2009). Involuntary Autobiographical Memories. Cambridge University Press.
- Bhömer, ten, M., Helmes, J., O'Hara, K., & van den Hoven, E. (2010). 4Photos: A Collaborative Photo Sharing Experience (pp. 52–61). Presented at the 6th Nordic Conference on Human-Computer Interaction, Reykjavik, Iceland: ACM. <http://doi.org/10.1145/1868914.1868925>
- Bluck, S. (2003). Autobiographical memory: Exploring its functions in everyday life. *Memory*, 11(2), 113–123. <http://doi.org/10.1080/741938206>
- Bluck, S., & Levine, L. J. (1998). Reminiscence as autobiographical memory: a catalyst for reminiscence theory development. *Ageing & Society*, 18(2), 185–208. <http://doi.org/10.1017/>

- s0144686x98006862
- Blythe, M. (2013). The hitchhiker's guide to ubicomp: using techniques from literary and critical theory to reframe scientific agendas. *Personal and Ubiquitous Computing*, 18(4), 795–808. <http://doi.org/10.1007/s00779-013-0679-6>
- Boehner, K., Vertesi, J., Sengers, P., & Dourish, P. (2007). How HCI interprets the probes. Presented at the 25th SIGCHI Conference on Human Factors in Computing Systems, ACM. <http://doi.org/10.1145/1250000/1240789/p1077-boehner.pdf>
- Bolger, N., Davis, A., & Rafaeli, E. (2003). Diary Methods: Capturing Life as it is Lived. *Annual Review of Psychology*, 54(1), 579–616. <http://doi.org/10.1146/annurev.psych.54.101601.145030>
- Bos, E. (1995). We can make forgetting impossible, but should we? *Interactions*, 2(3), 11–14. <http://doi.org/10.1145/208666.208671>
- Boyacioglu, I., & Akfirat, S. (2014). Development and psychometric properties of a new measure for memory phenomenology: The Autobiographical Memory Characteristics Questionnaire. *Memory*, 23(7), 1–23. <http://doi.org/10.1080/09658211.2014.953960>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <http://doi.org/10.1191/1478088706qp063oa>
- Breitbach, J. (2011). The Photo-as-thing. *European Journal of English Studies*, 15(1), 31–43. <http://doi.org/10.1080/13825577.2011.553895>
- Brereton, M., Robertson, T., Durick, J., Buys, L., Vaisutis, K., Vetere, F., & Nansen, B. (2014). Invisible Connections: Investigating Older People's Emotions and Social Relations Around Objects (pp. 1937–1940). Presented at the 32nd ACM Conference on Human-Computing Systems, Toronto, Canada: ACM. <http://doi.org/10.1145/2556288.2557314>
- Broekhuijsen, M., van den Hoven, E., & Markopoulos, P. (2017a). Design Directions for Media-Supported Collocated Remembering Practices (pp. 21–30). Presented at the 11th International Conference on Tangible, Embodied and Embedded Computing, Yokohama, Japan: ACM. <http://doi.org/10.1145/3024969.3024996>
- Broekhuijsen, M., van den Hoven, E., & Markopoulos, P. (2017b). From PhotoWork to PhotoUse: exploring personal digital photo activities. *Behaviour & Information Technology*, 3(2), 1–14. <http://doi.org/10.1080/0144929X.2017.1288266>
- Brown, B. (2001). Thing Theory. *Critical Inquiry*, 28(1), 1–22. <http://doi.org/10.2307/1344258>
- Bryant, F. B., Smart, C. M., & King, S. P. (2005). Using the Past to Enhance the Present: Boosting Happiness Through Positive Reminiscence. *Happiness Studies*, 6, 227–260. <http://doi.org/10.1007/s10902-005-3889-4>
- Bush, V. (1945, July). As We May Think, 176(1), 101–108. Retrieved from <http://www.theatlantic.com/magazine/archive/1945/07/as-we-may-think/3881/>
- Buxton, B. (2010). Sketching User Experiences: Getting the Design Right and the Right Design. Morgan Kaufmann.
- Bødker, S. (2006). When second wave HCI meets third wave challenges (pp. 1–8). Presented at the 4th Nordic Conference on Human-Computer Interaction, Oslo, Norway: ACM. <http://doi.org/10.1145/1182475.1182476>
- Bødker, S. (2015). Third-wave HCI, 10 years later--participation and sharing. *Interactions*, 22(5), 24–31. <http://doi.org/10.1145/2804405>
- Carter, S., & Mankoff, J. (2005). When Participants Do the Capturing: The Role of Media in Diary Studies (pp. 899–908). Presented at the 23rd SIGCHI conference on Human Factors in Computing Systems, Portland, Oregon, USA: ACM. <http://doi.org/10.1145/1054972.1055098>
- Cavalcanti, L. H. C. B., Pinto, A., Brubaker, J. R., & Dombrowski, L. S. (2017). Media, Meaning, and Context Loss in Ephemeral Communication Platforms: A Qualitative Investigation on Snapchat (pp. 1934–1945). Presented at the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing, Portland, OR, USA: ACM. <http://doi.org/10.1145/2998181.2998266>
- Chalfen, R. (1987). Snapshot Versions of Life. USA: Bowling Green State University Popular Press.
- Chalfen, R. (1998). Family Photograph Appreciation: Dynamics of Medium, Interpretation and Memory. *Communication & Cognition Monographies*, 31, 161–178.
- Chaudhari, C., Prakash, A., Tsaasan, A. M., Brubaker, J. R., & Tanenbaum, J. (2016). Penseive Box: Themes for Digital Memorialization Practices (pp. 398–403). Presented at the 10th International Conference on Tangible, Embodied, and Embodied Interaction, Eindhoven, NL: ACM. <http://doi.org/10.1145/2839462.2856552>
- Cohen, G. (1996). Memory in the Real World. Hove: Psychology Press.
- Colombetti, G., & Krueger, J. (2014). Scaffoldings of the affective mind. *Philosophical Psychology*, 28(8), 1157–1176. <http://doi.org/10.1080/09515089.2014.976334>
- Conway, M. A. (2005). Memory and the self. *Journal of Memory and Language*, 53(4), 594–628. <http://doi.org/10.1016/j.jml.2005.08.005>
- Conway, M. A. (2009). Episodic memories. *Neuropsychologia*, 47(11), 2305–2313. <http://doi.org/10.1016/j.neuropsychologia.2009.02.003>
- Conway, M. A., & Loveday, C. (2015). Remembering, imagining, false memories & personal meanings. *Consciousness and Cognition*, 33, 574–581. <http://doi.org/10.1016/j.concog.2014.12.002>

- Conway, M. A., & Pleydell-Pearce, C. W. (2000). The construction of autobiographical memories in the self-memory system. *Psychological Review*, 107(2), 261–287. <http://doi.org/10.1037/0033-295X.107.2.261>
- Conway, M. A., & Rubin, D. C. (1993). The structure of autobiographical memory. In A. F. Collins, S. E. Gathercole, M. A. Conway, & P. E. Morris (Eds.), *Theories of Memory* (pp. 103–162). Hove, UK: Psychology Press.
- Corbin, J., & Strauss, A. (2008). *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory* (3rd ed.). Thousand Oaks, California, USA: Sage Publications.
- Cosley, D., Sosik, V. S., Schultz, J., Peesapati, S. T., & Lee, S. (2012). Experiences With Designing Tools for Everyday Reminiscing. *Human-Computer Interaction*, 27, 175–198. <http://doi.org/10.1080/07370024.2012.656047>
- Cossins, P. (2015). *Alpe d'Huez*. Aurum Press Limited.
- Crabtree, A., Rodden, T., & Mariani, J. (2004). Collaborating Around Collections: Informing the Continued Development of Photoware (pp. 396–405). Presented at the 2004 ACM Conference on Computer Supported Cooperative Work, Chicago, IL, USA: ACM. <http://doi.org/10.1145/1031607.1031673>
- Crete-Nishihata, M., Baecker, R. M., Massimi, M., Ptak, D., Campigotto, R., Kaufman, L. D., et al. (2012). Reconstructing the Past: Personal Memory Technologies Are Not Just Personal and Not Just for Memory. *Human-Computer Interaction*, 27(1-2), 92–123. <http://doi.org/10.1080/07370024.2012.656062>
- Cross, N. (1982). Designerly ways of knowing. *Design Studies*, 3(4), 221–227. [http://doi.org/10.1016/0142-694X\(82\)90040-0](http://doi.org/10.1016/0142-694X(82)90040-0)
- Csikszentmihalyi, M. (1990). *Flow*. New York: Harper and Row.
- Csikszentmihalyi, M., & Rochberg-Halton, E. (1981). *The Meaning of Things*. Cambridge University Press.
- Csikszentmihalyi, M., & Sawyer, K. (1995). Creative Insight: The Social Dimension of a Solitary Moment. In *The Nature of Insight* (pp. 329–363). Cambridge, MA: Springer, Dordrecht.
- Dadlani, P., Sinitsyn, A., Fontijn, W., & Markopoulos, P. (2010). Aurama: caregiver awareness for living independently with an augmented picture frame display. *Ai & Society*, 25(2), 233–245. <http://doi.org/10.1007/s00146-009-0253-y>
- De Bono, E. (1993). *Serious Creativity*. HarperCollins.
- De Bruijn, O., & Spence, R. (2008). A New Framework for Theory-Based Interaction Design Applied to Serendipitous Information Retrieval. *Transactions on Computer-Human Interaction (TOCHI)*, 15(1), 5–38. <http://doi.org/10.1145/1352782.1352787>
- Desjardins, A., Wakkary, R., & Odom, W. (2015). *Investigating Genres and Perspectives in HCI Research on the Home* (pp. 3073–3082). Presented at the 33rd Annual ACM Conference on Human-Computing Systems, New York, New York, USA: ACM. <http://doi.org/10.1145/2702123.2702540>
- Desmet, P., & Hekkert, P. (2007). Framework of Product Experience. *International Journal of Design*, 1(1), 57–66.
- Desmet, P., & Pohlmeier, A. E. (2013). Positive Design: An Introduction to Design for Subjective Well-Being. *International Journal of Design*, 7(3), 5–19.
- Dib, L., Petrelli, D., & Whittaker, S. (2010). Sonic souvenirs: exploring the paradoxes of recorded sound for family remembering (pp. 391–400). Presented at the 2010 ACM Conference on Computer Supported Cooperative Work, Savannah, Georgia, USA: ACM. <http://doi.org/10.1145/1718918.1718985>
- DiSalvo, C., Sengers, P., & Brynjarsdóttir, H. (2010). Mapping the landscape of sustainable HCI (pp. 1975–1984). Presented at the 28th SIGCHI Conference on Human Factors in Computing Systems, Atlanta, Georgia, USA: ACM. <http://doi.org/10.1145/1753326.1753625>
- Donald, M. (2010). The Exographic Revolution: Neuropsychological Sequelae. In L. Malafouris & C. Renfrew (Eds.), *The Cognitive Life of Things* (pp. 71–79). Cambridge: McDonald Institute.
- Dorst, K. (2011). The core of 'design thinking' and its application. *Design Studies*, 32(6), 521–532. <http://doi.org/10.1016/j.destud.2011.07.006>
- Dorst, K. (2015). *Frame Innovation*. MIT Press.
- Dorst, K., & Cross, N. (2001). Creativity in the design process: co-evolution of problem-solution. *Design Studies*, 22(5), 425–437.
- Dourish, P. (2001). *Where the Action is*. Cambridge, MA: MIT Press.
- Dourish, P. (2004). What we talk about when we talk about context. *Personal and Ubiquitous Computing*, 8(1), 19–30. <http://doi.org/10.1007/s00779-003-0253-8>
- Dourish, P. (2006). Implications for design (pp. 541–550). Presented at the 24th SIGCHI Conference on Human Factors in Computing Systems, ACM. <http://doi.org/10.1145/1124772.1124855>
- Dourish, P. (2007). Responsibilities and Implications: Further Thoughts on Ethnography and Design. Presented at the 2007 Conference on Designing for User eXperiences, Chicago, IL, USA: ACM. <http://doi.org/10.1145/1389908.1389941>
- Dourish, P. (2013). Epilogue: Where the Action Was, Wasn't, Should Have Been, and Might Yet Be. *Transactions on Computer-Human Interaction (TOCHI)*, 20(1), 1–4. <http://doi.org/10.1145/2442106.2442108>
- Dourish, P., & Bell, G. (2011). *Divining a Digital Future: Mess and Mythology in Ubiquitous Computing*. MIT Press.

- Dourish, P., & Bell, G. (2013). "Resistance is futile": reading science fiction alongside ubiquitous computing. *Personal and Ubiquitous Computing*, 18(4), 769–778. <http://doi.org/10.1007/s00779-013-0678-7>
- Drazin, A., & Frohlich, D. M. (2007). Good Intentions: Remembering through Framing Photographs in English Homes. *Ethnos*, 72(1), 51–76. <http://doi.org/10.1080/00141840701219536>
- Durrant, A., Frohlich, D. M., Sellen, A. J., & Lyons, E. (2009a). Home curation versus teenage photography: Photo displays in the family home. *International Journal of Human-Computer Studies*, 67(12), 1005–1023. <http://doi.org/10.1016/j.ijhcs.2009.09.005>
- Durrant, A., Taylor, A. S., Frohlich, D. M., Sellen, A. J., & Uzzell, D. (2009b). Photo displays and intergenerational relationships in the family home (pp. 10–19). Presented at the 23rd British HCI Group Annual Conference on People and Computers, British Computer Society.
- Elsden, C., Kirk, D. S., & Durrant, A. (2015). A Quantified Past: Toward Design for Remembering With Personal Informatics. *Human-Computer Interaction*, 1–40. <http://doi.org/10.1080/07370024.2015.1093422>
- Fallman, D. (2003). Design-oriented human-computer interaction (pp. 225–232). Presented at the 21st SIGCHI conference on Human Factors in Computing Systems, Ft. Lauderdale, FL, USA: ACM. <http://doi.org/10.1145/642611.642652>
- Fallman, D. (2008). The interaction design research triangle of design practice, design studies, and design exploration. *Design Issues*, 24(3), 4–18.
- Fallman, D., & Stolterman, E. (2010). Establishing criteria of rigour and relevance in interaction design research. *Digital Creativity*, 21(4), 265–272. <http://doi.org/10.1080/14626268.2010.548869>
- Fallman, D., & Waterworth, J. (2010). Capturing User Experiences of Mobile Information Technology with the Repertory Grid Technique. *Human Technology*, 6(2), 250–268. <http://doi.org/10.17011/ht/urn.201011173094>
- Fawns, T. (2014). Photography and the disruption of memory and meaning. *Ubiquity: the Journal of Pervasive Media*, 3(1), 3–14. http://doi.org/10.1386/ubiq.3.1-2.3_1
- Fawns, T. (2017). *Blended Memory: Distributed Remembering and Forgetting through Digital Photography*. Edinburgh.
- Feixas, G., Geldschläger, H., & Neimeyer, R. A. (2002). Content Analysis of Personal Constructs. *Journal of Constructivist Psychology*, 15(1), 1–19. <http://doi.org/10.1080/107205302753305692>
- Felski, R. (1999). The invention of everyday life. *New Formations*, (39), 15–31.
- Finke, R. A. (1985). Theories relating mental imagery to perception. *Psychological Bulletin*, 98(2), 236–259. <http://doi.org/10.1037/0033-2909.98.2.236>
- Floridi, L. (2011). *The Philosophy of Information*. Oxford: Oxford University Press.
- Flusser, V. (2013). *Towards a Philosophy of Photography*. Reaktion Books.
- Forlizzi, J., & Battarbee, K. (2004). Understanding experience in interactive systems (pp. 261–268). Presented at the 5th Conference on Designing Interactive Systems, Cambridge, Mass, USA: ACM. <http://doi.org/10.1145/1013115.1013152>
- Forlizzi, J., & Ford, S. (2000). The building blocks of experience: an early framework for interaction designers (pp. 419–423). Presented at the 3rd Conference on Designing Interactive Systems, New York, New York, USA: ACM. <http://doi.org/10.1145/347642.347800>
- Frohlich, D. M. (2004). *Adiophotography*. Kluwer Academic Publishers.
- Frohlich, D. M., & Fennell, J. (2007). Sound, paper and memorabilia: resources for a simpler digital photography. *Personal and Ubiquitous Computing*, 11(2), 107–116. <http://doi.org/10.1007/s00779-006-0069-4>
- Frohlich, D. M., & Murphy, R. (2000). The Memory Box. *Personal and Ubiquitous Computing*, 4(4), 238–240. <http://doi.org/10.1007/BF02391566>
- Frohlich, D. M., Kuchinsky, A., Pering, C., Don, A., & Ariss, S. (2002). Requirements for photoware (pp. 166–175). Presented at the 2002 ACM Conference on Computer Supported Cooperative Work, New Orleans, Louisiana, USA: ACM. <http://doi.org/10.1145/587078.587102>
- Frohlich, D. M., Wall, S., & Kiddle, G. (2012). Rediscovery of forgotten images in domestic photo collections. *Personal and Ubiquitous Computing*, 17(4), 729–740. <http://doi.org/10.1007/s00779-012-0612-4>
- Gaver, B. (2012). What should we expect from research through design? (pp. 937–946). Presented at the 2012 ACM Annual Conference on Human Factors in Computing Systems, Austin, Texas, USA: ACM. <http://doi.org/10.1145/2207676.2208538>
- Gaver, B., & Bowers, J. (2012). Annotated portfolios. *Interactions*, 19(4), 40–49. <http://doi.org/10.1145/2212877.2212889>
- Gaver, B., Boucher, A., Bowers, J., Blythe, M., Jarvis, N., Cameron, D. W. T., et al. (2011). The photostroller: supporting diverse care home residents in engaging with the world (pp. 1757–1766). Presented at the 29th SIGCHI Conference on Human Factors in Computing Systems, Vancouver, BC, Canada: ACM. <http://doi.org/10.1145/1978942.1979198>
- Gaver, B., Boucher, A., Pennington, S., & Walker, B. (2004). Cultural probes and the value of uncertainty. *Interactions*, 11(5). <http://doi.org/10.1145/1020000/1015555/p53-gaver.pdf>
- Gaver, B., Sengers, P., Kerridge, T., Kaye, J., & Bowers,

- J. (2007). Enhancing ubiquitous computing with user interpretation: field testing the home health horoscope. Presented at the 25th SIGCHI Conference on Human Factors in Computing Systems.
- Gerritsen, D. B., Tasse, D., Olsen, J. K., Vlahovic, T. A., Gulotta, R., Odom, W., et al. (2016). Mailing Archived Emails as Postcards: Probing the Value of Virtual Collections (pp. 1187–1199). Presented at the 34th ACM SIGCHI Conference on Human-Computer Interaction, San Jose, CA, USA: ACM. <http://doi.org/10.1145/2858036.2858541>
- Giaccardi, E., & Karana, E. (2015). Foundations of Materials Experience: An Approach for HCI (pp. 2447–2456). Presented at the 33rd Annual ACM Conference on Human-Computing Systems, Seoul, Korea: ACM. <http://doi.org/10.1145/2702123.2702337>
- Gilboa, A. (2004). Autobiographical and episodic memory - one and the same? Evidence from prefrontal activation in neuroimaging studies. *Neuropsychologia*, 42(10), 1336–1349. <http://doi.org/10.1016/j.neuropsychologia.2004.02.014>
- Golsteijn, C., & van den Hoven, E. (2013). Facilitating parent-teenager communication through interactive photo cubes. *Personal and Ubiquitous Computing*, 17(2), 273–286.
- Golsteijn, C., van den Hoven, E., Frohlich, D. M., & Sellen, A. J. (2013). Hybrid crafting: towards an integrated practice of crafting with physical and digital components. *Personal and Ubiquitous Computing*, 18(3), 1–19. <http://doi.org/10.1007/s00779-013-0684-9>
- González, J. A. (1995). Autotopographies. In G. Brahm & M. J. Driscoll (Eds.), *Prosthetic Territories; Politics and Hypertechnologies* (pp. 133–150). Boulder, CO, USA: Westview Press, Inc.
- Graham, A., Garcia-Molina, H., Paepcke, A., & Winograd, T. (2002). Time as essence for photo browsing through personal digital libraries (pp. 326–335). Presented at the 2nd ACM/IEEE-CS Joint Conference on Digital Libraries, Portland, Oregon, USA: ACM. <http://doi.org/10.1145/544220.544301>
- Greenberg, D. L., & Rubin, D. C. (2003). The Neuropsychology of Autobiographical Memory. *Cortex*, 39(4-5), 687–728. [http://doi.org/10.1016/S0010-9452\(08\)70860-8](http://doi.org/10.1016/S0010-9452(08)70860-8)
- Greenberg, S., & Buxton, B. (2008). Usability evaluation considered harmful (some of the time) (pp. 111–120). Presented at the 26th SIGCHI Conference on Human Factors in Computing Systems, Florence, Italy: ACM. <http://doi.org/10.1145/1357054.1357074>
- Grimes, A., & Harper, R. (2008). Celebratory technology: new directions for food research in HCI. Presented at the 26th SIGCHI Conference on Human Factors in Computing Systems, ACM. <http://doi.org/10.1145/1357054.1357130>
- Gulotta, R., Odom, W., Forlizzi, J., & Faste, H. (2013). Digital artifacts as legacy: exploring the lifespan and value of digital data (pp. 1813–1822). Presented at the 31st SIGCHI Conference on Human Factors in Computing Systems, Paris, France: ACM. <http://doi.org/10.1145/2470654.2466240>
- Gulotta, R., Sciuto, A., Kelliher, A., & Forlizzi, J. (2015). Curatorial Agents: How Systems Shape Our Understanding of Personal and Familial Digital Information (pp. 3453–3462). Presented at the 33rd Annual ACM Conference on Human-Computing Systems, Seoul, Korea: ACM. <http://doi.org/10.1145/2702123.2702297>
- Güldenpennig, F., & Fitzpatrick, G. (2011). Getting more out of your images: augmenting photos for recollection and reminiscence (pp. 467–472). Presented at the 25th BCS Conference on Human-Computer Interaction 2011, British Computer Society.
- Güldenpennig, F., & Fitzpatrick, G. (2014). Personal digital archives on mobile phones with MEO. *Personal and Ubiquitous Computing*, 1–17. <http://doi.org/10.1007/s00779-014-0802-3>
- Habermas, T., & Paha, C. (2002). Souvenirs and Other Personal Objects: Reminding of Past Events and Significant Others in the Transition to University. In J. D. Webster & B. K. Haight (Eds.), *Critical Advances in Reminiscence Work: From Theory to Application* (pp. 123–139). New York: Springer.
- Halbwachs, M., & Coser, L. A. (1992). On Collective Memory. University of Chicago Press.
- Hallford, D. J., & Mellor, D. (2015). Brief reminiscence activities improve state well-being and self-concept in young adults: a randomised controlled experiment. *Memory*, 24(10), 1–10. <http://doi.org/10.1080/09658211.2015.1103875>
- Hangal, S., Lam, M. S., & Heer, J. (2011). MUSE: reviving memories using email archives (pp. 75–84). Presented at the 24th Annual ACM Symposium on UIST, Santa Barbara, CA, USA: ACM. <http://doi.org/10.1145/2047196.2047206>
- Harper, R., Randall, D., Smyth, N., Evans, C., Heledd, L., & Moore, R. (2008). The past is a different place: they do things differently there (pp. 271–280). Presented at the 7th ACM Conference on Designing Interactive Systems, Cape Town, South Africa: ACM. <http://doi.org/10.1145/1394445.1394474>
- Harris, C. B., Rasmussen, A. S., & Berntsen, D. (2014). The functions of autobiographical memory: An integrative approach. *Memory*, 22(5), 559–581. <http://doi.org/10.1080/09658211.2013.806555>
- Harris, C. B., Sutton, J., & Barnier, A. J. (2010). Autobiographical forgetting, social forgetting, and situated forgetting. In S. Della Sala (Ed.), *Forgetting* (pp. 253–284). London, UK: Psychology Press.
- Hassenzahl, M. (2004). The Interplay of Beauty,

- Goodness, and Usability in Interactive Products. *Human-Computer Interaction*, 19(4), 319–349. http://doi.org/10.1207/s15327051hci1904_2
- Hassenzahl, M. (2010). Experience Design: Technology for All the Right Reasons. Morgan & Claypool.
- Hassenzahl, M., & Tractinsky, N. (2006). User experience - a research agenda. *Behaviour & Information Technology*, 25(2), 91–97. <http://doi.org/10.1080/01449290500330331>
- Hassenzahl, M., & Wessler, R. (2000). Capturing Design Space From a User Perspective: The Repertory Grid Technique Revisited. *International Journal of Human-Computer Interaction*, 12(3-4), 441–459. <http://doi.org/10.1080/10447318.2000.9669070>
- Hekkert, P. (2006). Design aesthetics: principles of pleasure in design. *Psychology Science*, 48(2), 157–172.
- Helmes, J., O'Hara, K., Villar, N., & Taylor, A. S. (2011). Meerkat and tuba: design alternatives for randomness, surprise and serendipity in reminiscing (pp. 376–391). Presented at the 13th IFIP TC.13 International Conference on Human-Computer Interaction, Springer-Verlag.
- Hertzum, M., Clemmensen, T., Hornbaek, K., Kumar, J., Shi, Q., & Yammiyavar, P. (2011). Personal Usability Constructs: How People Construe Usability across Nationalities and Stakeholder Groups. *International Journal of Human-Computer Interaction*, 27(8), 729–761. <http://doi.org/10.1080/10447318.2011.555306>
- Heshmat, Y., Neustaeder, C., & DeBrincat, B. (2017). The Autobiographical Design and Long Term Usage of an Always-On Video Recording System for the Home (pp. 675–687). Presented at the 2017 Conference on Designing Interactive Systems, Edinburgh, UK: ACM. <http://doi.org/10.1145/3064663.3064759>
- Hester, S., & Francis, D. (1994). Doing Data: The Local Organization of a Sociological Interview. *The British Journal of Sociology*, 45(4), 675. <http://doi.org/10.2307/591889>
- Hilliges, O., & Kirk, D. S. (2009). Getting sidetracked: display design and occasioning photo-talk with the photohelix (pp. 1733–1736). Presented at the 27th ACM Conference on Human-Computing Systems, Boston, MA, USA: ACM. <http://doi.org/10.1145/1518701.1518967>
- Hirst, W., & Rajaram, S. (2014). Towards a Social Turn in Memory: An Introduction to a Special Issue on Social Memory. *Journal of Applied Research in Memory and Cognition*, 3(4), 239–243.
- Hoskins, A. (2011). Media, Memory, Metaphor: Remembering and the Connective Turn. *Parallax*, 17(4), 19–31. <http://doi.org/10.1080/13534645.2011.605573>
- Höök, K., & Löwgren, J. (2012). Strong concepts: Intermediate-level knowledge in interaction design research. *Transactions on Computer-Human Interaction (TOCHI)*, 19(3), 1–18. <http://doi.org/10.1145/2362364.2362371>
- Höök, K., Bardzell, J., Bowen, S., Dalsgaard, P., Reeves, S., & Waern, A. (2015). Framing IxD Knowledge. *Interactions*, 12(6), 33–36. <http://doi.org/10.1145/2830000/2824892/ins01.gif>
- Hsieh, H. F., & Shannon, S. E. (2005). Three Approaches to Qualitative Content Analysis. *Qualitative Health Research*, 15(9), 1277–1288. <http://doi.org/10.1177/1049732305276687>
- Hummels, C., & Overbeeke, K. (2010). Special Issue Editorial: Aesthetics of Interaction. *International Journal of Design*, 4(2), 1–2.
- Hutchins, E. L. (1995). *Cognition in the Wild*. Bradford Books.
- Hutchins, E. L. (2010). Cognitive Ecology. *Topics in Cognitive Science*, 2(4), 705–715. <http://doi.org/10.1111/j.1756-8765.2010.01089.x>
- Hutchinson, H., Mackay, W., Westerlund, B., Bederson, B. B., Druin, A., Plaisant, C., et al. (2003). Technology probes: inspiring design for and with families (pp. 17–24). Presented at the 21st SIGCHI conference on Human Factors in Computing Systems, Ft. Lauderdale, FL, USA.
- Ikemiya, M., & Rosner, D. K. (2013). Broken probes: toward the design of worn media. *Personal and Ubiquitous Computing*, 18(3), 1–13. <http://doi.org/10.1007/s00779-013-0690-y>
- Ingold, T. (2011). *Being alive: Essays on movement, knowledge and description*. Routledge.
- Ingold, T. (2012). Toward an Ecology of Materials. *Annual Review of Anthropology*, 41(1), 427–442. <http://doi.org/10.1146/annurev-anthro-081309-145920>
- Isaacs, E., Konrad, A., Walendowski, A., Lennig, T., Hollis, V., & Whittaker, S. (2013). Echoes from the past: how technology mediated reflection improves well-being (pp. 1071–1080). Presented at the 31st SIGCHI Conference on Human Factors in Computing Systems, Paris, France: ACM.
- IxDA. (2017). IxDA About & History. Retrieved March 10, 2017, from <http://ixda.org/ixda-global/about-history/>
- Jankowicz, D. (2005). *The Easy Guide to Repertory Grids*. John Wiley & Sons.
- Jansen, M., van den Hoven, E., & Frohlich, D. M. (2013). Pearl: living media enabled by interactive photo projection. *Personal and Ubiquitous Computing*, 1–17. <http://doi.org/10.1007/s00779-013-0691-x>
- Jayaratne, K. (2016). The Memory Tree: Using Sound to Support Reminiscence (pp. 116–121). Presented at the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems, San Jose, CA, USA: ACM. <http://doi.org/10.1145/2851581.2890384>
- Jones, J. (2016). Designing Social Memory Artifacts in a Smart Home (pp. 473–477). Presented at

- the 9th International Conference on Supporting Group Work, Sanibel Island, FL, USA: ACM. <http://doi.org/10.1145/2957276.2997021>
- Jones, J., & Ackerman, M. S. (2016). Curating an Infinite Basement: Understanding How People Manage Collections of Sentimental Artifacts (pp. 87–97). Presented at the 9th International Conference on Supporting Group Work, Sanibel Island, FL, USA: ACM. <http://doi.org/10.1145/2957276.2957316>
- Judge, T. K., & Neustaedter, C. (Eds.). (2014). *Studying and Designing Technology for Domestic Life: Lessons from Home*. San Francisco, USA: Morgan Kaufmann.
- Jung, H., & Stolterman, E. (2012). Digital form and materiality: propositions for a new approach to interaction design research (pp. 645–654). Presented at the 7th Nordic Conference on Human-Computer Interaction, Copenhagen, Denmark: ACM. <http://doi.org/10.1145/2399016.2399115>
- Kalnikaite, V., & Whittaker, S. (2011). A saunter down memory lane: Digital reflection on personal mementos. *International Journal of Human-Computer Studies*, 69(5), 298–310. <http://doi.org/10.1016/j.ijhcs.2010.12.004>
- Karapanos, E., Martens, J.-B., & Hassenzahl, M. (2012). Reconstructing experiences with iScale. *International Journal of Human-Computer Studies*, 70(11), 849–865. <http://doi.org/10.1016/j.ijhcs.2012.06.004>
- Keightley, E., & Pickering, M. (2014). Technologies of memory: Practices of remembering in analogue and digital photography. *New Media & Society*, 16(4), 576–593. <http://doi.org/10.1177/1461444814532062>
- Kelly, G. A. (1955). *The psychology of personal constructs*. Routledge.
- Kim, Jeong, & Zimmerman, J. (2006). Cherish: smart digital photo frames for sharing social narratives at home. *CHI '06 extended abstracts* (pp. 953–958). New York, New York, USA: ACM. <http://doi.org/10.1145/1125451.1125635>
- Kim, Jihwan, Kim, S., Yu, J., Yoon, S., & Han, S. (2011). Mourning tree: space interaction design for the commemoration ceremony (pp. 2197–2202). Presented at the 2011 CHI Conference Extended Abstracts on Human Factors in Computing Systems, Vancouver, Canada: ACM. <http://doi.org/10.1145/1979742.1979876>
- Kirk, D. S., & Sellen, A. J. (2010). On human remains: Values and practice in the home archiving of cherished objects. *Transactions on Computer-Human Interaction (TOCHI)*, 17(3), 1–43. <http://doi.org/10.1145/1806923.1806924>
- Kirk, D. S., Sellen, A. J., Rother, C., & Wood, K. R. (2006). Understanding photowork (pp. 761–770). Presented at the 24th SIGCHI conference on Human Factors in computing systems - CHI '06, New York, New York, USA: ACM. <http://doi.org/10.1145/1124772.1124885>
- Kjeldskov, J., Skov, M. B., Als, B. S., & Høegh, R. T. (2004). Is It Worth the Hassle? Exploring the Added Value of Evaluating the Usability of Context-Aware Mobile Systems in the Field (Vol. 3160, pp. 61–73). Presented at the International Conference on Mobile Human-Computer Interaction 2004, Berlin, Heidelberg: Springer, Berlin, Heidelberg. http://doi.org/10.1007/978-3-540-28637-0_6
- Koreshoff, T. L., Robertson, T., & Leong, T. W. (2013). Internet of things: a review of literature and products (pp. 335–344). Presented at the 25th Australian Computer-Human Interaction Conference, Adelaide, Australia: ACM. <http://doi.org/10.1145/2541016.2541048>
- Kwak, M., Hornbaek, K., Markopoulos, P., & Bruns Alonso, M. (2014). The design space of shape-changing interfaces (pp. 181–190). Presented at the 2014 Conference on Designing Interactive Systems, Vancouver, BC, Canada: ACM. <http://doi.org/10.1145/2598510.2598573>
- Landis, J. R., & Koch, G. G. (1977). The Measurement of Observer Agreement for Categorical Data. *Biometrics*, 33(1), 159. <http://doi.org/10.2307/2529310>
- Latour, B. (1992). Where are the missing masses? The sociology of a few mundane artifacts. In W. Bijker & J. Law (Eds.), *Shaping Technology/Building Society: Studies in Sociotechnical Change* (pp. 226–258).
- Laurenceau, J.-P., Barrett, L. E., & Pietromonaco, P. R. (1998). Intimacy as an Interpersonal Process: The Importance of Self-Disclosure, Partner Disclosure, and Perceived Partner Responsiveness in Interpersonal Exchanges. *Journal of Personality and Social Psychology*, 74(5), 1238–1251. <http://doi.org/10.1037/0022-3514.74.5.1238>
- Lawson, B. (2006). Towards a model of designing. In *How designers think: the design process demystified* (pp. 287–304). London, UK: Routledge.
- Lee, H.-C., & Hsu, J. Y.-J. (2016). PicMemory: Enriching Intergenerational Family Interaction and Memory Collection (pp. 3715–3718). Presented at the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems, San Jose, CA, USA: ACM. <http://doi.org/10.1145/2851581.2890233>
- Lefebvre, H., & Levich, C. (1987). The Everyday and Everydayness. *Yale French Studies*, (73), 7. <http://doi.org/10.2307/2930193>
- Leong, T. W., Harper, R., & Regan, T. (2011). Nudging towards serendipity: a case with personal digital photos. Presented at the 25th BCS Conference on Human-Computer Interaction.
- Leong, T. W., Vetere, F., & Howard, S. (2008). Abdicating choice: the rewards of letting go. *Digital Creativity*, 19(4), 233–243. <http://doi.org/10.1145/1124772.1124885>

- org/10.1080/14626260802550777
- Leong, T. W., Vetere, F., & Howard, S. (2012). Experiencing coincidence during digital music listening. *Transactions on Computer-Human Interaction (TOCHI)*, 19(1). <http://doi.org/10.1145/2147783.2147789>
- Li, I., Dey, A. K., & Forlizzi, J. (2011). Understanding my data, myself: supporting self-reflection with ubicomp technologies (pp. 405–414). Presented at the 13th International Conference on Ubiquitous computing, Beijing, China: ACM. <http://doi.org/10.1145/2030112.2030166>
- Lindley, S. E. (2012). Before I Forget: From Personal Memory to Family History. *Human-Computer Interaction*, 27(1-2), 13–36. <http://doi.org/10.1080/07370024.2012.656065>
- Lindley, S. E., & Monk, A. F. (2005). Augmenting Photographs With Sound For Collocated Sharing. In A. Sloane (Ed.), *Home-Oriented Informatics and Telematics* (Vol. 178, pp. 155–170). Boston: Springer. http://doi.org/10.1007/11402985_12
- Lindley, S. E., Glancy, M., Harper, R., Randall, D., & Smyth, N. (2011). “Oh and how things just don’t change, the more things stay the same”: Reflections on SenseCam images 18 months after capture. *International Journal of Human-Computer Studies*, 69(5), 311–323. <http://doi.org/10.1016/j.ijhcs.2010.12.010>
- Mace, J. H. (2004). Involuntary autobiographical memories are highly dependent on abstract cuing: the Proustian view is incorrect. *Applied Cognitive Psychology*, 18(7), 893–899. <http://doi.org/10.1002/acp.1020>
- Mancini, C., Rogers, Y., Bandara, A. K., Coe, T., Jedrzejczyk, L., Joinson, A. N., et al. (2010). ContraVision: Exploring Users’ Reactions to Futuristic Technology (pp. 153–162). Presented at the 28th SIGCHI Conference on Human Factors in Computing Systems, Atlanta, GA, USA: ACM. <http://doi.org/10.1145/1753326.1753350>
- Markopoulos, P. (2016). Using Video for Early Interaction Design. In P. Markopoulos, J.-B. Martens, J. Malins, K. Coninx, & A. Liapis (Eds.), *Collaboration in Creative Design* (pp. 271–293). Cham, CH: Springer. http://doi.org/10.1007/978-3-319-29155-0_13
- Marshall, C. C., Bly, S., & Brun-Cottan, F. (2006). The Long Term Fate of Our Digital Belongings: Toward a Service Model for Personal Archives (pp. 25–30). Presented at the Archiving Conference, Ottawa, Canada: Society for Imaging Science and Technology.
- Martin, H., & Gaver, B. (2000). Beyond the snapshot from speculation to prototypes in audiophotography (pp. 55–65). Presented at the 3rd Conference on Designing Interactive Systems, Brooklyn, New York, USA: ACM. <http://doi.org/10.1145/347642.347663>
- Massimi, M., & Baecker, R. M. (2010). A Death in the Family: Opportunities for Designing Technologies for the Bereaved (pp. 1821–1830). Presented at the 28th SIGCHI Conference on Human Factors in Computing Systems, Atlanta, Georgia, USA: ACM.
- Massimi, M., & Baecker, R. M. (2011). Dealing with Death in Design: Developing Systems for the Bereaved (pp. 1001–1010). Presented at the 29th SIGCHI Conference on Human Factors in Computing Systems, Vancouver, BC, Canada: ACM.
- Mattelmäki, T. (2006). Design probes. Helsinki: University of Art and Design Helsinki.
- Mayer-Schönberger, V. (2011). Delete. Princeton University Press.
- McCarthy, J., & Wright, P. (2004a). Technology as Experience. Cambridge, Massachusetts: MIT Press.
- McCarthy, J., & Wright, P. (2004b). Technology as experience. *Interactions*, 11(5), 42–43. <http://doi.org/10.1145/1015530.1015549>
- McLuhan, M., Molinaro, M., McLuhan, C., & Toye, W. (1987). Letters of Marshall McLuhan. Oxford University Press, USA.
- Merleau-Ponty, M. (2012). Phenomenology of Perception. (D. A. Landes, Trans.). Routledge.
- Merton, R. K., & Barber, E. (2004). The Travels and Adventures of Serendipity: A Study in Sociological Semantics and the Sociology of Science. Princeton, New Jersey: Princeton University Press.
- Michaelian, K. (2011). Generative memory. *Philosophical Psychology*, 24(3), 323–342. <http://doi.org/10.1080/09515089.2011.559623>
- Michaelian, K. (2012). Is external memory memory? Biological memory and extended mind. *Consciousness and Cognition*, 21(3), 1154–1165. <http://doi.org/10.1016/j.concog.2012.04.008>
- Middleton, D., & Brown, S. D. (2005). The Social Psychology of Experience. London, UK: SAGE. <http://doi.org/10.4135/9781446221808>
- Millen, D. R. (2000). Rapid Ethnography: Time Deepening Strategies for HCI Field Research (pp. 280–286). Presented at the 3rd conference on Designing Interactive Systems 2000, New York, USA: ACM. <http://doi.org/10.1145/347642.347763>
- Moggridge, B. (2007). Designing Interactions. Massachusetts: MIT Press.
- Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., The PRISMA Group. (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLOS Medicine*, 6(7), e1000097. <http://doi.org/10.1371/journal.pmed.1000097>
- Mols, I., van den Hoven, E., & Eggen, B. (2014). Making memories: a cultural probe study into the remembering of everyday life (pp. 256–265). Presented at the 8th Nordic Conference on

- Human-Computer Interaction, Helsinki, Finland. <http://doi.org/10.1145/2639189.2639209>
- Mols, I., van den Hoven, E., & Eggen, B. (2016). Ritual Camera: Exploring Domestic Technology to Remember Everyday Life. *IEEE Pervasive Computing*, 15(2), 48–58. <http://doi.org/10.1109/MPRV.2016.25>
- Mols, I., van den Hoven, E., & Eggen, B. (2017). Balance, Cogito and Dott: Exploring Media Modalities for Everyday-Life Reflection (pp. 427–433). Presented at the 11th International Conference on Tangible, Embodied and Embedded Computing, Yokohama, Japan: ACM. <http://doi.org/10.1145/3024969.3025069>
- Moncur, W., & Kirk, D. S. (2014). An emergent framework for digital memorials (pp. 965–974). Presented at the 2014 Conference on Designing Interactive Systems, Vancouver, BC, Canada: ACM. <http://doi.org/10.1145/2598510.2598516>
- Moncur, W., Julius, M., van den Hoven, E., & Kirk, D. S. (2015). Story Shell: The Participatory Design of a Bespoke Digital Memorial (pp. 470–477). Presented at the Participatory Innovation Conference, Den Haag, Netherlands. <http://doi.org/10.13140/RG.2.1.2802.4489>
- Moustakas, C. (1994). *Phenomenological Research Methods*. Sage Publications.
- Munteanu, C., Molyneux, H., Moncur, W., Romero, M., O'Donnell, S., & Vines, J. (2015). Situational Ethics: Re-thinking Approaches to Formal Ethics Requirements for Human-Computer Interaction (pp. 105–114). Presented at the 33rd Annual ACM Conference on Human-Computing Systems, Seoul, Korea: ACM. <http://doi.org/10.1145/2702123.2702481>
- Neustaedter, C., Brush, A. J. B., & Greenberg, S. (2007). A Digital Family Calendar in the Home: Lessons From Field Trials of LINC (pp. 199–218). Presented at the Graphics Interface 2007, Montreal, Canada: ACM. <http://doi.org/10.1145/1268517.1268551>
- Niemantsverdriet, K., & Versteeg, M. (2016). Interactive Jewellery as Memory Cue: Designing a Sound Locket for Individual Reminiscence (pp. 532–538). Presented at the 10th International Conference on Tangible, Embedded, and Embodied Interaction, Eindhoven, NL: ACM. <http://doi.org/10.1145/2839462.2856524>
- Niemantsverdriet, K., Broekhuijsen, M., van Essen, H., & Eggen, B. (2016). Designing for Multi-User Interaction in the Home Environment (pp. 1303–1314). Presented at the 2016 ACM Conference on Designing Interactive Systems, Brisbane, Australia: ACM. <http://doi.org/10.1145/2901790.2901808>
- Nishimoto, K., Amano, K., & Usuki, M. (2006). pHotOluck: A Home-use Table-ware to Vitalize Mealtime Communications by Projecting Photos onto Dishes (pp. 9–16). Presented at the First IEEE International Workshop on Horizontal Interactive Human-Computer Systems (TABLETOP '06), IEEE. <http://doi.org/10.1109/TABLETOP.2006.24>
- Norman, D. A. (1976). *Memory and attention*. John Wiley & Sons.
- Norman, D. A. (1988). *The Design of Everyday Things*. Basic Books.
- Norman, D. A. (2004). *Emotional Design*. Basic Books.
- Nunes, M., Greenberg, S., & Neustaedter, C. (2009). Using physical memorabilia as opportunities to move into collocated digital photo-sharing. *International Journal of Human-Computer Studies*, 67(12), 1087–1111. <http://doi.org/10.1016/j.ijhcs.2009.09.007>
- O'Brien, J., & Rodden, T. (1997). *Interactive Systems in Domestic Environments* (pp. 247–259). Presented at the 2nd Conference on Designing Interactive Systems, Amsterdam, NL: ACM. <http://doi.org/10.1145/263552.263617>
- O'Hara, K., Harper, R., Unger, A., Wilkes, J., Sharpe, B., & Jansen, M. (2005). TxtBoard: from text-to-person to text-to-home (pp. 1705–1708). Presented at the CHI '05 Extended Abstracts on Human factors in computing systems, Portland, OR, USA: ACM. <http://doi.org/10.1145/1056808.1057002>
- O'Hara, K., Helmes, J., Sellen, A. J., Harper, R., Bhömer, ten, M., & van den Hoven, E. (2012). Food for Talk: Phototalk in the Context of Sharing a Meal. *Human-Computer Interaction*, 27(1), 124–150.
- Odom, W., Selby, M., Sellen, A. J., Kirk, D. S., Banks, R., & Regan, T. (2012). Photobox: on the Design of a Slow Technology (p. 665). Presented at the 2012 ACM Conference on Designing Interactive Systems, Newcastle, UK: ACM. <http://doi.org/10.1145/2317956.2318055>
- Odom, W., Sellen, A. J., Banks, R., Kirk, D. S., Regan, T., Selby, M., et al. (2014). Designing for Slowness, Anticipation and Re-visitation: a Long Term Field Study of the Photobox (pp. 1961–1970). Presented at the 32nd ACM Conference on Human-Computing Systems, Toronto, Canada: ACM. <http://doi.org/10.1145/2556288.2557178>
- Odom, W., Zimmerman, J., & Forlizzi, J. (2011). Teenagers and Their Virtual Possessions: Design Opportunities and Issues (p. 1491). Presented at the 29th SIGCHI Conference on Human Factors in Computing Systems, Vancouver, Canada: ACM. <http://doi.org/10.1145/1978942.1979161>
- Osgood, C. E. (1964). Semantic Differential Technique in the Comparative Study of Cultures. *American Anthropologist*, 66(3), 171–200. <http://doi.org/10.1525/aa.1964.66.3.02a00880>
- Petrelli, D., & Whittaker, S. (2010). Family memories in the home: contrasting physical and digital mementos. *Personal and Ubiquitous Computing*, 14(2), 153–169. <http://doi.org/10.1007/s00779->

- 009-0279-7
- Petrelli, D., Bowen, S., & Whittaker, S. (2013). Photo Mementos: Designing Digital Media to Represent Ourselves At Home. *International Journal of Human-Computer Studies*, 72, 320–336. <http://doi.org/10.1016/j.ijhcs.2013.09.009>
- Petrelli, D., van den Hoven, E., & Whittaker, S. (2009). Making History: Intentional Capture of Future Memories (pp. 1723–1732). Presented at the 27th ACM Conference on Human-Computing Systems, Boston, MA, USA: ACM. <http://doi.org/10.1145/1518701.1518966>
- Petrelli, D., Villar, N., Kalnikaite, V., Dib, L., & Whittaker, S. (2010). FM Radio: Family Interplay with Sonic Mementos (pp. 2371–2380). Presented at the 28th SIGCHI Conference on Human Factors in Computing Systems, Atlanta, GA, USA: ACM. <http://doi.org/10.1145/1753326.1753683>
- Petrelli, D., Whittaker, S., & Brockmeier, J. (2008). AutoTopography: what can physical mementos tell us about digital memories? (pp. 53–62). Presented at the 26th SIGCHI Conference on Human Factors in Computing Systems, Florence, Italy: ACM.
- Petty, R. E., & Briñol, P. (2010). Attitude Change. In R. F. Baumeister & E. J. Finkel (Eds.), *Advanced Social Psychology* (pp. 217–262). New York.
- Pink, S. (2014). Digital-visual-sensory-design anthropology: Ethnography, imagination and intervention. *Arts and Humanities in Higher Education*, 13(4), 412–427. <http://doi.org/10.1177/1474022214542353>
- Pink, S., & Morgan, J. (2013). Short-Term Ethnography: Intense Routes to Knowing. *Symbolic Interaction*, 36(3), 351–361. <http://doi.org/10.1002/symb.66>
- Pinquart, M., & Forstmeier, S. (2012). Effects of reminiscence interventions on psychosocial outcomes: A meta-analysis. *Aging & Mental Health*, 16(5), 541–558. <http://doi.org/10.1080/13607863.2011.651434>
- Platt, J. C., Czerwinski, M., & Field, B. A. (2003). PhotoTOC: Automatic Clustering for Browsing Personal Photographs (pp. 6–10). Presented at the 4th International Conference on Information, Communications and Signal Processing and the 4th Pacific Rim Conference on Multimedia, Singapore: IEEE. <http://doi.org/10.1109/ICICS.2003.1292402>
- Plotz, J. (2005). Can the Sofa Speak? A Look at Thing Theory. *Criticism*, 47(1), 109–118. <http://doi.org/10.1353/crt.2006.0006>
- Pohlmeier, A. E. (2014). Enjoying Joy: A Process-Based Approach to Design for Prolonged Pleasure (pp. 871–876). Presented at the 8th Nordic Conference on Human-Computer Interaction, Helsinki, Finland: ACM. <http://doi.org/10.1145/2639189.2670182>
- Preece, J., Rogers, Y., & Sharp, H. (2015). *Interaction Design* (4 ed.). Wiley.
- Proust, M. (1913). *À la Reserche du Temps Perdu*. Grasset.
- Quoidbach, J., Quoidbach, J., Berry, E. V., Berry, E. V., Hansenne, M., & Mikolajczak, M. (2010). Positive emotion regulation and well-being: Comparing the impact of eight savoring and dampening strategies. *Personality and Individual Differences*, 49(5), 368–373. <http://doi.org/10.1016/j.paid.2010.03.048>
- Rathbone, C. J., Moulin, C. J. A., & Conway, M. A. (2008). Self-centered memories: The reminiscence bump and the self. *Memory & Cognition*, 36(8), 1403–1414. <http://doi.org/10.3758/MC.36.8.1403>
- Reckwitz, A. (2002). Toward a Theory of Social Practices. *European Journal of Social Theory*, 5(2), 243–263. <http://doi.org/10.1177/13684310222225432>
- Reitsma, L., Smith, A., & van den Hoven, E. (2013). StoryBeads: Preserving Indigenous Knowledge through Tangible Interaction Design (pp. 79–85). Presented at the International Conference on Culture and Computing, Kyoto: IEEE. <http://doi.org/10.1109/CultureComputing.2013.22>
- Ricci, F., Rokach, L., Shapira, B., & Kantor, P. B. (Eds.). (2011). *Recommender Systems Handbook*. Boston, MA: Springer US.
- Ritchie, T. D., Sedikides, C., & Skowronski, J. J. (2015). Emotions experienced at event recall and the self: Implications for the regulation of self-esteem, self-continuity and meaningfulness. *Memory*, 1–15. <http://doi.org/10.1080/09658211.2015.1031678>
- Rodden, K., & Wood, K. R. (2003). How Do People Manage Their Digital Photographs? (pp. 409–416). Presented at the 21st SIGCHI Conference on Human Computer Systems, Ft. Lauderdale, FL, USA: ACM. <http://doi.org/10.1145/642611.642682>
- Romero, N., Markopoulos, P., van Baren, J., De Ruyter, B., IJsselstein, W. A., & Farshchian, B. (2006). Connecting the family with awareness systems. *Personal and Ubiquitous Computing*, 11(4), 299–312. <http://doi.org/10.1007/s00779-006-0089-0>
- Roto, V., Law, E. L.-C., Vermeeren, A. P. O. S., & Hoonhout, J. (2011). *User Experience White Paper* (pp. 1–12). Retrieved from <http://www.allaboutux.org/files/UX-WhitePaper.pdf>
- Rubin, D. C. (1995a). *Memory in Oral Traditions : The Cognitive Psychology of Epic, Ballads, and Counting-out Rhymes*. New York: Oxford University Press.
- Rubin, D. C. (1995b). *Remembering Our Past*. Cambridge: Cambridge University Press.
- Sarvas, R., & Frohlich, D. M. (2011). *From Snapshots to Social Media - The Changing Picture of Domestic Photography*. Springer.

- Sas, C., & Whittaker, S. (2013). Design for Forgetting: Disposing of Digital Possessions After a Breakup (pp. 1823–1832). Presented at the 31st SIGCHI Conference on Human Factors in Computing Systems, Paris, France: ACM.
- Schacter, D. L. (2012). Adaptive constructive processes and the future of memory. *American Psychologist*, 67(8), 603. <http://doi.org/10.1037/a0029869>
- Schatzki, T. R. (1996). *Social Practices*. Cambridge University Press.
- Schlagman, S., & Kvavilashvili, L. (2008). Involuntary autobiographical memories in and outside the laboratory: How different are they from voluntary autobiographical memories? *Memory & Cognition*, 36(5), 920–932. <http://doi.org/10.3758/MC.36.5.920>
- Schlagman, S., Kvavilashvili, L., & Schulz, J. (2007). Effects of age on involuntary autobiographical memories. In J. H. Mace (Ed.), *Involuntary Memory* (pp. 87–112). Malden, MA: Blackwell.
- Schmidt, A., & Herrmann, T. (2017). Intervention User Interfaces: A New Interaction Paradigm for Automated Systems. *Interactions*, 24(5), 40–45. <http://doi.org/10.1145/3121357>
- Schön, D. A. (1983). *The reflective practitioner*. Basic Books.
- Schön, D. A., & Wiggins, G. (1992). Kinds of seeing and their functions in designing. *Design Studies*, 13(2), 135–156. [http://doi.org/10.1016/0142-694X\(92\)90268-F](http://doi.org/10.1016/0142-694X(92)90268-F)
- Schwarz, O. (2014). The past next door: Neighbourly relations with digital memory-artefacts. *Memory Studies*, 7(1), 7–21. <http://doi.org/10.1177/1750698013490591>
- Sellen, A. J., & Whittaker, S. (2010). Beyond Total Capture: A Constructive Critique of Lifelogging. *Communications of the ACM*, 53, 70–77. <http://doi.org/10.1145/1735223.1735243>
- Sellen, A. J., Fogg, A., Aitken, M., Hodges, S., Rother, C., & Wood, K. R. (2007). Do Life-Logging Technologies Support Memory for the Past? An Experimental Study Using Sensecam. Presented at the 25th SIGCHI Conference on Human Factors in Computing Systems, San Jose, CA, USA: ACM. <http://doi.org/10.1145/1240624.1240636>
- Sengers, P., & Gaver, B. (2006). Staying Open to Interpretation: Engaging Multiple Meanings in Design and Evaluation (pp. 99–108). Presented at the 6th ACM Conference on Designing Interactive Systems, Univeristy Park, PA, USA: ACM. <http://doi.org/10.1145/1142405.1142422>
- Shaw, M. L. G., & Gaines, B. R. (1995). Comparing constructions through the Web. Presented at the 1st International Conference on Computer Support for Collaborative Learning, Bloomington, Indiana, USA: L. Erlbaum Associates Inc.
- Simon, H. A. (1996). *The Sciences of the Artificial* (3rd ed.). Cambridge, Massachusetts: MIT Press.
- Singer, J. A., & Conway, M. A. (2014). The varieties of remembered experience: Moving memory beyond the bounded self. *Memory Studies*, 7(3), 385–392. <http://doi.org/10.1177/1750698014530626>
- Slater, D. (1995). Domestic Photography and Digital Culture. In M. Lister (Ed.), *The Photographic Image in Digital Culture* (pp. 129–146). London: Routledge.
- Sparrow, B., Liu, J., & Wegner, D. M. (2011). Google Effects on Memory: Cognitive Consequences of Having Information at Our Fingertips. *Science*, 333(6043), 776–778. <http://doi.org/10.1126/science.1207745>
- Stevens, M. M., Abowd, G. D., Truong, K. N., & Vollmer, F. (2003). Getting into the Living Memory Box: Family archives & holistic design. *Personal and Ubiquitous Computing*, 7(3-4).
- Stolterman, E. (2008). The Nature of Design Practice and Implications for Interaction Design Research. *International Journal of Design*, 2(1), 55–65.
- Stolterman, E., & Wiberg, M. (2010). Concept-Driven Interaction Design Research. *Human-Computer Interaction*, 25(2), 95–118. <http://doi.org/10.1080/07370020903586696>
- Storni, C. (2015). A personal perspective on research through design. *Interactions*, 22(4), 74–76. <http://doi.org/10.1145/2786974>
- Suchman, L. (2007). *Human-Machine Reconfigurations*. Cambridge University Press.
- Sutin, A. R., & Robins, R. W. (2007). Phenomenology of autobiographical memories: The Memory Experiences Questionnaire. *Memory*, 15(4), 390–411. <http://doi.org/10.1080/09658210701256654>
- Sutton, J. (2006). Introduction: Memory, Embodied Cognition, and the Extended Mind. *Philosophical Psychology*, 19(3), 281–289. <http://doi.org/10.1080/09515080600702550>
- Sutton, J. (2010). Exograms and Interdisciplinarity: History, the Extended Mind, and the Civilizing Process. In R. Menary (Ed.), *Extended Mind* (pp. 189–225). Cambridge, Mass: MIT Press.
- Sutton, J., Harris, C. B., Keil, P. G., & Barnier, A. J. (2010). The psychology of memory, extended cognition, and socially distributed remembering. *Phenomenology and the Cognitive Sciences*, 9(4), 521–560. <http://doi.org/10.1007/s11097-010-9182-y>
- Svanæs, D. (2013). Interaction design for and with the lived body. *Transactions on Computer-Human Interaction (TOCHI)*, 20(1), 1–30. <http://doi.org/10.1145/2442106.2442114>
- Swan, L., & Taylor, A. S. (2008). Photo Displays in the Home (pp. 261–270). Presented at the 7th ACM Conference on Designing Interactive Systems, Cape Town, South Africa: ACM. <http://doi.org/10.1145/1394445.1394473>
- Talarico, J. M., LaBar, K. S., & Rubin, D. C. (2004).

- Emotional intensity predicts autobiographical memory experience. *Memory & Cognition*, 32(7), 1118–1132. <http://doi.org/10.3758/BF03196886>
- Taylor, A. S., Swan, L., & Durrant, A. (2007). Designing family photo displays (pp. 79–98). Presented at the Proceedings of the Tenth European Conference on Computer Supported Cooperative Work, London: Springer London. http://doi.org/10.1007/978-1-84800-031-5_5
- Thomas, L., & Briggs, P. (2015). Assessing the value of brief automated biographies. *Personal and Ubiquitous Computing*. <http://doi.org/10.1007/s00779-015-0896-2>
- Thomas, L., & Briggs, P. (2016). Reminiscence through the Lens of Social Media. *Frontiers in Psychology*, 7, 117. <http://doi.org/10.3389/fpsyg.2016.00870>
- Thudt, A., Baur, D., Huron, S., & Carpendale, S. (2015). Visual Mementos: Reflecting Memories with Personal Data. *IEEE Transactions on Visualization and Computer Graphics*, 22(1), 369–378. <http://doi.org/10.1109/TVCG.2015.2467831>
- Tomico, O., Karapanos, E., Levy, P., Mizutani, N., & Yamanaka, T. (2009). The repertory grid technique as a method for the study of cultural differences. *International Journal of Design*, 3(3), 55–63.
- Tsai, W.-C., Orth, D., & van den Hoven, E. (2017). Designing Memory Probes to Inform Dialogue (pp. 889–901). Presented at the 2017 Conference on Designing Interactive Systems, Edinburgh, UK: ACM. <http://doi.org/10.1145/3064663.3064791>
- Tsai, W.-C., Wang, P.-H., Lee, H.-C., Liang, R.-H., & Hsu, J. (2014). The Reflexive Printer: Toward Making Sense of Perceived Drawbacks in Technology-Mediated Reminiscence. Presented at the 2014 Conference on Designing Interactive Systems, Vancouver, BC, Canada: ACM. <http://doi.org/10.1145/2598510.2598589>
- Tulving, E. (2002). Episodic Memory: From Mind to Brain. *Annual Review of Psychology*, 53(1), 1–25. <http://doi.org/10.1146/annurev.psych.53.100901.135114>
- Tulving, E. (2007). Are There 256 Different Kinds of Memory? In H. L. Roediger III & J. S. Nairne (Eds.), *The foundations of remembering: essays in honor of Henry L. Roediger III* (p. 451). Psychology Press.
- Turkle, S. (2007). *Evocative Objects: Things We Think with*. Cambridge, MA: MIT Press.
- Turner, P., & Turner, S. (2011). My grandfather's iPod: an investigation of emotional attachment to digital and non-digital artefacts (pp. 149–156). Presented at the 29th Annual European Conference on Cognitive Ergonomics, Rostock, Germany: ACM. <http://doi.org/10.1145/2074712.2074742>
- Uriu, D., & Odum, W. (2016). Designing for Domestic Memorialization and Remembrance: A Field Study of Fenestra in Japan (pp. 5945–5957). Presented at the 34th ACM SIGCHI Conference on Human-Computer Interaction, San Jose, CA, USA: ACM. <http://doi.org/10.1145/2858036.2858069>
- Uriu, D., & Okude, N. (2010). ThanatoFenestra: Photographic Family Altar Supporting a Ritual to Pray for the Deceased (pp. 422–425). Presented at the 8th ACM Conference on Designing Interactive Systems, Aarhus, Denmark: ACM. <http://doi.org/10.1145/1858171.1858253>
- Uriu, D., Shiratori, N., Hashimoto, S., Ishibashi, S., & Okude, N. (2009). CaraClock: An Interactive Photo Viewer Designed for Family Memories (pp. 3205–3210). Presented at the CHI '09 Extended Abstracts on Human Factors in Computing Systems, Boston, MA, USA: ACM. <http://doi.org/10.1145/1520340.1520458>
- van den Hoven, E. (2014). A future-proof past: Designing for remembering experiences. *Memory Studies*, 7(3), 370–384. <http://doi.org/10.1177/1750698014530625>
- van den Hoven, E., & Connell, J. (2016). Joint Doctoral Supervision across Countries: Changes, Challenges and Considerations. In BlessingerStockley (Eds.), *Emerging Directions in Doctoral Education* (Vol. 6, pp. 259–280). Emerald Group Publishing Limited. <http://doi.org/10.1108/S2055-364120160000006021>
- van den Hoven, E., & Eggen, B. (2003). Digital Photo Browsing with Souvenirs (pp. 1000–1003). Presented at the Interact 2003, Zurich, Switzerland.
- van den Hoven, E., & Eggen, B. (2008). Informing augmented memory system design through autobiographical memory theory. *Personal and Ubiquitous Computing*, 12(6), 433–443. <http://doi.org/10.1007/s00779-007-0177-9>
- van den Hoven, E., & Eggen, B. (2009). The effect of cue media on recollections. *Human Technology*, 5(1), 47–67.
- van den Hoven, E., & Eggen, B. (2014). The cue is key: Design for real-life remembering. *Zeitschrift Für Psychologie*, 222(2), 110–117.
- van den Hoven, E., Sas, C., & Whittaker, S. (2012). Introduction to this Special Issue on Designing for Personal Memories: Past, Present, and Future. *Human-Computer Interaction*, 27(1-2), 1–12. <http://doi.org/10.1080/07370024.2012.673451>
- van Dijck, J. (2007). *Mediated Memories in the Digital Age*. Stanford University Press.
- van Dijck, J. (2008). Digital photography: communication, identity, memory. *Visual Communication*, 7(1), 57–76. <http://doi.org/10.1177/1470357207084865>
- Van House, N. A. (2009). Collocated photo sharing, story-telling, and the performance of self. *International Journal of Human-Computer Studies*,

- 67(12), 1073–1086. <http://doi.org/10.1016/j.ijhcs.2009.09.003>
- Van House, N. A. (2011). Personal photography, digital technologies and the uses of the visual. *Visual Studies*, 26(2), 125–134. <http://doi.org/10.1080/1472586X.2011.571888>
- Verbeek, P.-P. (2005). What things do: Philosophical reflections on technology, agency, and design. University Park, PA: Pennsylvania State University Press.
- Verplank, B. (2000). Interaction Design sketch-lecture. Stanford. Retrieved from <http://billverplank.com/Lecture/>
- Vitruvius, M. (2001). Vitruvius: “Ten Books on Architecture.” (I. D. Rowland & T. Noble Howe, Eds.). Cambridge University Press.
- Wang, Q., & Brockmeier, J. (2002). Autobiographical Remembering as Cultural Practice: Understanding the Interplay between Memory, Self and Culture. *Culture & Psychology*, 8(1), 45–64. <http://doi.org/10.1177/1354067X02008001618>
- Watkins, R. D., Sellen, A. J., & Lindley, S. E. (2015). Digital Collections and Digital Collecting Practices (pp. 3423–3432). Presented at the 33rd Annual ACM Conference on Human-Computing Systems, Seoul, Korea: ACM. <http://doi.org/10.1145/2702123.2702380>
- Webster, J. D. (2003). The reminiscence circumplex and autobiographical memory functions. *Memory*, 11(2), 203–215. <http://doi.org/10.1080/741938202>
- Webster, J. D., Bohlmeijer, E. T., & Westerhof, G. J. (2010). Mapping the Future of Reminiscence: A Conceptual Guide for Research and Practice. *Research on Aging*, 32(4), 527–564. <http://doi.org/10.1177/0164027510364122>
- Weiser, M. (1991). The computer for the 21st century. *Scientific American*, 265(3), 94–104.
- West, D., Quigley, A., & Kay, J. (2006). MEMENTO: a digital-physical scrapbook for memory sharing. *Personal and Ubiquitous Computing*, 11(4), 313–328. <http://doi.org/10.1007/s00779-006-0090-7>
- Westerhof, G. J., & Bohlmeijer, E. T. (2014). Celebrating fifty years of research and applications in reminiscence and life review: State of the art and new directions. *Journal of Aging Studies*, 29, 107–114. <http://doi.org/10.1016/j.jaging.2014.02.003>
- Whittaker, S., Bergman, O., & Clough, P. (2010). Easy on that trigger dad: a study of long term family photo retrieval. *Personal and Ubiquitous Computing*, 14(1), 31–43. <http://doi.org/10.1007/s00779-009-0218-7>
- Whittaker, S., Kalmikaite, V., Petrelli, D., Sellen, A. J., Villar, N., Bergman, O., et al. (2012). Socio-Technical Lifelogging: Deriving Design Principles for a Future Proof Digital Past. *Human-Computer Interaction*, 27, 37–62. <http://doi.org/10.1080/07370024.2012.656071>
- Wright, P., McCarthy, J., & Meekison, L. (2003). Making Sense of Experience. In M. Blythe, A. F. Monk, K. Overbeeke, & P. Wright (Eds.), *Funology* (pp. 43–53). Kluwer Academic Publishers.
- Ylirisku, S. P., & Buur, J. (2007). *Designing with Video*. Springer.
- Zargham, S., Čalić, J., & Frohlich, D. M. (2015). 4streams: an ambient photo sharing application for extended families (pp. 165–174). Presented at the 2015 British HCI Conference, Lincoln, UK: ACM. <http://doi.org/10.1145/2783446.2783589>
- Zemeckis, R. (Ed.). (2000). *Cast Away*. 20th Century Fox.
- Zimmerman, J., Stolterman, E., & Forlizzi, J. (2010). An Analysis and Critique of Research Through Design: Towards a Formalization of a Research Approach (pp. 310–319). Presented at the 8th ACM Conference on Designing Interactive Systems, Aarhus, Denmark: ACM. <http://doi.org/10.1145/1858171.1858228>

Appendix 4.1 – Diary study consent form

I _____ (*participant's name*) agree to participate in the research project Materialising memories (UTS HREC reference 2012000570) being conducted by Doménique van Gennip (contact info omitted) of the University of Technology, Sydney for his degree as Doctor of Philosophy. Funding for this research has been provided by University of Technology, Sydney.

I understand that my participation in this research will involve keeping a diary and taking photos relevant to the diary entries for two weeks, which should take about ten minutes per day, and taking part in two interview sessions after the diary-keeping period. One of the interviews will be in a small group and will take two hours. All contributions made will be kept confidential, and I understand I have the option not to report on anything I rather keep private, nor am I obliged to share things during interviews I am not comfortable with sharing. I might be inconvenienced by the time required to be involved in this study, including the taking of photos in your daily life, but no other harm is likely to result from my participation.

I am aware that I can contact Doménique van Gennip or his supervisor Elise van den Hoven if I have any concerns about the research. I also understand that I am free to withdraw my participation from this research project at any time I wish, without consequences, and without giving a reason. I will not be penalised in any way for declining to take part in any stage of the research.

I agree that Doménique van Gennip has answered all my questions fully and clearly. I agree that the research data gathered from this project may be published, if so it will be done in a form that does not identify me in any way.

Signature (participant)

Signature (researcher or delegate)

NOTE: This Human Research Ethics Committee of the University of Technology, Sydney has approved this study. If you have any complaints or reservations about any aspect of your participation in this research, which you cannot resolve with the researcher, you may contact the following independent persons, who will treat your complaint or reservation in confidence, investigate it fully and inform you of the outcome. When the researcher's primary affiliation is with the University of Technology, Sydney, you can contact: the Ethics Committee through the Research Ethics Officer (contact info omitted), at the University of Technology, Sydney. Please quote the UTS HREC reference number. When the researcher's primary affiliation is with the Eindhoven University of Technology, you can contact: the Project Officer of the Industrial Design department at the Eindhoven University of Technology (contact info omitted). Please quote the names of the project and researcher.

Appendix 4.2. – Diary instructions

General introduction

Dear participant,

Thank you for participating in this study. We are interested in learning about the various ways people may be reminded of their past by encountering things in daily life. We would like to know about what things you encounter in everyday life, and what kind of memories those things brings back for you.

In the first part of this study, you will keep a diary (this booklet). This part lasts for 10 days in which you should write something in this diary on a daily basis. Specific instructions for each task are included on the next pages. The final task in this booklet is hidden and should not be opened until the diary keeping task is complete. When the 10 days are over, you are kindly asked to return this booklet.

Before starting it is good to know there are no right or wrong answers to any question. We are interested in what our participants have to tell, including any differences between them.

The information you provide will be used for anonymised data analysis. One goal is to find common themes for the second part of the study for which you are invited to an interview on UTS campus or another location that is convenient to you. This interview seeks additional insight to help further interpretation.

If you would like any extra information or need something clarified, feel free to contact me via phone (+61416119485) or email (dominique.vangennip@student.uts.edu.au). If you doubt the conduct during this study, you can contact my supervisor at Elise. Vandenhoven@uts.edu.au or register a complaint with Research. Ethics@uts.edu.au.

Kind regards,

Doménique van Gennip

Figure A4.2.1. General introduction (page 1).

A few questions about you...

The following questions aim to get a better view of you.

Your name? _____

What is your age? _____ (in years)

What is your gender? M / F

What is the highest level of education you have attained? _____

What is your main occupation at the moment? _____

Household situation? Living alone / Living with _____ people

For how long have you lived at the current location? _____ (in years)

For how long have you lived in the current area? _____ (in years)

Diary instructions

This task will be repeated daily for the duration of this study, 10 days.

The core idea is that you write down the things you encounter throughout the day that remind you of something about your own past, and perhaps made you go back to that moment for awhile. Such a thing could be an object such as a souvenir at home, an item at work, or an inherited tool.

Each such a remembering experience triggered by an item goes on one of the provided diary pages that follow, and there are several pages per day. Your task is thus to add encounters with a memory triggered item once these occur. Try to add at least a few items each day, but don't worry if some days yield less items.

Because this task could pop up any moment of the day we suggest to keep this diary on you throughout the day. In addition we would like to ask you to take a photo of the item you encountered, for example using your mobile phone. This way describing the item can be less time consuming.

There could be quite a variety in the things you may list and in the related memories, which is part of the reason we are doing this study. The best way to go is to just take note of the item and what it is that it reminds you of, without much deliberation whether it is a good addition or not. There is no need to seek items to add, we are really interested in what you encounter naturally throughout a regular day.

Any item only has to be written down once, even if you encounter it everyday. If it triggers different memories at different times, you may add one page for each time a different memory comes up.

If you have digital photos of the things mentioned in the diary, it would be handy to match the filenames according to the page numbers in this diary.

Figure A4.2.3. *Diary instructions (page 3).*

Date: ___/___/___ **Time:** _____ **Location:** _____

(give a brief description of the memory you were reminded of)

I remembered...

(give a brief description or drawing of the thing that made you remember)

Because I noticed...

(give a brief description of how remembering this affected you)

This made me feel...

Figure A4.2.4. Empty diary entry with sentences to complete (repeats pages 4 to 82).

Second part: please wait until the last day...

Please don't open the next pages until you have completed the diary study part. This part is hidden to avoid any influence of the final task on your earlier diary keeping.

On the tenth day, the tape can be cut to reveal the final task.



Figure A4.2.5. *Second part: initially hidden with tape (page 83).*

Part II: Home environment mapping instructions

This final task is about getting insight into the items that you keep in your living environment which remind you of something about your life. This task will ask you to map those items on the next pages. If there is anything you do not want to share, you can simply omit it.

While you are at home, you probably spend most time in one or two rooms while awake (for example, living room, kitchen, or bedroom).

- (1) Please go to the room you spend most time in.
- (2) Use the next pages to draw a map of this space, and indicate the locations of all the items that remind you of something about your life. Please include what it is you are reminded of (you can keep it brief). You can include items stored inside cupboards if those are important to you.

Examples: a photo frame of your late pet, a note from the doctor to call, a vase that was a gift from a friend, or a cupboard bought together with your partner.

- (3) Now mark all items that you keep around primarily because of what it reminds you of, and not because of any actual function of the item. You can simply mark these items with an asterisk *, or encircle them with a pen of different colour.

Figure A4.2.6. Home mapping instructions (page 84).

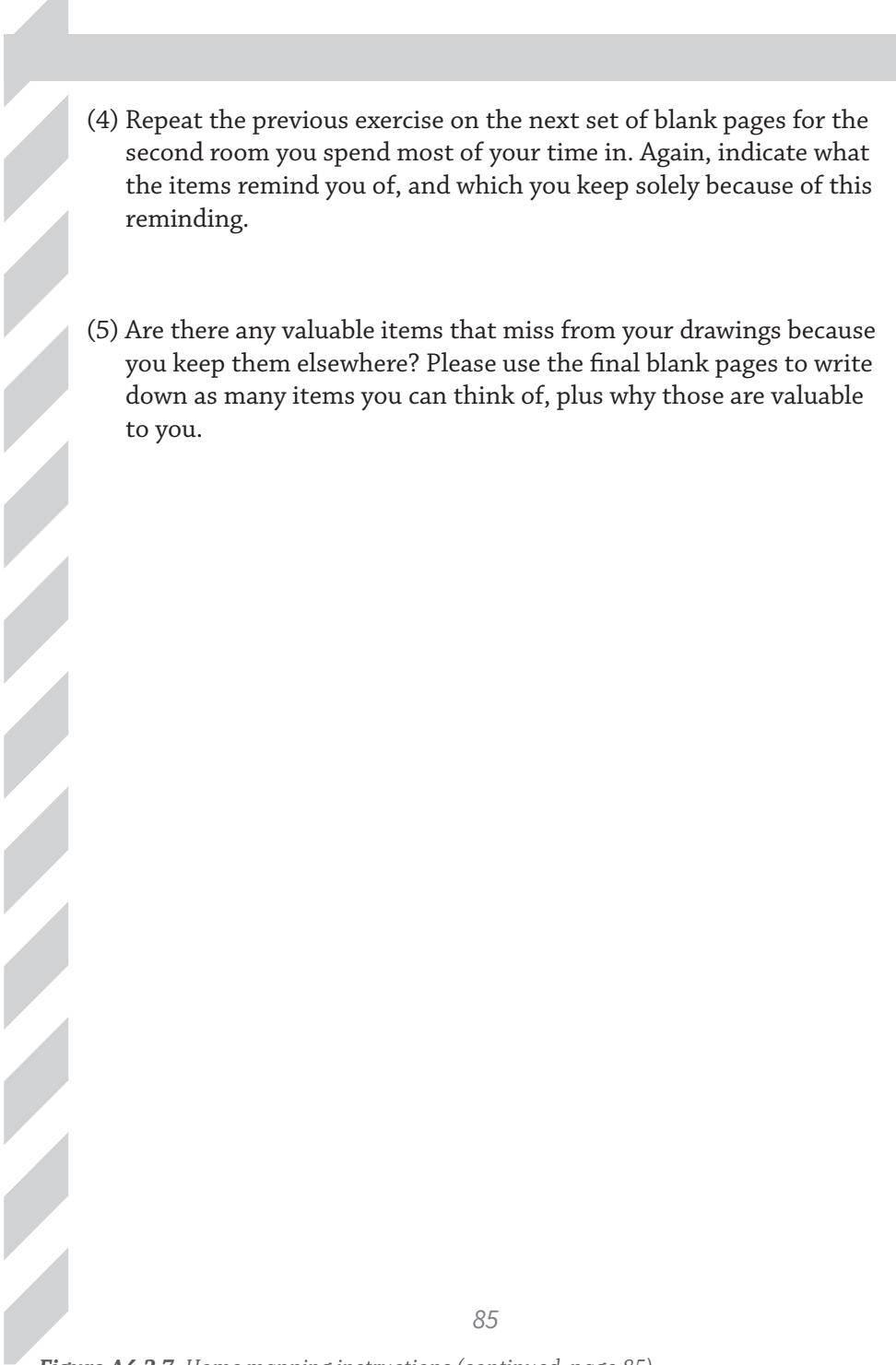
- 
- (4) Repeat the previous exercise on the next set of blank pages for the second room you spend most of your time in. Again, indicate what the items remind you of, and which you keep solely because of this reminding.
 - (5) Are there any valuable items that miss from your drawings because you keep them elsewhere? Please use the final blank pages to write down as many items you can think of, plus why those are valuable to you.

Figure A4.2.7. Home mapping instructions (continued, page 85).

Following the instructions were three times two empty pages with the following instructions:

- (draw a map of the room you spend most of your time and locate the various items in this place that remind you of something about your life; please make a note of what an item reminds you of)
- (draw a map of the room you spend most of your time and locate the various items in this place that remind you of something about your life; please make a note of what an item reminds you of)
- (Are there any valuable items that miss from your drawings on previous pages because you keep them elsewhere? Please use these pages to write down as many items you can think of that remind you of something about your life; please make a note of what an item reminds you of)

The End!

You have completed the diary. Thanks for your participation!

Please make sure this diary gets back to the researcher. You can use the included envelop, visit me on UTS campus (building 6, level 6, room 49), or contact me via mail or phone (see details on the first page).

After this booklet is collected the researcher will invite you for a final interview, during which additional insight is sought to help the interpretation and analysis. You are free to contact the researcher at any time if you have comments or questions.

You may also use the blank area on this page for any comments you have during or after completion of the diary.



Figure A4.2.8. Final page with instructions for returning the diary (page 92).

Appendix 4.3 – Interview protocol

Practical matters

- Recording equipment ready (if smartphone; set to flight mode to reduce disturbances)
- Have some means of keeping time (watch?).
- Have a notepad for single purpose of keeping interview notes.
- Bring the participant's diary + prints of any photos [bring those as cards].

Introduction (~5 min)

The goal of this interview is to discuss your experiences while keeping the diary, to help me interpret the data, as well as deepening my understanding of the remembering experiences you've had. In addition, I would also like to talk about remembering and personal memories beyond the diary entries.

This interview will last for approximately one hour.

I would like to point out this is not a test in any way, it is really about learning from you. In addition, I'd like to remind you that you are free to not disclose or discuss anything you are uncomfortable with. Some or all of the things disclosed may be published, but this will only be done such that it cannot be linked back to you individually.

Before we start I would like to indicate that I'll be recording this interview to help me keep track of everything being discussed.

Topic: diary (~20 min)

In the first part of the interview I would like to go back to the diary you've kept. I hope keeping the diary was an interesting experience for you.

- Could you relate some of the experiences you've had during the days you kept the diary?
 - *[probe]* Was it enjoyable? If (not) so, why?
 - *[probe]* Was it easy to do?
 - *[probe]* If not, what could be reasons for that? Would there be a way to improve on it?
- What made you take note of these items?
 - *[probe]* What is it about these items that triggered the memories?
 - *[probe]* Did you come across these items or were there items you had been actively looking for?
- What is a personal memory for you?
 - *[probe]* Did you filter what was recorded in the diary based on that view? If so,

- in what way?
- Did you have any observations or insights at some point?
 - *[probe]* Were there any unexpected memory triggers during these days?
 - *[probe]* Did you realise something about the way you remember things on a daily basis?
 - Some days saw no recorded items, while others had several. Why?
 - *[probe]* Might awareness or sensitivity be different for some days?
 - *[probe]* Were there things that triggered memories which you did not write down?
 - *[probe]* If so, in what way were those remembering experiences different?
 - Have you noticed any changes in sensitivity to memory triggers during the task?
 - Between now and the day you finished the diary task, have you gotten any new insights? Have you been more aware of memory-related items?
 - Going over the diary entries, I noticed there is quite a variety of things you wrote down.
 - *[probe]* How strongly did you feel you relived the (earlier) moment?
 - *[probe]* Where were there differences between the various kinds?
 - Are these items that you regularly come across?
 - *[probe]* Do those bring back the related memories every time? If not, why?
 - *[probe]* Would you consider those items as memories (as in, enabling you to relive the event)?

The room (as illustrated)...

- Was there any particular idea or principle behind the arrangement of these items in this way? (e.g., a shelf with various souvenirs)?
 - *[probe]* Have things been organised to enable you to encounter those?
- Are these items important for you?
 - *[probe]* Is there a relation between the items and your identity?
- What makes these items be put on display and not others?
 - *[probe]* Is it the related memory, the appearance of the item, or something else?
- What about items that do not really bring back any memories? What happens to those?
 - *[probe]* Would you think there is a reason for that?

Topic: current reminiscing and reflection practices (~15 min)

- What causes you to reminisce (alt wording: relive certain moments of your life)?
 - *[probe]* Are there any specific triggers, like the items noted in the diary?
 - *[probe]* Or rather internal motivation?

- Is reminiscing important for you?
 - *[probe]* Has this changed over the years? If so, how?
- Does reminiscing and remembering of your personal life play a role for you?
 - *[probe]* Have there been phases in your life where this has been different?
 - *[probe]* What about the near/far future?
- Do you have a goal when you engage in reminiscing?
 - *[probe]* Do you look for a certain experience or feeling? Or merely relaxation?
 - *[probe]* What about reflection?
- Do you purposely relive moments of your life?
 - *[probe]* If so, how often?
 - *[probe]* Does it depend on mood?
 - *[probe]* Do you have any favourite place or moment for such activities?
- Are there moments you are more likely to engage in such reminiscing?
 - *[probe]* Are you usually alone in such moments, with friends or family, or else?
 - *[probe]* Where are you mostly likely to engage in this?
 - *[probe]* Does it happen at other times/elsewhere?
- What ends or interrupts such reminiscing activities?
 - *[probe]* When would you feel done with it (i.e., is there an end goal for you)?

Topic: role of digital & physical objects in remembering (~10 min)

- What role do items play for your remembering practices?
 - *[probe]* Is this different for different social situations?
 - *[probe]* Do you see those as reminders?
- Do you ever actively go over a collection for the purpose of remembering?
 - *[probe]* Or is remembering more something that happens while sorting through stuff?
- Are those items a memory for you (i.e., causing you to relive the event)?
 - *[probe]* Do you think you would no longer relive those moments if the item(s) were not there?
- How do you decide to keep and collect items?
 - *[probe]* Is this a deliberated choice or more implicit?
 - *[probe]* If items are a 'side-effect' of some activity, what makes you keep those things and not others?
- Have you ever had items which related to some memory you'd rather not think of?
 - *[probe]* Assuming you came across some item that relates to it, what do you do with it?
 - *[probe]* What do you wish the situation would be?
 - *[probe]* Have you thrown out items to later regret?

[Physical versus digital] – Going over the diary entries, I noticed there were no/some/

many digital items listed.

- Perhaps you have many digital items related to memories nowadays, compared to a more physical collection earlier in life. Is this the case?
- Do you experience a difference in use pattern or ability to reminisce between certain types of items?
 - *[probe]* Do you think there is a difference between digital items and physical items in terms of triggering memories for you?
- Do you think something has been gained and/or lost by these items being digital?
 - *[probe]* Do you have a preference? If so, why?
- Is there any difference in how you approach digital items that relate to memories?
 - *[probe]* Would there be a reason for this?
- With more media moving towards a digital format, do you think it affects you in any way?
 - *[probe]* Have you noticed changes in your relation to (for example) photos you have taken yourself?
 - *[probe]* Is there a difference in terms of value to you?
- What do you do with digital souvenirs or other such digital memory-related items?
 - *[probe]* Are such files or items stored in a specific place?
 - *[probe]* How often are these encountered?

Topic: desired experiences (~5 min)

So far we have been discussing earlier and current practices. In the final part of the interview I would like to talk about desired remembering experiences. In other words, these would be ideal situations.

- NOTE: These questions have been skipped in later interviews as it proved difficult to answer.
- It would be better to ask for suboptimal/ideal situations in earlier parts of the interview.
- How would you describe the ideal remembering/reminiscing experience?
 - *[probe]* Different for different memories?
- Let's assume you have a magical wand... (?)

Wrap-up (~5 min)

- Briefly summarise the key points of the discussion.

Before we wrap-up, do you have any things you would like to add to what we have discussed so far, or perhaps missed in the discussion?

We have reached the end of the interview. I would like to thank you for your participation and contributions, it has been very helpful for my research.

From here on, I will use the diary and interview input together with those of others to help come to an understanding of how items (both digital and physical) support the remembering and reminiscing process. My research is looking at how everyday life remembering can be supported through (interaction) design, and this first study helps me to understand current practices. If you like I can inform you once this study's data has been synthesised and written up.

Finally, if in the next few hours or even days you think of something that might be helpful, I'm glad to hear about that.

- Don't stop recording until after participant has left.

Appendix 5.1 – Repertory grid study consent form

I _____ (*participant's name*) agree to participate in the research project Materialising memories (UTS HREC reference 2012000570) being conducted by Doménique van Gennip (contact info omitted) of the University of Technology, Sydney for his degree as Doctor of Philosophy. Funding for this research has been provided by University of Technology, Sydney.

I understand that my participation in this research will involve a brief remembering session and a structured interview (together lasting approximately 1.5 hour) during which I have to complete several tasks on paper, and that I can be asked to note personal memories, and answer questions about these memories. All contributions made will be kept confidential, and I understand I have the option not to report on anything I rather keep private, nor am I obliged to share anything in writing or during an interview that I am not comfortable with sharing. I might be inconvenienced by the time required to be involved in this study, but no other harm is likely to result from my participation.

I am aware that I can contact Doménique van Gennip or his supervisor Elise van den Hoven if I have any concerns about the research. I also understand that I am free to withdraw my participation from this research project at any time I wish, without consequences, and without giving a reason. I will not be penalised in any way for declining to take part in any stage of the research.

I agree that Doménique van Gennip has answered all my questions fully and clearly. I agree that the research data gathered from this project may be published, if so it will be done in a form that does not identify me in any way.

Signature (participant)

Signature (researcher or delegate)

NOTE: This Human Research Ethics Committee of the University of Technology, Sydney has approved this study. If you have any complaints or reservations about any aspect of your participation in this research, which you cannot resolve with the researcher, you may contact the following independent persons, who will treat your complaint or reservation in confidence, investigate it fully and inform you of the outcome. When the researcher's primary affiliation is with the University of Technology, Sydney, you can contact: the Ethics Committee through the Research Ethics Officer (contact info omitted), at the University of Technology, Sydney. Please quote the UTS HREC reference number. When the researcher's primary affiliation is with the Eindhoven University of Technology, you can contact: the Project Officer of the Industrial Design department at the Eindhoven University of Technology (contact info omitted). Please quote the names of the project and researcher.

Appendix 5.2 – Keyword sheets

Participants answered the demographic questions on the first card, after which they filled in the remaining six cards with memories around the themes of Rejection, Childhood, Theme party, Ceremony, Fleeing, and Chocolate. Originals were printed on A4 paper and cut prior to participants' arrival (6x Keywords cards, 1x Demographics card).

Demographic questions (participant #.....)	Keyword/theme
-----	-----
What is your age? _____	Briefly describe the past event:
-----	-----
What is your gender? M / F / Other	

What is the highest level of education you have attained?	Describe your experience, how you felt, at that time:
_____	-----
-----	-----
What is your main occupation at the moment?	

-----	-----
Keyword/theme	Keyword/theme
-----	-----
Briefly describe the past event:	Briefly describe the past event:
-----	-----
Describe your experience, how you felt, at that time:	Describe your experience, how you felt, at that time:
-----	-----

Appendix 5.3 – Repertory grid interview protocol

Practical matters

- Recording equipment ready (phones: set to flight mode/silent to reduce disturbances)
- Have some means of keeping time (watch?).
- Have a notepad for the single purpose of keeping interview notes.
- Six (6) elements for the RGT. Also bring empty cards, one for each element.
- Empty grid sheet (2x).
- List of pseudo-randomised order for the comparisons.

Introduction (~5 min)

Thank you participating today. The plan for this session is for you to experience several ways of remembering. What follows is a structured interview. The goal of this session is for me to try and understand you in your own terms, so there are no right or wrong answers. I would like to point out this is not a test in any way, it is really about learning from you.

This interview will last for approximately 1 to 1,5 hour.

In addition, I'd like to remind you that you are free to not disclose or discuss anything you are uncomfortable with. Some or all of the things disclosed may be published, but this will only be done in such a way that it cannot be linked back to you individually.

Before we start I would like to indicate that I'll be recording this interview to help me keep track of everything being discussed.

Part 1: training session (~5 min)

Before starting with the actual session, I would like to do a brief training round as a way of explaining the procedure.

Let's say my topic of interest is personality. In this instance, we have a set of toys and my aim is to find out how you think about these toys in terms of how you feel about their personality (rather than their physical properties). I'll be doing that by asking you to make a series of systematic comparisons. To make such a comparison, I'm going to select three of the toys at random.

- If I were to say to you: these three toys, which two of these toys are alike in some way, and different from the third, in terms of how you think about their personality?
 - *[probe]* See additional questions below for checking understanding, laddering, etc.

Having identified the opposites of your contrast pair, I'm going to put the opposites on this grid sheet. It has the different toys [elements] as columns, and one row per contrast pair. Imagine these opposites defining a scale that ranges from 1 to 7. The phrase on the left stands for the '1' end of the scale, and the phrase on the right stands for the '7' end. The next step is that you rate each of the three toys on a scale from 1-7 on this construct. It is perfectly fine for more than one toy to have the same rating.

- Rate the three selected elements on the newly identified construct on a scale from 1-7.
- Rate the remaining (unselected) elements as well on this newly identified construct.

GRID SHEET DATA (FOR DEMONSTRATION PURPOSES)

- Topic: personality of the toys.
- Elements: (4x) Tiger print, Orange, Striped purple, & Green/white.

Part 2: experiencing elements (~10 min)

In the next part of this session I would like you consider several cards with words. For each theme, try to remember an event from your own personal past that relates to this theme. This event could be general or specific. Pick the first event that comes to you for which you remember a strong experience. If possible, try to relive this event for a minute. You have ample time to do so.

PER CUE CARD/ELEMENT (6X)

- Briefly describe the remembered event? [on the card] (open)
- How would you describe your overall experience during the past section? [on the card] (open)

GRID SHEET DATA

- Topic: your experience as remembered.
- Elements: (6x) (see below).

CUE WORDS

- Rejection, Childhood, Theme party, Chocolate, Ceremony, Fleeing

Part 3: construct elicitation (~60 min)

In this part, my aim is to find out how you think about these past events in terms of your experience while remembering them [topic; qualifying phrase]. Again, I'll be doing that by asking you to make a series of systematic comparisons. The way I go about this makes for great precision, but you as the interviewee can choose how much detail to go into.

- Start of construct elicitation cycle.
I'm going to take three <elements> from our set.

- Which two of these are the same in some way, and different from the third?
 - *[alternative]* If I were to say to you: these three elements, which two of these elements are alike in some way, and different from the third, in terms of how you think about them as topic?”
- Why: what do the two have in common, as opposed to the third?
 - *[probe]* Make sure also the converse word or phrase is identified.
 - *[probe]* Make sure we’ve obtained a truly bipolar expression (a pair of words or phrases which express a contrast).
- Make sure the constructs are expressed in terms that are self-explanatory and clear.
 - *[probe]* Aim for: clear contrast, appropriate detail, clear relationship to topic.
 - *[probe]* Could this contrast be encompassing more than one construct, and thus be split up?
 - *[probe]* Check my understanding of the construct being expressed.
 - *[probe]* Discuss what the participant means (using their words if possible), and perhaps negotiate a form of words that makes sense to you both.
 - *[probe]* Terms should not be prone to diverse interpretation or rely on another personal construct, jargon, etc.
 - *[alternative]* How do you mean; in what way?
 - *[alternative]* What sort of thing do you have in mind when you say something is or isn’t phrase?
 - *[alternative]* Can you give me an example of the one and the other?
 - *[alternative]* What happens when this phrase is the case that is different from those lacking phrase?
 - *[alternative]* Can you suggest a particular and important way of being phrase?
- If a construct appears similar to an earlier one, I could ask if the participant feels similar or that the construct may well be different in a meaningful way.

Having identified the opposites of your contrast pair, I’m going to put the opposites on this grid sheet. It has the different XXX [elements] as columns, and one row per contrast pair. Imagine these opposites defining a scale that ranges from 1 to 7. The phrase on the left stands for the ‘1’ end of the scale, and the phrase on the right stands for the ‘7’ end. The next step is that you rate each of the three elements on a scale from 1-7 on this construct. It is perfectly fine for more than one element to have the same rating.

- Rate the three selected elements on the newly identified construct on a scale from 1-7.
- Rate the remaining (unselected) elements as well on this newly identified construct.
 - *[probe]* Occasionally, check whether the dimensionality of the scaling is preserved (so a 1 isn’t rated 7, and vice versa).

That completes this round. We shall now move on to another set of three.

- This cycle continues until the participant cannot produce any more personal constructs, or time runs out.

Before moving on to the final bit, I have a final question related to the grid. Looking at the grid we've produced so far, do you feel there is a construct/contrast pair that has not been discussed but would apply to all these elements?

- If yes [give some time to think], do a similar rating task as above.

Before wrapping-up, I have several standard contrast-pairs I would like you to use for rating the elements. These pairs are not better or worse than those we've discussed so far, but allow me to better compare responses across participants.

- Do a similar rating task as above, but skip any contrast-pair that is already included.
 - [contrast-pair] lively – dull
 - [contrast-pair] personally relevant – personally irrelevant
 - [contrast-pair] meaningful – meaningless
 - [contrast-pair] positive – negative
 - [contrast-pair] intense – mild
 - [contrast-pair] mixed feelings – clear/single feeling
 - [contrast-pair] satisfaction – disappointment

Wrap-up (~5 min)

- Briefly summarise the key points of the discussion.

Before we wrap-up, do you have any things you would like to add to what we have discussed so far, or perhaps missed in the discussion?

We have reached the end of the interview. I would like to thank you for your participation and contributions, it has been very helpful for my research.

From here on, I will use the interview input, constructs, and ratings together with those of others to help come to an understanding of how people describe and contrast their experiences. My research is looking at how remembering in everyday life can be supported through (interaction) design, and this second study helps me to understand experiences while remembering. If you'd like I can inform you once this study's data has been synthesised and written up.

Finally, if in the next few hours or even days you think of something that might be helpful, I'm glad to hear about that.

- Don't stop recording until after participant has left.

Appendix 5.4 – Quantitative analysis details

This appendix serves to give a more elaborate explanation of the generation of the PRINCOM map in Figure 5.5 (replicated below as Figure A5.4.4) and more precisely detail how the quantitative ratings were used and analysed with this aim. To recap, participants wrote down six personal memories around an equal number of themes: *Childhood*, *Rejection*, *Fleeing*, *Chocolate*, *Theme party*, and *Ceremony*. These elements were then contrasted using the repertory grid technique, such that from each comparison of three elements we obtained a commonality between two, with the remaining element representing an opposite pole. For example, two memories may be distinguished as Happy versus Sad for the third one. Next, participants would rate each element between 1 and 7 on this Happy/Sad scale, and so on. Eventually, this yields a large set of quantitative data that can be used to assess (dis)similarity between constructs based on a correlation in ratings.

Because a total of 337 constructs were rated across all participants, it is helpful to cluster similarly rated constructs together to obtain a smaller, hopefully semantically meaningful set. To explain this visually, consider Figure A5.4.1. Instead of clustering constructs together, this figure depicts a dendrogram of the elements that were rated. Such a dendrogram creates a tree-like data structure in which similar elements share a root and dissimilar elements split off early to sit on their own branch. In the figure, it is evident that *Childhood* stands apart from the other elements. That may be due to more diverse interpretations of the theme and as a result, divergent ratings. *Rejection* and *Fleeing* are however quite similar, as are *Theme party* and *Chocolate*. Based on this graph, one may surmise that future studies could seek more diversity by exchanging the more closely related themes.

The above image was generated using R with the *HMISC* library. With that library, a hierarchical cluster analysis was done for the elements as the variables of interest. Of course, the tables may be turned such that we can cluster the constructs that participants generated during the interviews. A visual representation of this is shown in Figure A5.4.2. Note that a particular construct can only be assigned to one cluster, which reduces overlap and ambiguity in interpretation of a cluster's semantics. In the previous situation it was clear that the final result would contain six clusters, one for each element. When generating a hierarchical tree for a large set, the number of clusters has to be determined in a different fashion. In the figure below, a number of fifteen clusters was set ahead of 'cutting the tree' to demonstrate the general hierarchical clustering technique. Ideally, though, the number of clusters is determined using some data-driven meaningful determinant.

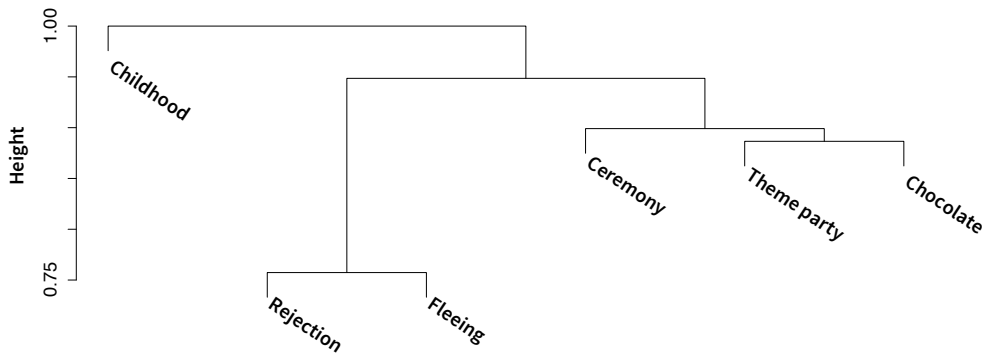


Figure A5.4.1. Hierarchical clustering of elements, shown as a dendrogram in which more alike clusters tend to share roots in the tree structure.

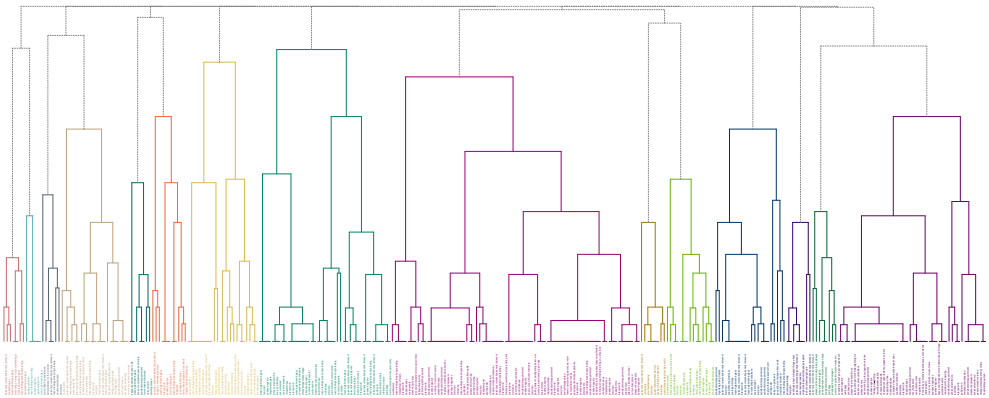


Figure A5.4.2. Hierarchical clustering of elements, shown as a dendrogram with fifteen clusters. The emphasis is on the overall structure rather than readability of the individual constructs listed on the bottom.

For the final analysis as reported in Chapter 5, we opted to use clusters' Eigenvalues as a means of determining a cut-off point for accepting additional clusters. Clusters with a large Eigenvalue display a clearer co-variability and vice versa, low Eigenvalues signify a difficult to interpret cluster that may offer little explanatory benefit in practice. With an Eigenvalue of 1.5, we obtained fourteen clusters. Had we used a more lenient Eigenvalue of 1, twenty clusters would have come out. To ease interpretation, we opted for the stricter criterion. It should be noted that this step of the analysis, as well as the next, were performed using custom software and generous assistance by prof.dr.ir. Jean-Bernard Martens of Eindhoven University of Technology. His approach to oblique clustering follows the same tenets as described above, with the added benefit of working from proven code and experience to arrive at solid outcomes.

To make the resultant clusters more useful, these can be put into a two-dimensional plot such that interrelations between clusters become apparent. For this purpose, the clusters are submitted to a principal component analysis (PCA). The clusters' loadings towards the two dominant factors of the PCA analysis are used to map the clusters onto a graph, as shown in Figure A5.4.3. Because our constructs go both ways (e.g., happy on the one end, and sad on the other), Figure A5.4.4 has the clusters' dimensional lines going both ways from the origin. In addition, this PRINCOM map provides clear labels for each cluster that were based on interpreting the commonality in constituent constructs.

Individual principal component maps, as shown in Figure 5.6 and replicated here as Figure A5.4.5, were generated in similar fashion to the two figures above. Thus, a principal component analysis for a participant's constructs was used to map these constructs onto the two dominant PCA factors. Of course, no interpretation was necessary for the constructs' labels. A key benefit of individual maps is that the constructs map directly to their views (i.e., ratings) of the themes, which makes for an interesting visual instrument to compare participants with each other. It should be noted that the figure below, like the similarly styled figure directly above, were generated by hand using Adobe Illustrator from PCA plots. It is possible to generate this automatically using software (see Fallman & Waterworth, 2010; Shaw & Gaines, 1995; Tomico et al., 2009), which was not available to us at the time.

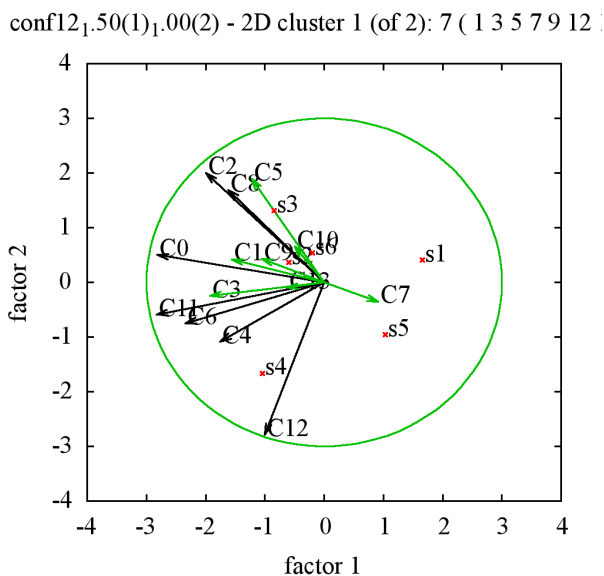


Figure A5.4.3. The 14 clusters/dimensions mapped onto a two-dimensional plane (using principal components analysis on the clusters), with the six memory themes (s1-6) placed within these dimensions.

Appendix 5.5 – Network graphs from quantitative data

One of the goals of the analysis of the repertory grid data was to arrive at categories that meaningfully describe remembered experience as a phenomenon. In Chapter 5, the clearest result in this regard stems from a qualitative approach in which participants' constructs were hierarchically clustered and interpreted to obtain the categories in Table 5.1. Using the quantitative ratings, another attempt was made using oblique clustering (as explained in the previous appendix). A third method was also employed, namely network graph analysis. The idea is that if constructs can be related to each other, for example through correlation of their rating, it may be possible to map these constructs onto a canvas such that more closely related constructs appear closer together and vice versa. In theory, if clear groupings would occur, a network graph could provide an alternative way of arriving at clusters of related constructs (as visualised in Figure A5.5.1). It did not work out so well in practice.

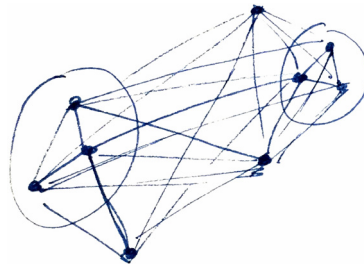


Figure A5.5.1. Illustration of an idealised network graph with clear clusters (circled), courtesy of our professional graphics designer.

The network graphs shown below (Figures A5.5.2 and A5.5.3) were generated using GEPHI, an open source tool available via gephi.org. The data it ingests assumes that constructs are nodes within a network. The relations between constructs count as edges. The stronger the connection between two nodes, the closer these nodes will end up together in the graph. This positioning is based on a force algorithm, where high edge weights pull in nodes, and low connections push away nodes. Better connected nodes are therefore better able to attract other nodes, with weakly connected nodes left to drift away from the core groups. We used several metrics to assign edge weights between constructs. The simplest approach uses a straightforward Pearson correlation coefficient based on ratings given for each construct (Figures A5.5.2 and A5.5.3). If ratings were similar, the coefficient would be 1 and 0 in the opposite case. These coefficients were calculated with a script written in Python that generated an edge table for all possible combinations of constructs (equal to $1/2 * (n^2 - n)$, where n is the number of constructs). This table is then imported into Gephi to create a network graph.

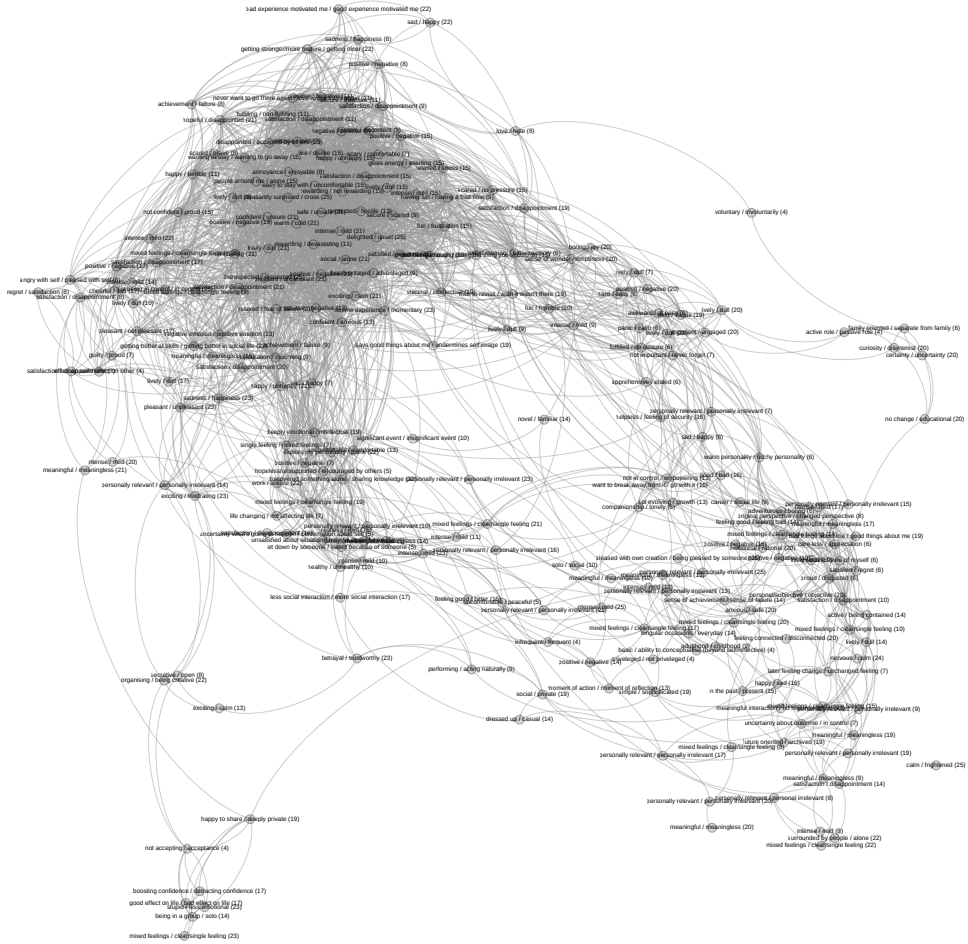


Figure A5.5.3. Network graph of constructs based on correlation between ratings, now filtered such that low-correlation connections were left out to obtain clearer grouping compared to the earlier graph (previous page). At the least, that was the plan, in which this graph decided to play no helpful part: no clear clusters can be identified.

An alternative path we explored was to use semantic analysis of the words using to describe a construct to arrive at useful edge weights. This kind of analysis typically depends on an existing lexicon and means to assess the similarity in meaning between two terms. Figure A5.5.4 employs semantic path analysis, which is based on how many degrees of separation exist between the dictionary definitions of two words. Synonyms would be very close neighbours, in contrast to terms that share little commonality in their definitions. To arrive at a suitable single dictionary term to reflect these constructs. For example, a participant's 'sense of achievement' would use 'achievement' as its corresponding

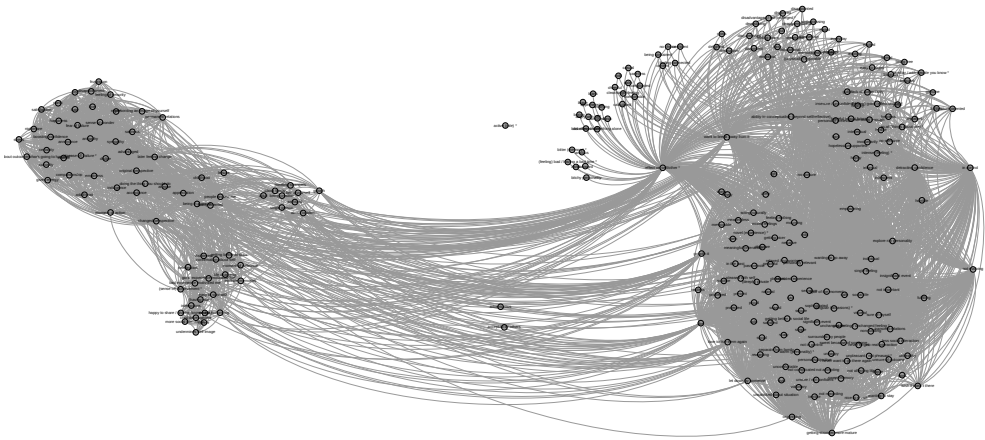


Figure A5.5.4. Network graph based on lexical path similarity of the words used to describe constructs. There is a large divide between constructs on the left and the right, as well as between me and grasping what is going on.

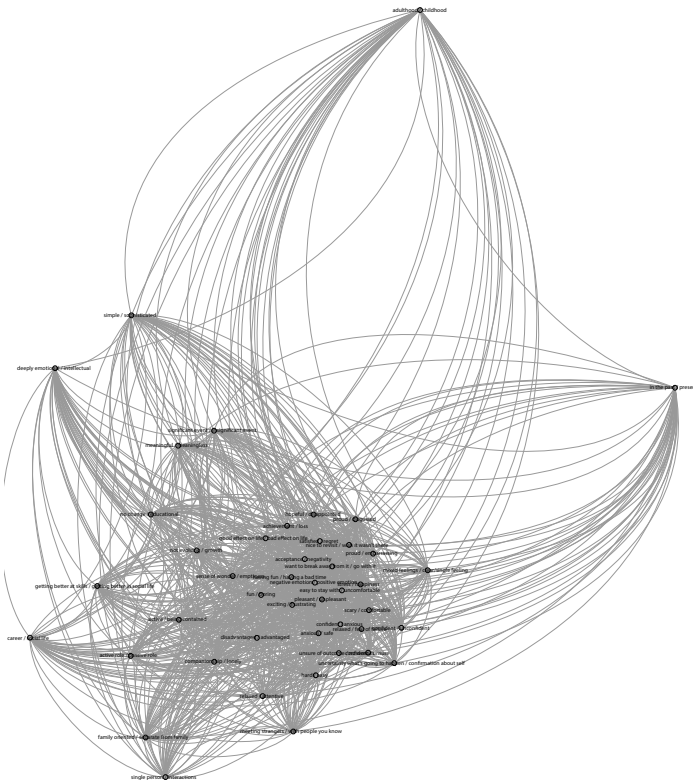







Figure A5.5.5. Network graph based on the subjective semantic similarity between a subset of 45 constructs. Apart from some outliers, no clear grouping is evident.

dictionary term. Then, those terms with equivalent dictionary terms omitted. The actual similarity metric was derived from <http://ws4jdemo.appspot.com/>, developed by Hideki Shima and based on earlier computational methods to derive similarity between words in the WordNet corpus.

The graphs fell short of our expectations. Clustering was too strong (one big blob of constructs), lacking a clear differentiation into separate groups, while the groups that did form defied interpretation. Because none of the above approaches proved very fruitful, another attempt was made to subjectively code the perceived similarity between constructs. Because of the time intensive nature, our endeavour was limited to a subset of 45 constructs selected at random. Once again, the resultant network graph (Figure A5.5.5) was lacking in clear demarcation of clusters.

It is not immediately evident what caused this approach to fail. It seems some constructs may be considered similar to another but not to a third. If the second and third are considered similar, this would violate internal consistency of the data (similar to how, when $A < B < C$, A must not be larger than C), causing the network graph to remain indistinct. In summary, network graph analysis failed to deliver on its promise to reveal clusters of interest. For this reason, the graphing exercises explained here were omitted from the main body of the thesis. Its inclusion here in the appendix serves to outline our thinking and approach such that a reader may benefit from our tribulations.


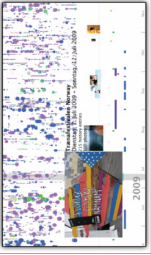

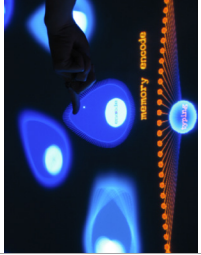
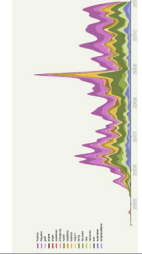
Appendix 6.1 – Design work included in review





Name	Source	Year	Category	Image	Description	Media	Location	Interaction
Family Album (digital lamp)	Jaafar, S., Johns, M., Li, X., et al. (2014). Family Album- Photo Sharing for InterGenerational Connection. Presented at TEI 2014 (WIP).	2014	1.1		A table lamp with a fixed photo album, that upon opening works as an interface for virtual albums. Pulling the shade's string switches between albums, whereas flipping the pages moves between photos. Uploading photos is done via WiFi per app or email.	Photos sourced from personal digital archives (cloud based).	Home-living room	Pulling the string on the lamp moves between albums. Flipping the physical pages moves from one photo to the next. Organisation of photos is done either through an app or other interface with its cloud storage.
Living Memory Box	Stevens, M. M., Abowd, G. D., Truong, K. N., & Vollmer, F. (2003). Getting into the Living Memory Box: Family archives & holistic design. <i>Personal and Ubiquitous Computing</i> , 7(3-4).	2003	1.1		Living Memory Box is one manifestation of a digital-physical hybrid archiving architecture. The display features a microphone for recording annotations about any objects placed within the space below. Not large enough to store everything, it is rather a portal between the physical and digital world. Through this device, people can annotate and listen back old recordings to help in remembering and reminiscing.	Objects and audio annotations.	Home	Placing an object in the 'box' makes an interface available to review or add annotations, audio, or video.
MEMENTO	West, D., Quigley, A., & Kay, J. (2006). MEMENTO: a digital-physical scrapbook for memory sharing. <i>Personal and Ubiquitous Computing</i> , 11(4), 313-328. http://doi.org/10.1007/s00779-006-0090-7	2006	1.1		MEMENTO is a digital/hybrid scrapbooking system that integrates physical writing with audio, video, and digital photos through a distributed system. It allows people to connect digital and physical mementos to stimulate reminiscing away from traditional interface paradigms.	Photos, video, audio, written annotations	Home	The system is flexible to integrate various modes of writing, annotating, and viewing. Notable elements include a digital pen and a web-based interface that mimics traditional photo/scrapbooks in its appearance and content.
Memory Box	Frohlich, D. M., & Murphy, R. (2000). The Memory Box. <i>Personal and Ubiquitous Computing</i> , 4(4), 238-240. http://doi.org/10.1007/BF02391566	2000	1.1		"The Memory Box used a jewelry box metaphor to associate a recorded narrative with a souvenir, considered of value only if given/received as a gift, but not for personal use. The work identified a clear need for a self-contained, simple technology for recording and play back."	Audio clips linked to souvenirs.	Home	Using RFID tags, a small number of physical items can be linked to audio recordings. When holding the item in front of the tag reader, this clip can be listened to.
Photo Browser	Hoven, E., van den, & Eggen, B. (2003). Digital Photo Browsing with Souvenirs (pp. 1000-1003). Presented at the Interact 2003, Zurich, Switzerland.	2003	1.1		Photo Browser is a photo collection viewer intended for the living room. By combining tangible tokens (that represent and can bring up certain collections), a tablet device for individual browsing and control, with a large living room display (tv), this design intends to support family photo talk and reminiscing.	Photos sourced from personal digital archives, plus linked tangible items.	Home-living room	Souvenirs or custom tokens may serve as RFID tags, that when held close to a tablet device open a related collection of photos. The tablet allows browsing, and facilitates the display of photos on a connected TV.



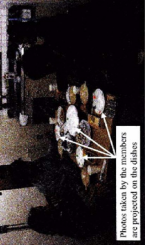

Name	Source	Year	Category	Image	Description	Media	Location	Interaction
Photo Mementos: PicGrabber/DigiPrint	Petrelli, D., Bowen S., & Whittaker, S. (2013). Photo Mementos: Designing Digital Media to Represent Ourselves At Home. <i>International Journal of Human-Computer Studies</i> . http://doi.org/10.1016/j.ijhcs.2013.09.009	2013	1.1		These three concepts work together to create a freer system for placing digital photos in physical frame. The PicGrabber is a digital pipet that allows one to assign an image to a DigiPrint display, which is thin enough to fit behind a regular frame. Thus, with this display existing frame designs and preferences can be leveraged.	Digital photos	Home	The PicGrabber is a tool to bridge from a digital medium (computer) to a physically present one (DigiPrint display). Thus, it provides a tangible means to assign images to a digital display by 'sucking in' and 'squirting out' a file.
Portable photo viewer	Balabanović, M., Chu, L., & Wolff, G. J. (2000). Storytelling with digital photographs (pp. 564–571). Presented at the Proceedings of the SIGCHI conference on Human factors in computing systems - CHI '00. The Hague, NL: ACM. http://doi.org/10.1145/332040.332505	2000	1.1		A digital photo browsing application, somewhat similar to a tablet with dedicated interface elements for photo viewing. This design is one of the early digital photo browsing designs. It is meant for co-located storytelling and reminiscing. To that end, it focuses on story and track-based organisation.	Photos sourced from personal digital archives.	Home	The viewer offers various ways to navigate and organise a collection of photos. It offers people to create a story of connected images, save this story and revisit others. In addition, a microphone can be used to add annotations.
SOUVENIRS	Nunes, M., Greenberg, S., & Neustaedter, C. (2008). Sharing digital photographs in the home through physical mementos, souvenirs, and keepsakes. <i>DIS '08</i> (pp. 250–260). New York, New York, USA: ACM. http://doi.org/10.1145/1394445.1394472	2008	1.1		A photo browser based around physical objects. People can tag things and couple those to a photo collection that is managed on a computer or tablet device. By holding the object's tag close to the tablet, the collection can be brought up. It is then available for browsing and storytelling.	Digital photos	Home	Souvenirs consists of two parts. The first is a collection of RFID tags that are attached to objects. These objects are then linked to the software, which constitutes the second part. This software allows people to create and manage photo sets to accompany the object.
Tales of Things	Barthel, R., Mackley, K. L., Hudson-Smith, A., Karpovich, A., de Jode, M., & Speed, C. (2011). An internet of old things as an augmented memory system. <i>Personal and Ubiquitous Computing</i> , 17(2), 321–333. http://doi.org/10.1007/978-91-01-04968-6	2011	1.1		Tales of Things focuses on capturing and revisiting annotations to physical things. People are able to maintain a collection of stories attached to things they own. This functionality is made available through a website where users can add text, images, and other media such as video.	Various (see description)	App - desktop	Tales of Things works via RFID tags and a mobile phone application or website. The tags serve to link things with the tales that are collated digitally. In addition, QR codes can be used to visit the tales' pages and share these with others.
Heirlooms: Backup Box	Banks, R., Kirk, D. S., & Sellen, A. J. (2012). A Design Perspective on Three Technology Heirlooms. <i>Human-Computer Interaction</i> . http://doi.org/10.1080/07370024.2012.656042	2012	1.2		Backup Box is a device that quietly accumulates and backs up mundane digital content, e.g. tweets and other status updates that seemingly are without much significance. It is intended to work over a very long time.	Online status updates	Home	The device provides a modern equivalent to old diaries that merely seemed to capture mundane activities, e.g. 'did laundry today, called friend, albeit an automatic, silent observer. No direct interaction. // A display does show a timeline of recent tweets, although it is normally hidden from view by a lid.
MemoryLane	Kainikaite, V., & Whittaker, S. (2011). A saunter down memory lane: Digital reflection on personal mementos. <i>International Journal of Human-Computer Studies</i> , 69(5), 298–310. http://doi.org/10.1016/j.ijhcs.2010.12.004	2011	1.2		MemoryLane orients towards spatially organising digital memorabilia, similar to how physical counterparts fit particular locations. To this end, the software uses a stereotypical home view in which the digital items are placed. These can then be reviewed later for reminiscing and reflection.	Digital media (various, including photos, video, and audio)	App - desktop	The application offers views for place, home, and people. Through each mode, digital memorabilia can be accessed and viewed.

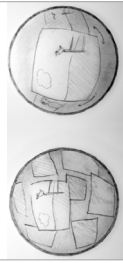
Name	Source	Year	Category	Image	Description	Media	Location	Interaction
Mobbox	Gildenpennig, F., & Fitzpatrick, G. (2014). Personal digital archives on mobile phones with MEO. <i>Personal and Ubiquitous Computing</i> , 1–17. http://doi.org/10.1007/s00779-014-0802-3	2014	1.2		Alongside the Media Object Recorder Mobile (MORM), the Mobbox presents a medium for viewing capturing media objects. Such objects are containers for a variety of media types, all held together into one unit. // Mobboxes are typically enhanced photo frames to be placed in the living room and come in various designs, as shown in the figure.	Digital media (various, including photos, video, and audio)	Home	Mobbox is typically a 10-inch tablet-like device that shows any MEO at random, and allows the selection of one. // It features a simple browser or, alternatively, a long tap plays a random MEO. Its interface is deliberately kept simple, as it is more about passive consumption of content actively captured earlier. // If showing a MEO it plays back all visual content, sequentially (a few seconds each), while playing any audio content at the same time.
Museum of Me	Thomas, L., & Briggs, P. (2015). Assessing the value of brief automated biographies. <i>Personal and Ubiquitous Computing</i> . http://doi.org/10.1007/s00779-015-0896-2	2011	1.2		Intel's Museum of Me allows its visitors to take a tour through a virtual museum, filled with their own photo collection (source is Facebook profile). // Users browse the virtual museum, watching their own photos and profile pictures of friends. // It proved popular with over 10 million 'visitors'.	Digital photos from personal archive (source was online photo collections)	App	The virtual museum lets its visitors login with their Facebook account. Once this is done, it taps into the user's collection of photos and friends to present a virtual exhibit. Similar to a real life counterpart, photos grace the walls in a large size. Some photos are put close together with other ones. Profile photos of friends are interspersed throughout the exhibit.
Photo Mementos: MemoryBook	Petrelli, D., Bowen, S., & Whittaker, S. (2013). Photo Mementos: Designing Digital Media to Represent Ourselves At Home. <i>International Journal of Human-Computer Studies</i> . http://doi.org/10.1016/j.ijhcs.2013.09.009	2013	1.2		A MemoryBook is a digital variety on a scrapbook in the sense that it harvests digital material as keepsakes. It is located on a bookshelf and does not draw attention to itself. Upon taking the book out, the display and internal speakers can be used to play media. Alike a 'memory box', this device would only be picked up for special moments and glanced through.	Digital media (various, including photos, video, and audio)	Home	This device collects information from various sources, although the process of its acquisition is not entirely clear. The side may softly glow, perhaps in response to significant dates related to its contained keepsakes. // When picked up, it behaves as a regular media browser.
Project Greenwich	Thiry, E., Lindley, S. E., Banks, R., & Regan, T. (2013). Authoring personal histories: exploring the timeline as a framework for meaning making. Proceedings of the 31st SIGCHI Conference on Human Factors in Computing Systems (pp. 1619–1628). New York, New York, USA: ACM. http://doi.org/10.1145/2470654.2466215	2013	1.2		Project Greenwich adopts the timeline as an instrument for making meaning. This can be done by adding personal moments and photos onto a timeline, thus using this timeline as a canvas to paint one's life onto.	Photos sourced from personal digital archives.	App - web	The focus of the application is on the creation of the timeline by adding elements. The app supports multiple timelines onto which people can add text, images, and link to Wikipedia articles. Each timeline could address a particular topic and be viewed in conjunction with other timelines, and if so desired, shared with others by making it public.
Shoebbox	Banks, R., & Sellen, A. J. (2009). Shoebbox: mixing storage and display of digital images in the home. Presented at the TEI '09: Proceedings of the 3rd International Conference on Tangible and Embedded Interaction. http://doi.org/10.1145/1517664.1517678	2009	1.2		Shoebbox is a photo storage and viewing device that aims to fit in contemporary home photograph practices. It takes photos from linked mobile devices and allows for storage and browsing through its front-mounted display. It provides an alternative to more complex technological solutions.	Digital photos from personal archive (source was photos on mobile device)	Home	People can place and keep several Shoebboxes together. The devices would link to a mobile device and automatically collect and show photos, now stored locally. Browsing can be done by picking up the device and using the top interface for scrolling through its collection. A box can be labelled with a strip of paper.



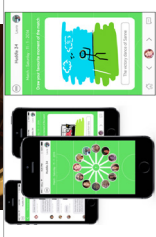
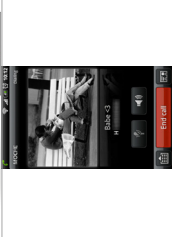

Name	Source	Year	Category	Image	Description	Media	Location	Interaction
Audiophoto Desk	Frohlich, D. M., & Fennell, J. (2007). Sound, paper and memorabilia: resources for a simpler digital photography. <i>Personal and Ubiquitous Computing</i> , 11(2). http://doi.org/10.1007/s00779-006-0069-4	2007	2.1		This desk gives a platform to place regular printed photos. A camera on top recognises these photos and allows for playback of related audio. The placement of the print determines the audio volume and left-/right speaker balance. Sounds were chosen at a moment after capture.	Printed photos.	Home - living room	Placing a printed photo on the desk will play a related audio file. Moving the photo further away dims the audio and vice versa. Moving it left or right distributes the sound to that side. In this way, several photos can be combined into a soundscape.
Digital Shelf	Martin, H., & Gaver, B. (2000). Beyond the snapshot from speculation to prototypes in audiophotography. Proceedings of the 3rd conference on Designing interactive systems: processes, practices, methods, and techniques (pp. 55-65). DIS '00. ACM. http://doi.org/10.1145/347642.347663	2000	2.1		The digital shelf is a holder for a large number of postcards. Upon placing these cards on the display in front of it, the display shows the photo as shown on the postcard and plays an accompanying sound. Even without the postcards, a user can move the display left and right to browse the archive.	Audiophotographs	Home - living room	"Digital Shelf would not only be able to play the sounds from each card, but store both the image and sound digitally. Rather like a digital photo album, the small postcard-sized screen would allow hundreds of different images and sounds to be displayed and played. Such a system would enable people to send or swap their audio postcards with friends or family, confident that the shelf had stored each audio postcard permanently."
Memento (sound locker)	Niemantsverdriet, K., & Versteeg, M. (2016). Interactive Jewellery as Memory Cue: Designing a Sound Locket for Individual Reminiscence (pp. 532-538). Presented at the TEI '16: Tenth International Conference, Eindhoven, NL: ACM. http://doi.org/10.1145/2839462.285624	2016	2.1		Memento is a locket that records sounds and allows their play/back. It is a wearable and personal device, aiming for individual reminiscing.	Audio clips, self-recorded	Wearable	Opening the front lid allows for the recording of 10 seconds of audio. Opening the back lid allows playback, whereby sliding the chain moves to different tracks (recordings).
Memory Tree	Jayarathne, K. (2016). The Memory Tree: Using Sound to Support Reminiscence (pp. 116-121). Presented at the 2016 CHI Conference Extended Abstracts, San Jose, CA, USA: ACM. http://doi.org/10.1145/2851581.2890384	2016	2.1		Memory Tree is a device to support reminiscing between family members. Similar to a real life tree, the branches represent diversity and connectedness. Using audio recordings, the tree captures a personal history.	Audio clips, self-recorded	Home	"Memories are recorded by pressing a leaf for five seconds and releasing. They are then played back when the leaves are touched. Memories can be played back an unlimited number of times, and can be stored in the leaves for as much time as desired. Each leaf can also be recorded over to make room for other memories."
StoryBeads	Reitama, L., Smith, A., & Hoven, E. van den. (2013). StoryBeads: Preserving Indigenous Knowledge through Tangible Interaction Design (pp. 79-85). Presented at the International Conference on Culture and Computing, Kyoto: IEEE. http://doi.org/10.1109/CultureComputing.2013.22	2013	2.1		StoryBeads covers the process of designing a storytelling device using beads, tailored for an African tribe. These beads are traditionally used to convey stories and oral indigenous knowledge.	Audio clips, self-recorded by storyteller	Wearable	Beads work as RFID tags. When placed upon the recording device, either a message is played back (if the bead had been assigned to a recording before), or the device announces that a new recording is about to start.




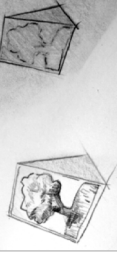
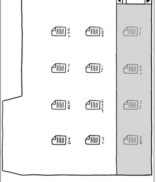
Name	Source	Year	Category	Image	Description	Media	Location	Interaction
Automics	Durrant, A., Rowland, D., Kirk, D. S., Benford, S., Fischer, J. E., & McAuley, D. (2011). Automics: souvenir generating photoware for theme parks. <i>CHI '11 Proceedings of the SIGCHI Conference on Human Factors in Computing Systems</i> , 1767–1776.	2011	2.2		Automics is a service to support mobile tourism. It entails a smartphone app that allows a group of theme park visitors to share their photos directly, and later create an annotated collage as a souvenir.	Digital photos on mobile, plus theme park action shots.	Theme park	A smartphone app allows the sharing and initial curation of photos across multiple devices in a group setting. Later, a selection of the pictures can be put into a comic-like collage and animated with speech bubbles, etc.
LastHistory	Baur, D., Seiffert, F., Sedlmair, M., & Boring, S. (2010). The Streams of Our Lives: Visualizing Listening Histories in Context. <i>IEEE Transactions on Visualization and Computer Graphics</i> , 16(6), 1119–1128. http://doi.org/10.1109/TVCG.2010.206	2010	2.2		LastHistory is primarily a data visualisation of music listening history, using data from last.fm . In addition, it has a personal mode where the date and time view is amended with personal photos and calendar events that correspond to the visual overview.	Photos and music, sourced from personal archives.	App - desktop	People can switch between an analysis mode and personal mode, the latter of which follows a calendar and adds personal photos. Clicking on any data point allows listening to the songs. A photo slideshow is also available, concurrently playing related songs. It is exploration-oriented.
Map - making	Matassa, A., & Rapp, A. (2015). Map - making: designing a mobile application for enhancing memories retrieval. <i>the 17th International Conference on Mobile HCI</i> (pp. 994–1001). New York, New York, USA: ACM. http://doi.org/10.1145/2786567.2794318	2015	2.2		This application enhances the idea of geographic emotional mapping with memory-retrievable content. Thus, it intends to map frequented spaces with how people felt in those areas, such that people may be able to remembering and reflect on their past situated experiences.	Location data, emotional data.	App - mobile	Locations can be tagged with emotional keywords. Later, these geographical emotions can be mapped onto a geographical map or a form of emotional arrangement. Through this, past moments and places may be reexplored.
Memory [en]code	Schmidt, H., Hinrichs, U., & Dunning, A. (2007). memory [en]code-Building a Collective Memory within a Tabletop Installation. <i>Computational Aesthetics in Graphics, Visualisation, and Imaging</i> .	2007	2.2		“Designed to be installed in a public space, memory [en]code enables people to enter their personal memories and to explore memories entered by other people. Reacting to people’s interactions, memory [en]code dynamically changes and redefines itself continuously, in ways similar to human memory. Over time memory [en]code forms a collective memory mirroring the experiences and associations of people that have participated in the installation.”	Text fragments	Museum	An onscreen keyboard allows for text input, which is turned into a memory cell. These cells float around organically. Upon touching, the full text is revealed. People can drag and move one cell onto another, which merges them. Lifetime of the cell depends on the length of the narrative.
MUSE	Hangal, S., Lam, M. S., & Heer, J. (2011). MUSE: reviving memories using email archives. <i>the 24th annual ACM symposium</i> (pp. 75–84). New York, New York, USA: ACM. http://doi.org/10.1145/2047196.2047206	2011	2.2		MUSE facilitates the exploration of email archives, through a visualisation of email sentiments over time, various senders and topics, and browsing images in email attachments.	Emails	App - desktop	MUSE presents a user’s email archive by groups of people involved, keyword-based tags, as automatically generated memory cues. It also provides sentiment analysis based cues. To help people explore their archives, the interface uses a jog/dial interface to facilitate rapid browsing through fairly large numbers of messages in a short amount of time.

Name	Source	Year	Category	Image	Description	Media	Location	Interaction
Visual Mementos	Thudt, A., Baur, D., Huron, S., & Cепендe, S. (2015). Visual Mementos: Reflecting Memories with Personal Data. <i>IEEE Transactions on Visualization and Computer Graphics</i> , 22(1), 369–378. http://doi.org/10.1109/TVCG.2015.2467831	2015	2.2		Visualisation of personally relevant data to see patterns, enable reminiscing and sharing experiences. This project used trip data and visualisation of maps, in particular small, round maps that depict significant places. Also, the system allows users to add stories and photos to help them rekindle memories at a later point or simply use the act of adding these as a way of reminiscing about a trip.	Various (see description)	App - desktop	Initially, users would need to upload GPS data track to the application. Afterwards, people can explore the maps and routes using the interface. In addition, the system aggregates other relevant statistics and overviews that people may enjoy. Because visits to places are often tied to particular times or periods in one's life, there is the ability to filter via a timeline.
4 Photos	O'Hara, K., Helmes, J., Sellen, A. J., Harper, R., Blömer, ten, M., & Hoven, E., van den. (2012). Food for Talk: Phototalk in the Context of Sharing a Meal. <i>Human-Computer Interaction</i> , 27(11). Blömer, ten, M., Helmes, J., O'Hara, K., & Hoven, E., van den. (2010). 4Photos: A Collaborative Photo Sharing Experience (pp. 52–61). Presented at the NordCHI 2010, Reykjavik, Iceland: ACM Press. http://doi.org/10.1145/1868914.1868925	2010	3.1		A rectangular device with 4 displays on each side is placed in the middle of a dinner table. Photos displayed can initiate or influence the conversations around the table.	Photos sourced from social media (Facebook)	Home - dinner table	Device shows four photos, sourced from one album on Facebook belonging to one person. It selects this person from membership of a dedicated Facebook group. A knob on the top can be turned to get a different set relating to a different person. A proximity sensor close to a screen allows this photo to be shared across all screens.
Caraclock	Uriu, D., Shiratori, N., Hashimoto, S., Ishibashi, S., & Okude, M. (2009). Caraclock: an interactive photo viewer designed for family memories (pp. 3205–3210). Presented at the 27th international conference extended abstracts, Boston, MA, USA: ACM. http://doi.org/10.1145/1520340.1520458	2009	3.1		"Caraclock is an interactive photo viewing device which allows for the sharing of 'Collective Memory' among family members. The server-based algorithm uses a Bayesian Network that employs probabilistic computation to model each user's interpersonal relationships. When multiple Caraclock devices are synchronized, they display related photos according to the settings. This often results in serendipitous discoveries for the whole family by reminding them of their collective experiences through images of their past."	Photos sourced from personal digital archives.	Home	Users can connect the individual devices together. In addition, the knobs on the sides allow the user to set a time period and adjust the kind of synchronisation. The latter aspects affects what kind of images are preferred and shown together. At the heart of this selection process is an inference algorithm that seeks to provide images that are relevant to the devices that are connected (and by extent, their owners).
Cueb	Golsteijn, C., & Hoven, E., van den. (2013). Facilitating parent-teenager communicative photo cubes. <i>Personal and Ubiquitous Computing</i> , 17(2), 273–286.	2013	3.1		Two cube-shaped devices (both covered with displays) can generate a serendipitous combination of family pictures, ideally initiating a discussion between a parent and their child. The design was oriented towards fostering such discussions through the use of photos to spark conversation.	Photos sourced from personal digital archives.	Home	Family members would each have one cube and manually fill its storage with personal photos. When together, the devices can be brought together to show several pictures randomly. // Shaking would randomly reassign photos to the displays on the sides, while pressing on a photo it can be locked in place. // Connecting cubes together offers an incentive for shared storytelling.

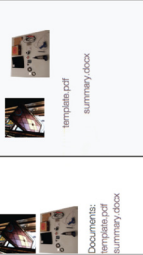


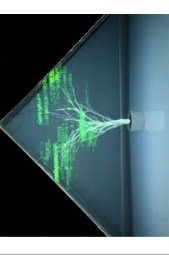
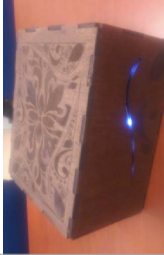
Name	Source	Year	Category	Image	Description	Media	Location	Interaction
Family Memory Radio	Petrelli, D., Villar, N., Kainikaite, V., Dib, L., & Whittaker, S. (2010). FM radio: family interplay with sonic mementos. (pp. 2371–2380). Presented at the CHI '10: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. http://doi.org/10.1145/1753336.1753683	2010	3.1		A customised FM radio that now allows families to play back audio recording (sonic souvenirs) as a means to foster social remembering.	Audio clips from personal digital archives.	Home	AFM radio was modified to use its knobs to browse and explore, while buttons in the middle selected channels. Its tangible, explorative character was deliberately chosen to fit with the evocative, temporal character of sound clips (you have to listen to understand what's going on).
PhotoHelix	Hilliges, O. Baur, D. & Butz, A. Photohelix: Browsing, Sorting and Sharing Digital Photo Collections. In Proc. Tabletop '07 Hilliges, O., & Kirk, D. S. (2009). Getting sidetracked: display design and occasional photo-talk with the photohelix. (pp. 1733–1736). Presented at the Proceedings of the 27th ACM Conference on the Human-Computing Systems, New York, New York, USA: ACM. http://doi.org/10.1145/1518701.1518967	2007	3.1		PhotoHelix is an interactive tabletop application that allows for the application of sets of photos. It was designed for co-located browsing and the idea that getting side-tracked is perhaps a force for good in sharing stories, etc.	Photos sourced from personal digital archives.	Home	"Events are represented as image piles on a helix-shaped calendar. Events and pictures are accessed, manipulated and inspected using a hybrid, bi-manual interaction technique. One hand operates a physical handle to position and control the calendar view (rotation adjusts the current time setting). The other hand is used to inspect and modify events as well as individual pictures for browsing and sharing purposes."
PHotOluck	Nishimato, K., Amano, K., & Usuki, M. (2006). pHotOluck: A Home-use Table-ware to Vitalize Mealtime Communications by Projecting Photos onto Dishes. (pp. 9–16). Presented at the First IEEE International Workshop on Horizontal Interactive Human-Computer Systems (TABLETOP '06). IEEE. http://doi.org/10.1109/TABLETOP.2006.24	2006	3.1		PHotOluck presents photos taken by members of a dinner party onto the plates on the table. It does via an overhead projector that is angled down. On personal dishes, photos taken by that person are shown. Larger, shared dishes are able to show photos if someone decides to share their photo.	Photos sourced from personal digital archives.	Home - dinner table	People send photos in advance to a server. Once at the dinner, there is a need to link a dish to the person using it. Later, during the dinner, someone can "spill" their current image by flipping their place. It will be replaced upon putting the dish back. To share a photo with others, someone would have to hold their personal dish over the shared dish. Coloured markers unique to each dish help with the identification.
PhotoStroller	Gaver, W., Boucher, A., Bowers, J., Blythe, M., Jarvis, N., Cameron, D., et al. (2011). The photoStroller: supporting diverse care home residents in engaging with the world. <i>CHI '11 Proceedings of the SIGCHI Conference on Human Factors in Computing Systems</i> (pp. 1757–1766). New York, New York, USA: ACM. http://doi.org/10.1145/1978942.1978988	2011	3.1		PhotoStroller is a device that can be moved around a retirement home. It shows images sourced from Flickr around particular keywords (tags) for the residents' enjoyment. A remote control is available to change the current keywords and set the amount of semantic drift allowed for the device.	Photos sourced from social media (Flickr)	Care centre	The stroller itself is non-interactive. The remote allowed viewers to exert some control over the stroller as described earlier.

Name	Source	Year	Category	Image	Description	Media	Location	Interaction
Public media touchscreens	André, P., Sellen, A. J., schraefel, M. C., & Wood, K. (2011). Making public media personal: nostalgia and reminiscence in the office, BCS-HCI'11, 351–360.	2011	3.1		Two touchscreens are combined (and show the same content) to provoke reminiscing in the work place. For this reason, the device does not depict personal photos but rather takes images from the public domain that correspond to particular time periods that are deemed of interest to the user. For example, period-specific fashion, movies, and other cultural aspects are shown. Because this is visible from at least two sides, it may also inspire co-workers to comment and reminisce.	Photos sourced from personal digital archives.	Work	The device uses information from the participant, such as the place of birth, age, and other significant life characteristics to determine which kind of media would best fit that participant. It compiles a corpus of around 500 images which are then shown and shuffled through in a random fashion at a rate of one per minute. Upon pausing this slideshow, a user has the ability to mark an image as a favourite, as inviting discussion, or share it with others.
Family Photo Displays: Photo Mesh	Taylor, A. S., Swan, L., & Durrant, A. (2007). Designing family photo displays (pp. 79–98). Presented at the Proceedings of the Tenth European Conference on Computer Supported Cooperative Work, London: Springer London. http://doi.org/10.1007/978-1-84800-031-5_5	2007	3.2		PhotoMesh is an ambient collage display that provides a view onto a family photo archive. Upon walking up, someone would be able to tap a particular photo and fill the screen. Otherwise it would cycle randomly through photos.	Photos sourced from personal digital archives.	Home	Family members may be able to add items and decide which photos to display larger by tapping those.
Family Photo Displays: Photo Switch	Taylor, A. S., Swan, L., & Durrant, A. (2007). Designing family photo displays (pp. 79–98). Presented at the Proceedings of the Tenth European Conference on Computer Supported Cooperative Work, London: Springer London. http://doi.org/10.1007/978-1-84800-031-5_5	2007	3.2		Photo Switch is a wall-mounted display that in its simplest form hold two photos. By moving the sliding door, one photo may be revealed at the cost of hiding the other from view. Optionally, the device could incorporate digital displays for a more dynamic situation.	Photos sourced from personal digital archives.	Home	Family members may move the slider, which hides one photo.
Pearl	Jansen, M., Hoven, E., van den, & Frohlich, D. M. (2013). Pearl: living media enabled by interactive photo projection. <i>Personal and Ubiquitous Computing</i> , 1–17. http://doi.org/10.1007/978-3-642-36691-x	2013	3.2		Pearl is a photo collage viewer, which incorporates some lightweight management of valuable photos. Through making photos central or peripheral in a shown collage, a user can denote certain photos as more favourable. Although it was conceptualised as a collage viewer and regular photo browser, only the collage aspect has been implemented (as this was the most interesting).	Photos sourced from personal digital archives.	Home - living room	Touch a photo: The central photo is displayed on the foreground. Touching a photo enlarges it and brings it to the foreground. Touch a faded photo to let it light up and unveil the content. // Centralize a photo: When a user sees a photo he/she enjoys, it can be dragged to the middle to swap it with the middle photo and ensure that it is still there tomorrow. // Remove a photo: When a photo is inappropriate or unwanted, the user can remove that photo by dragging it out of the projection area. A new photo will appear on the place of the removed photo. // Refresh the collage: interrupt the projection beam by waving in front of the object and it will show a new collage.

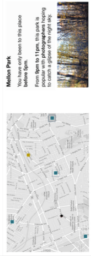
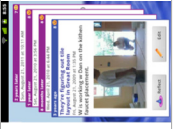
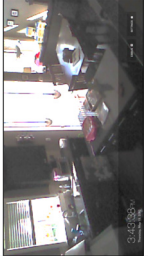


Name	Source	Year	Category	Image	Description	Media	Location	Interaction
Photo Mementos: ProjectoFrame	Petrelli, D., Bowen, S., & Whitaker, S. (2013). Photo Mementos: Designing Digital Media to Represent Ourselves At Home. <i>International Journal of Human-Computer Studies</i> . http://doi.org/10.1016/j.jhcs.2013.09.009	2013	3.2		ProjectoFrame allows a small number of selected images to be shown at a larger scale when someone touches the frame with their hands. In doing so, the imagery can take on a role in an ongoing conversation or simply invoke the curiosity of the viewer (perhaps for deliberate effect intended by the curator).	Digital photos from personal archive (curated)	Home	People select the set of photos shown together and upload it to the device (this is assumed), similar to a regular photo slideshow. When viewed on the frame itself, a proximity/heat sensor detects a touch to the frame after which the images are projected onto a surface behind the frame.
4streams	Zargham, S., Čajić, J., & Fröhlich, D. M. (2015). 4streams: an ambient photo sharing application for extended families. <i>the 2015 British HCI Conference</i> (pp. 165–174). New York, New York, USA: ACM. http://doi.org/10.1145/2783446.2783589	2015	3.3		4streams shows recently uploaded photos from four people on a standard tablet device. Placed in the home, it allows one to keep an eye of what others are or were doing very recently.	Photos sourced from social media (Facebook)	Home-living room	A standard tablet computer runs a slideshow app that shows the most recent photos taken from Facebook. A user can also browse the history of concurrent photos and thus see what people were doing at moments in the past.
Huddle	Pohlmeier, A. E. (2014). Enjoying Joy: A Process-Based Approach to Design for Prolonged Pleasure (pp. 871–876). Presented at the NordCHI 2014, Helsinki: ACM Press. http://doi.org/10.1145/2639189.2670182	2014	3.3		In sports, the focus after a match is often on what went wrong with an eye to improve ahead of the next game. This app attempts to capture and let team players savour the things that did go right or were fun. So it collects positive memories for the team to look back on.	Messages and hand-drawn sketches	App - mobile	Sportsteam players all install this app and only when they add to a group's positive moments are they able to see those of others. Thus, this builds on a curiosity and willingness to interact with team members. // They can add text or draw pictures, deliberately simple means to connect with others.
Look what I found!	Gouveia, É., Azevedo, F., Ferreira, L., Calderia, P., Almeida, V., Gouveia, R., & Karapanos, E. (2013). Look what I found!: augmenting phone calls with memories of the past. CHI 2013 Extended Abstracts (pp. 589–594). New York, New York, USA: ACM. http://doi.org/10.1145/2468356.2468460	2013	3.3		Look what I found! is a smartphone application that displays a random photo associated to a caller. Once a call is active, a photo appears that at least one party has associated with the other person. This way both may reminisce on the events depicted or otherwise find value in it.	Photos sourced from personal digital archives.	App - mobile	Users may associate photographs on their phone with another person, and vice versa. Upon calling this person, the app may decide to show a photo, which from then on is available to both parties.
Augmenting Photos: EyeOfDetail	Gildenpfeffig, F., & Fitzpatrick, G. (2011). Getting more out of your images: augmenting photos for recollection and reminiscence (pp. 467–472). Presented at the BCS-HCI '11, British Computer Society.	2011	4.1		“The overall intention then of EyeOfDetail is to slow the observer down for a while, to focus attention and to encourage them to spend time, and deal in-depth, with the moment that is captured in the image. One small spot of the image is left un-blurred. This clearly visible spotting window is designed to focus the observer’s attention to one area at a time.”	Photos sourced from personal digital archives.	App - desktop	The device picks one spot to keep sharp, while the remainder of the image is blurred. Through an accelerometer (presumably wrist-worn?) people have some crude control to move the clear spot.

Name	Source	Year	Category	Image	Description	Media	Location	Interaction
Augmenting Photos: ForgetMeNot	Gildenplennig, F., & Fitzpatrick, G. (2011). Getting more out of your images: augmenting photos for recollection and reminiscence. (pp. 467-472). Presented at the BCS-HCI '11, British Computer Society.	2011	4.1		<p>"ForgetMeNot is a screensaver that randomly chooses pictures from a selected folder and displays them with various degrees of blurring on the user's screen during idle time. The images are replaced after a couple of seconds. The aim of the application is to provide the observer with cues to encourage them to proactively remember an event. Cues are given by the degree of de-blurring of the image (in contrast to EyeOfDetail the whole picture is affected), and the degree of blurring is inversely related to time passed."</p>	Photos sourced from personal digital archives.	App - desktop	Images cycle every few seconds. No further manipulation is possible on the user's behalf.
Digital artifacts: BitLogic	Gulotta, R., Odom, W., Forlizzi, J., & Faste, H. (2013). Digital artifacts as legacy: exploring the lifespan and value of digital data. (pp. 1813-1822). Presented at the CHI '13: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. http://doi.org/10.1145/2470654.2466240	2013	4.1		<p>BitLogic follows the idea of DataFade, but allows people only a single photo at a time. It decays the image using a process that is inspired by digital degrading artefacts, e.g. introducing noise and binary code.</p>	Digital photos	App	The user uploads a photograph via a web service and is given a link to revisit the file. On later visits, digital decay is applied. This decay takes the form of introduced noise and eventually leaves only 1s and 0s on a white background.
Digital artifacts: DataFade	Gulotta, R., Odom, W., Forlizzi, J., & Faste, H. (2013). Digital artifacts as legacy: exploring the lifespan and value of digital data. (pp. 1813-1822). Presented at the CHI '13: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. http://doi.org/10.1145/2470654.2466240	2013	4.1		<p>DataFace is a file uploading service and viewer. However, files decay following physically-based principles. If decaying based on time, weather, or page visits, the image undergoes different forms of fading.</p>	Digital photos	App	The user uploads a photograph via a web service and is given a link to revisit the file. On the first webpage, the user also selects a method to use for the decay. On later visits, this decay is applied. By visit reduces opacity, by weather reduces saturation, and by time since upload applies a sepia tone.
Family Photo Displays: Photo Illume	Taylor, A. S., Swan, L., & Durrant, A. (2007). Designing family photo displays. (pp. 79-98). Presented at the Proceedings of the Tenth European Conference on Computer Supported Cooperative Work, London. Springer London. http://doi.org/10.1007/978-1-84800-031-5_5	2007	4.1		<p>Photo Illume is a single photo display that dims if not exposed to light. What this forces upon its owners is to be active in the continued display of the desired photo. Relegation of a photo frame comes with a consequence of its 'disappearance'.</p>	Photos sourced from personal digital archives.	Home	The frame can be picked and moved around as the owner sees fit. It is also necessary to move the frame or at least keep it where enough daylight comes, in turn keeping the photo in easy view.
GrayArea	Bergman, O., Tucker, S., Beyth-Marom, R., Currell, E., & Whitaker, S. (2009). It's Not That Important: Demoting Personal Information of Low Subjective Importance using GrayArea. (pp. 269-278). Presented at CHI '09. http://doi.org/10.1145/1518701.1518745	2009	4.1		<p>To deal with large collections of files on a computer, GrayArea introduces the idea of demoting unimportant files into a grey zone at bottom of a file explorer.</p>	Digital files	App - desktop	Demoting of files that have been untouched for a while, or manual placement in the grey zone, is the primary way of dealing with files that people would rather have out of sight. These files are shown in a separate, greyed-out area as not to attract attention in daily use.



Name	Source	Year	Category	Image	Description	Media	Location	Interaction
Oblivescence Board	Tsai, W.-C., Lee, H.-C., Hsiao, J. C.-Y., Liang, R.-H., & Hsu, J. Y.-J. (2013). Framing design of reminiscence aids with transactive memory theory (pp. 331-336). Presented at the CHI 2013 Extended Abstracts, Paris, France: ACM.	2013	4.1		"The Oblivescence Board is a situated photo display with touchscreen designed to serve as a digital memory board for photo sharing among close friends who are living together. It has two main features: in addition to a regular digital frame, the first feature is the self-expression of the limitation on its 'memory', that is to say photos can be forgotten.	Digital photos from personal archive (curated)	Home living room	"Once a photo is uploaded and shared on the board by users, its opacity, the analogy of system's memory retention on this photo, is fading." // Users can revive a forgotten photo by tapping its thumbnail, which will make it go fullscreen and reset the fading process. // Thus, the board presents a dialogue between its users and itself, akin to transactive memory theory.
Photo Mementos: Never Fade Away	Petrelli, D., Bowen, S., & Whitaker, S. (2013). Photo Mementos: Designing Digital Media to Represent Ourselves At Home. <i>International Journal of Human-Computer Studies</i> . http://doi.org/10.1016/j.ijhcs.2013.09.009	2013	4.1		As photos and their placement relate to personal significance, mementos of the past, and present identity, this design concept plays with the idea that photos may explicitly fade away. A frame that has not been touched for some time gradually becomes more sepia toned, fading into obscurity.	Digital photos from personal archive (curated)	Home living room	A photo is placed on the (digital?) frame. Over time, this image starts to fade as described. Upon picking up the frame, a sensor registers this movement (simple tilt sensor) and refreshes the image to its original state, perhaps along with a person's own memory related to that picture.
Curatorial Agents: Calendera	Gulotta, R., Scuito, A., Kelliher, A., & Forlizzi, J. (2015). Curatorial Agents: How Systems Shape Our Understanding of Personal and Familial Digital Information (pp. 3453-3462). Presented at the Proceedings of the 33rd Annual ACM Conference on Human-Computing Systems, Seoul, Korea: ACM Press. http://doi.org/10.1145/2702123.2702297	2015	4.2		Calendera is a calendar that integrates records from one's forerunners into the user's monthly view of their schedule and was developed to explore how systems might be involved in deriving meaning from multigenerational records. While these micro-remembrances are integrated into a calendar, this format was used primarily as a tool to introduce the idea of routinely reflecting on digital records from past generations.	Data from family history	App - web	In a digital calendar, bookmarks show up that upon further inspection provide an interesting record from that day in history.
Curatorial Agents: MailMem	Gulotta, R., Scuito, A., Kelliher, A., & Forlizzi, J. (2015). Curatorial Agents: How Systems Shape Our Understanding of Personal and Familial Digital Information (pp. 3463-3462). Presented at the Proceedings of the 33rd Annual ACM Conference on Human-Computing Systems, Seoul, Korea: ACM Press. http://doi.org/10.1145/2702123.2702297	2015	4.2		"MailMem is an email system that identifies meaningful email threads and then presents them to users in their inbox (Fig. 2). This process included an analysis of metadata collected by the system, such as the number of times an email had been viewed, the presence or absence of media, and the number of replies, in addition to a rudimentary, simulated semantic analysis of the content itself. We described how MailMem would unpredictably and periodically unearth these conversations and present them to the owner of the inbox, which allowed us to experiment with both time and agency."	Emails	App - web	Emails are chosen by the system and reinserted into the regular email viewing experience, and can be read as one normally would.

Name	Source	Year	Category	Image	Description	Media	Location	Interaction
Digital artifacts: BlackBox	Giulotta, R., Odom, W., Fortizzi, J., & Faste, H. (2013). Digital artifacts as legacy: exploring the lifespan and value of digital data (pp. 1813–1822). Presented at the CHI '13: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. http://doi.org/10.1145/2471058.2466240	2013	4.2		Blackbox is a file uploading service. Upon uploading people get a link to revisit, but revisiting a file will only give information about the file and its storage. The original file itself is not shown, taking the idea of 'purging by storing' to an extreme.	Digital photos	App	User uploads photograph via a web service and is given a link. Rather than the system showing the original file, only information about the file is shown. The file itself is thus no longer accessible.
Heirlooms: Digital Slide Viewer	Banks, R., Kirk, D. S., & Sellen, A. J. (2012). A Design Perspective on Three Technology Heirlooms. <i>Human-Computer Interaction</i> . http://doi.org/10.1080/07370024.2012.656042	2012	4.2		The digital slide viewer is a conceptual design that allows people to browse collections of photos, now represented by the vintage appearance of slides as tokens. The idea is that photos are stored locally, taken from their online collections to ease reminiscing after the owner of the accounts has passed away.	Digital photos from personal archive (source was online photo collections)	Home	Photo collections would be downloaded and linked to the device, with each set represented by a slide. Then, at any time the viewer could be used to browse the images. The slides act as tokens.
Heirlooms: Timecard	Banks, R., Kirk, D. S., & Sellen, A. J. (2012). A Design Perspective on Three Technology Heirlooms. <i>Human-Computer Interaction</i> . http://doi.org/10.1080/07370024.2012.656042	2012	4.2		Timecard is a personal timeline object and system. It is a wooden digital photo frame, which, like an ordinary photo frame, lives on display in the home. Using timestamped items for a person, it displays the structure of a life and encourages the telling of stories about the represented by presenting rich material for reminiscing.	Digital photos from personal archive (curated)	Home - living room	Family members can add items to the system using a PC. These items can include text and images and are associated with specific dates by the user. They are then sent to a wooden digital photo frame, which, like an ordinary photo frame, lives on display in the home. Photos are shown randomly on it by default. In a slideshow view. Clicking on a photo, though, brings up a timeline view that shows all the images of that person chronologically.
Mourning Tree	Kim, J., Kim, S., Yiu, J., Yoon, S., & Han, S. (2011). Mourning tree: space interaction design for the commemoration ceremony, the 2011 annual conference extended abstracts (pp. 2197–2202). CHI'11 EA. ACM. http://doi.org/10.1145/1979742.1979876	2011	4.2		This is tool meant to support commemoration, both at traditional sites for such purposes and at home. Mourning Tree is shown as a hologram made up of text messages (the leaves). A tree represent a deceased person and enables those commemorating to send messages to and in memory of this person.	Text, emails, SMS messages	Home	In its default state, Mourning Tree shows itself as a tree. Users can send text messages to this tree upon which the tree briefly transforms into a cloud of particles before it regains its tree-like shape. As the amount of messages grow, so do the branches of the tree to support this volume.
Pensive Box	Chaudhari, C., Prakash, A., Tsaasan, A., Brubaker, J. R., & Tanenbaum, J. (2016). Pensive Box: Themes for Digital Memorization Practices. the TEI '16: Tenth International Conference (pp. 398–403). New York, New York, USA: ACM. http://doi.org/10.1145/2839462.2856552	2016	4.2		A tangible means to commemorate a deceased person, which ingests media from online sources (if possible) and displays these on a tablet screen inside. Light visible on the outside can give subtle reminders on significant dates.	Various digital media	Home	In principle, Pensive Box should collect data autonomously without the need for user intervention. Only if someone so desires, can they open the lid and browse the messages stored inside. The light on the outside serves as an invitation to interaction but can be ignored if people do not feel like remembered someone at any point in time.

Name	Source	Year	Category	Image	Description	Media	Location	Interaction
PicMemory	Lee, H.-C., & Hsu, J.-Y. (2016). PicMemory: Enriching Intergenerational Family Interaction and Memory Collection (pp. 3715–3718). Presented at the 2016 CHI Conference Extended Abstracts, San Jose, CA, USA: ACM Press. http://dx.doi.org/10.1145/2851581.2890233	2016	4.2		PicMemory is a tablet and phone application that intends to support family communication, in particular between those in different locations. The application allows its user to share photos, add annotations through text or speech, and in this way, together piece together a story around an image.	Photos sourced from personal digital archives.	App	To help communication across generations and different levels of technological ability, PicMemory uses photos as its base sharing element. On top of this, people can add text or speech in the way they prefer. On the other side, this is presented in the preferred way of the recipient through text-to-speech mechanisms etc. Also, people can edit the stories and add tags to ease future search and revisitation of the created memory cues.
Story Shell	Moncur, W., Julius, M., Hoven, E., van den, & Kirk, D. S. (2015). Story Shell: The Participatory Design of a Bespoke Digital Memorial (pp. 470–477). Presented at the Participatory Innovation Conference, Den Haag, Netherlands. http://doi.org/10.13140/RG.2.1.2802.4489	2015	4.2		A bespoke memorial device that allowed a bereaved parent to remember her deceased child through self-recorded stories.	Audio clips, recorded by bereaved parent on stories involving her son.	Home - living room	When the device is held in one's hand, a recorded audio clip will play and some LEDs light up the inside.
ThanatosFenestra	Uriu, D., & Okude, N. (2010). ThanatosFenestra: photographic family altar supporting a ritual to play for the deceased (pp. 422–425). Presented at the DIS '10: Proceedings of the 8th ACM Conference on Designing Interactive Systems, New York, New York, USA: ACM Request Permissions. http://doi.org/10.1145/1858171.1858253	2010	4.2		A physical altar that creates a meditative atmosphere by displaying digital content of deceased relatives flickering to the light of a real candle	Digital photos from personal archive (curated)	Home	People light a candle. Its light triggers both the aroma in the dish above the candle and the appearance and the projection of a photo. When the candle is dimmed or flickers, the photo switches or the device turns off.
Curatorial Agents: Gather	Gulotta, R., Sciuto, A., Kellher, A., & Forlizzi, J. (2015). Curatorial Agents: How Systems Shape Our Understanding of Personal and Familial Digital Information (pp. 3453–3462). Presented at the Proceedings of the 33rd Annual ACM Conference on Human-Computer Systems, Seoul, Korea: ACM Press. http://doi.org/10.1145/2702123.2702297	2015	4.3		"This system combines heterogeneous information in the form of an assemblage to tell a story about a time in one's life. Assemblages are curated from data captured from a variety of sources tied to the user about whom the assemblages are created. // System utilised a number of different types of information for this assemblage including travel records, photographs taken on the trip, credit card expenditures, and location information captured from social network posts."	Various (see description)	App - web	"Unlike the other systems, Gather allows users to add notes to the system-generated representations."

Name	Source	Year	Category	Image	Description	Media	Location	Interaction
Curatorial Agents: Locale	Giulotta, R., Sciuto, A., Kellher, A., & Forlizi, J. (2015). Curatorial Agents: How Systems Shape Our Understanding of Personal and Familial Digital Information (pp. 3463–3462). Presented at the Proceedings of the 33rd Annual ACM Conference on Human-Computer Systems, Seoul, Korea: ACM Press. http://doi.org/10.1145/2702123.2702297	2015	4.3		"A map-based system that combines information about where a person has been with information captured from his or her own records and from external, publicly available sources."	Various (see description)	App - web	"Locale displays a map on which particular locations have been highlighted. If a location is clicked, it displays information about that location, the user's history at that location and, in some cases, external information about that place."
Echo	Isaacs, E., Konrad, A., Walendowski, A., Lennig, T., Hollis, V., & Whitaker, S. (2013). Echoes from the past: how technology mediated reflection improves well-being (pp. 1071–1080). Presented at the CHI'13: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, ACM.	2013	4.3		App that allows capturing certain feelings/moments throughout the day. At a later point, the app brings these back up for reflection and reconsideration.	Own captured notes/feelings/photos.	App - mobile	The app allows users to capture, record, or write about an event that happened to them during the day (journaling). At random points in the future, the app asks the user to reflect on those earlier recordings. People can once again add their feelings towards this event, stimulating their reflection.
Moments	Heshmat, Y., Neustaedter, C., & DeBrimcat, B. (2017). The Autobiographical Design and Long Term Usage of an Always-On Video Recording System for the Home (pp. 675–687). Presented at the 2017 Conference on Designing Interactive Systems, Edinburgh, UK: ACM Press. https://doi.org/10.1145/3064663.3064729	2017	4.3		Using always-on video recording in the home and tablet computers, Moments provides a way to record, store, and review mundane household occasions. In particular, it can show recordings from around the same time a year ago (or any arbitrary interval) to enable looking back at previous occasions.	Video	Home	Video recordings are always ongoing. Audio is not recorded for privacy reasons. At various places in the home, tablet devices enable people to watch and review recordings. The interface puts several constraints on such review. Only displays close to a camera can show videos, and then only those recorded around a similar time of the day. These restrictions reduce the surveillance aspect and introduce a limitation to user freedom in order to stimulate a view on family moments.
Ritual Camera	Mols, I., Hoven, E., van den, & Eggen, B. (2016). Ritual Camera: Exploring Domestic Technology to Remember Everyday Life. <i>IEEE Pervasive Computing</i> , 15(2), 48–58. http://doi.org/10.1109/MPRV.2016.25	2016	4.3		Ritual Camera aims to capture mundane moments in everyday life, which represent one's family life but are otherwise fairly insignificant and so, these don't get captured. The camera is positioned towards a place of domestic congregation such as a dining table and captures a large number of still images. Later, the concept represents these moments in abstracted ways.	Visual representations of everyday presence	Home-dinner table	During the capturing phase, there is no interaction other than the camera distance as a trigger to capture images. Later, people are able to revisit their past through the visualisations which abstract or blur periods of time, such that only stable elements remain clear. These visualisations aim to inspire reflection on one's everyday life and whom this is shared with.
Photo Display System	Leong, T. W., Harper, R., & Regan, T. (2011). Nudging towards serendipity: a case with personal digital photos. Presented at the 25th BCS Conference on Human-Computer Interaction.	2011	5.1		A display of personal photos, built the idea that chance encounters may lead to a meaningful moment. Uses the notions of randomness, defamiliarisation, and temporality in the design.	Digital photos	Home	Photos would be shown at random, unconstrained to maximise chances for serendipitous encounters. // A dice-like mechanism is available to 'spin' photos while disturbed. This, once reacted, presents two photos side-by-side before resuming its normal routine.

Name	Source	Year	Category	Image	Description	Media	Location	Interaction
Photobox	Odom, W. T., Sellen, A. J., Banks, R., Kirk, D. S., Regan, T., Selby, M., et al. (2014). Designing for slowness, anticipation and re-visitatio: a long term field study of the photobox. <i>CHI '14: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems</i> . (pp. 1961-1970). New York, New York, USA: ACM. http://doi.org/10.1145/2556288.2557178	2012	5.1		Photobox is a device that prints a photo from its owner's digital photo library (Flickr), 4 to 5 times a month. Which photo and when is randomly decided, plus the photo gets printed in a box and is thus not visible unless the owner opens the lid.	Digital photos from personal archive (source was online photo collections)	Home	Interaction with the device is limited to opening the lid and fetching any printed photos, if available. The primary effect would be in how those prints are interacted with and appropriated, e.g., where and why people keep those prints.
SoundCapsule	Hsieh, P. C., Liang, R. H., & Chen, H. C. (2011). SoundCapsule: The study of reminiscence triggered by utilizing sound media and technology. Presented at the ISOR2011.	2011	5.2		SoundCapsule explores the use of audio recordings as time capsules. It records mobile phone audio and a few months later, randomly replays a clip from such recordings. The idea is that these sound capsules may inspire reminiscing based on the recent past.	Audio clips	App - mobile	The SoundCapsule app can be used to record audio fragments. After recording, a user can set a period of time after which this recording may be replayed. When this moment has come (the exact time is determined randomly), the user receives a call that replays this recording, which may invoke both surprise and delight.
Meerkat: Meerkat	Helmes, J., O'Hara, K., Villar, N., & Taylor, A. S. (2011). Meerkat and tuba: design alternatives for randomness, surprise and serendipity in reminiscing (Vol. 6947, pp. 376-391). Presented at the INTERACT'11: Proceedings of the 13th IFIP TC 13 international conference on Human-computer interaction, Springer-Verlag.	2011	5.2		Meerkat is a small device that can wobble and display three photos on its small screens. The device upon detecting someone's presence will show three randomly selected photos, aiming at a serendipitous effect, while attracting attention through movement (wobble plus moving displays).	Digital photos from personal archive (source was photo library on computer)	Home - living room	Meerkat can wobble via its motor and lift the three displays. It has a sense of autonomy and character as such. It attempts to attract attention to steer those around towards the photos (shown if proximity sensors detect presence), leaving people to interpret those. If no attention is given, it will try harder to gain it.
Meerkat: Tuba	Helmes, J., O'Hara, K., Villar, N., & Taylor, A. S. (2011). Meerkat and tuba: design alternatives for randomness, surprise and serendipity in reminiscing (Vol. 6947, pp. 376-391). Presented at the INTERACT'11: Proceedings of the 13th IFIP TC 13 international conference on Human-computer interaction, Springer-Verlag.	2011	5.2		Tuba is a small device with a display that may show personal photos or Facebook conversations that someone was part of. The display is hidden from view by default and requires deliberate physical manipulation to reveal it and thereby its content.	Digital photos from personal archive (source was photo library on computer) + Facebook messages	Home - living room	Tuba has a display and a speaker on its back. It requires deliberate opening in order for it to show one media item, picked at random from FB messages, photos, audio, or general facts. The idea is that this heightens the potential surprise and anticipation. To listen, one would have to close the device again and point the speaker upwards.
Pensieve	Cosley, D., Sosik, V. S., Schultz, J., Peesapati, S. T., & Lee, S. (2012). Experiences With Designing Tools for Everyday Reminiscing. <i>Human-Computer Interaction</i> , 27, 175-198. http://doi.org/10.1080/07370024.2012.656047	2012	5.2		Pensieve is an email-based application that inspires to invoke everyday reminiscing. It does so by emailing cues in a randomised fashion. These cues come from Facebook messages, email, and other social media. In addition, people could write diary entries that in the future may come back as prompts too.	Online messages (Facebook), email, and general reflective texts.	App	The memory triggers would be sent via email at various but random moments. At that point, people could reminisce and optionally revisit the media if it came from an online source. The other means of interaction was the ability to write a diary entry, which would be saved for future revisiting.

Name	Source	Year	Category	Image	Description	Media	Location	Interaction
Dot	Mols, I., Hoven, E., van den, & Eggen, B. (2017). Balance, Cogito and Dot: Exploring Media Modalities for Everyday-Life Reflection (pp.427-433). Presented at the the Tenth International Conference, New York, New York, USA: ACM Press. http://doi.org/10.1145/3029969.3025069	2017	5.3		Dot uses a smartphone application and a digital frame in the home to let users create abstract representations of their personal media. In its display, people are encouraged to reflect on otherwise mundane everyday life experiences.	Photos sourced from personal digital archives.	Home / App - mobile	Using a smartphone app, people can manipulate their personal photos and store these. The manipulations create abstract images based on the colours available in the original, through large dots of colours.
Reflexive Printer	Tsai, W.-C., Wang, P.-H., Lee, H.-C., Liang, R.-H., & Hsu, J. (2014). The reflexive printer: toward making sense of perceived drawbacks in technology-mediated reminiscence. Presented at the DIS '14: Proceedings of the 2014 conference on Designing interactive systems. ACM Request Permissions. http://doi.org/10.1145/2598510.2598589	2014	5.3		Combination of a smartphone app and thermal printing device, placed at home. The printer would occasionally print a digital picture sent by the app, which subsequently deleted that image. Only the temporal black & white print remained.	Digital photos on mobile, thermal prints of photos.	Home / App - mobile	The photo browsing app randomly picks a photo, which gets sent to the thermal printer. That picture gets deleted and is thus only available as a black & white print, although users can scan the print to retrieve the digital counterpart. It is now up to the user to decide what to do with the transformed image as a fading print.

Appendix 7.1 – Design mock-up study consent form

I _____ (*participant's name*) agree to participate in the research project Materialising memories (UTS HREC reference 2012000570) being conducted by Doménique van Gennip (contact info omitted) of the University of Technology Sydney for his degree as Doctor of Philosophy. Funding for this research has been provided by University of Technology Sydney.

I understand that my participation in this research will involve one interview session (lasting approximately 1 to 1.5 hour) during which I am exposed to five ideas about presenting personal media in everyday life. I can be asked to note personal memories, and answer questions about these memories. In addition, my response is sought to the presented five ideas. All contributions made will be kept confidential, and I understand I have the option not to report on anything I rather keep private, nor am I obliged to share anything in writing or during an interview that I am not comfortable with sharing. I might be inconvenienced by the time required to be involved in this study, but no other harm is likely to result from my participation.

I am aware that I can contact Doménique van Gennip or his supervisor Elise van den Hoven if I have any concerns about the research. I also understand that I am free to withdraw my participation from this research project at any time I wish, without consequences, and without giving a reason. I will not be penalised in any way for declining to take part in any stage of the research.

I agree that Doménique van Gennip has answered all my questions fully and clearly. I agree that the research data gathered from this project may be published, if so it will be done in a form that does not identify me in any way.

Signature (participant)

Signature (researcher or delegate)

NOTE: This Human Research Ethics Committee of the University of Technology Sydney has approved this study. If you have any complaints or reservations about any aspect of your participation in this research, which you cannot resolve with the researcher, you may contact the following independent persons, who will treat your complaint or reservation in confidence, investigate it fully and inform you of the outcome. When the researcher's primary affiliation is with the University of Technology, Sydney, you can contact: the Ethics Committee through the Research Ethics Officer (contact info omitted), at the University of Technology Sydney. Please quote the UTS HREC reference number. When the researcher's primary affiliation is with the Eindhoven University of Technology, you can contact: the Project Officer of the Industrial Design department at the Eindhoven University of Technology (contact info omitted). Please quote the names of the project and researcher.

Appendix 7.2 – Mock-ups interview protocol

Practical matters

- Recording equipment ready (phones: set to flight mode/silent to reduce disturbances).
- Bring a consent form for the participant to sign.
- Have some means of keeping time (watch?).
- Have a notepad for the single purpose of keeping interview notes.
- Bring all design mock-ups, plus a way to demonstrate any video (or other interactive demo).

Introduction (~5 min)

Thank you participating today. The plan for this session is for us to discuss some of your everyday practices of remembering and to see how some design ideas fit in with that.

What follows is a loosely structured interview, during which I'll introduce several early ideas I'd like to get feedback on. The goal of this session is for me to try and understand you and your views in your own terms, so there are no right or wrong answers. I would like to point out this is not a test in any way, it is really about learning from you.

This interview will last for approximately 1 hour.

In addition, I'd like to remind you that you are free to not disclose or discuss anything you are uncomfortable with. Some or all of the things disclosed may be published, but this will only be done in such a way that it cannot be linked back to you individually.

Before we start I would like to indicate that I'll be recording this interview to help me keep track of everything being discussed.

- Ask for permission to record the interview; if granted, start the recording.
- Ask the participant to sign the consent form.

Part I: Role of remembering (~10 min)

In this first part, I would like to start the discussion by asking what role remembering your past plays in your life. Along with that, I would like to discuss how things, such as physical objects, digital photos, etc., play a role in those practices or are otherwise important to you.

- How do you relate to your past?
 - *[probe]* Do you often think about it or tell about people about your past?
- Do you purposely relive moments of your life?

- *[probe]* If so, how often?
- *[probe]* Does it depend on mood or some other influence?
- *[probe]* Do you have any favourite place, moment, or item/device for such activities?
- What reasons do you have for remembering your past?
 - *[probe]* Anything apart from the purposes identified before?
 - *[probe]* How important is a given purpose for you?

I would like to ask a few more questions about the role of personal media for your remembering practices.

- What role do items (such as objects, songs, or personal photos) play for your remembering practices?
 - *[probe]* In what way do you interact with those, if at all?
 - *[probe]* Is this different for different social situations?
- In what ways do you use your personal media, such as a photo collection?
 - *[probe]* When do you look at those?
 - *[probe]* Are such files or items stored in a specific place?
 - *[probe]* What about digital items?
 - *[probe]* How often are these encountered?
- Do you ever actively go over a collection for the purpose of remembering?
 - *[probe]* Or is remembering more something that happens while sorting through stuff?

Part 2: Design ideas (~35 min)

Now we have an idea of how you approach reminiscing/thinking about your past, I would like to discuss a small number of design proposals. I will demonstrate each of five ideas we came up with to present personal media in everyday life. In these examples I'll focus on personal (digital) photos. These are currently just ideas to see how people respond to them, so feel free to be frank in your feedback. The plan is to learn from your response to see what a system aiming to support remembering should do or not do and in what way.

I would like to go over each idea one by one, so I'll explain one, we'll discuss it, and so on. As you'll see, these ideas are still in development, but I'm very interested to hear your thoughts on them.

- For each design idea, explain and discuss:
 - *[explain]* What it is.
 - *[explain]* How it works.
 - *[explain]* What are the interactions, who has control, and when.

- *[explain]* The kind of data it uses.
- *[Skip]* material and technical issues, as focus ought to be on the interactions.
- *[explain]* Where it would be located (somewhat open-ended if possible).

Having demonstrated the idea, I'm interested in your response.

- Let's say you could take this thing home, what would you do with it?
 - *[probe]* Can you imagine this device being in your home? Why (not)?
 - *[probe]* Where would you place it in your home? Why?
 - *[probe]* What do you think would be your response to the behaviour of this design idea?
 - *[probe]* Is there something you particularly (dis)like?
- What kind of value do you think you may get out of this device?
 - *[probe]* If (not) so, how and why?
 - *[probe]* What would you want to get from it?
 - *[probe]* If you could change something about this device, what would you change?
- How well does the behaviour of this design idea match with how you would like to deal with your personal media (photos)?
 - *[probe]* Which (dis)similarities do you see?
- Do you think that some of your personal media would go better than other types with what this idea does?
 - *[probe]* Would you be comfortable with the device picking from all your personal media, or would you prefer to filter ahead of its active use?
 - *[probe]* Does this depend on how visible/exposed this device would be to others?
 - *[probe]* Might there be personal media that you'd rather not see displayed through this device?
- Questions appropriate to some design ideas:
 - *What* do you think of amount of control you'd have over this device's operation?
 - *As* it offers (little) opportunity to interact with it, do you see yourself doing/missing that?
 - *What* would you tell someone who visits your place and asks about it?
- Discuss the next design idea; or continue when all have been discussed.

Part 3: General discussion (~10 min)

Now we have seen and discussed each individual design idea, I have some general questions.

- Do you have a general preference for any of the designs?
 - *[probe]* Does it vary by the purpose you see for it?
- Could you rank the designs in order of your preference?
 - *[explain]* For this, you can use the cards I made to represent the designs.
- Between the demonstrated designs, do you feel the different way these devices would work could have any influence on thoughts that come to mind for you, such as memories of past events?
 - *[probe]* If so, how? And why?
- Would you say any differences in your responses are more a result of the different ways in which the devices operate, or in the way you would interact with these items?
- If I could leave your favourite device with you, what kind of use do you see for it?
 - *[probe]* How would you introduce it to your family members or friends?
 - *[probe]* If they're skeptical, how would you win them over?

Wrap-up (~5 min)

- Briefly summarise the key points of the discussion.

Before we wrap-up, do you have any things you would like to add to what we have discussed so far, or perhaps missed in the discussion?

We have reached the end of the interview. I would like to thank you for your participation and contributions, it has been very helpful for my research.

From here on, I will use the input from several interviews together to understand what value could or want to get from such design ideas. My research is looking at how remembering in everyday life can be supported through (interaction) design, and this second study helps me to understand experiences while remembering. My intention is to take all the feedback and build one prototype device that would be placed in people's homes to see how things work out in practice. Of course, you are welcome to stay in touch for the follow-up study if you would be interested?

If you'd like I can inform you once this study's data has been synthesised and written up.

Finally, if in the next few hours or even days you think of something that might be helpful, I'd be glad to hear about that.

- Don't stop recording until after participant has left.

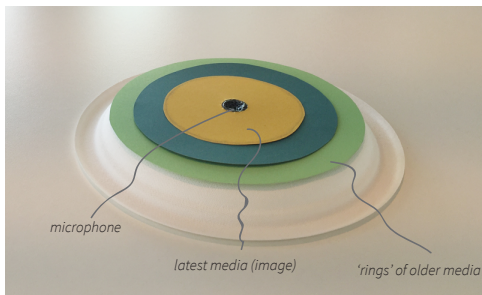
Appendix 7.3 – Additional material on design mock-ups

Videos of the animations used to explain the design concepts in Chapter 7 are available online:

<https://www.youtube.com/playlist?list=PL2BXGkZPQI6jf7ZOFdOg20CWAixaDW0Cb>.

On this page and those that follow, we also include the printed material shared with participants. Alongside the cardboard and foam mock-ups, these materials helped participant understand and discuss the design concepts.

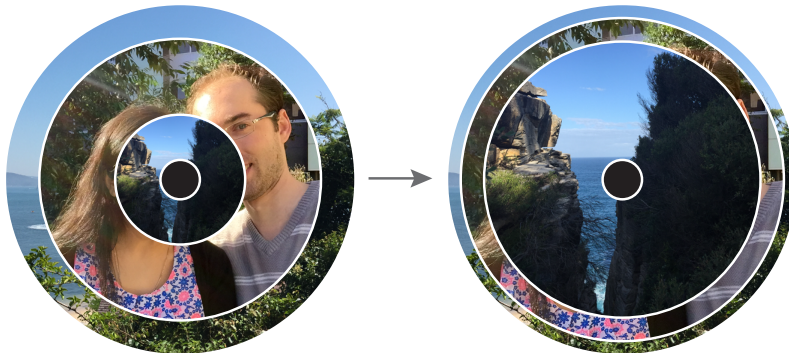
The Listener



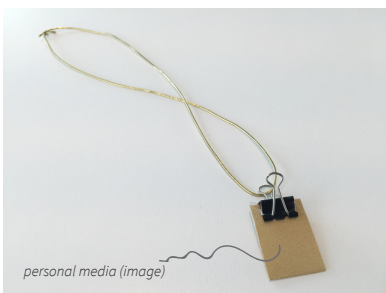
The Listener taps into ongoing conversations and aims to display content on its circular screen that fits with the speech.

Thus, this concept is reactive to its social environment and responds with (hopefully) relevant visual media. As such, it does not interfere with any conversation but merely tries to enhance it. Of course, it also responds if directly spoken to.

The visuals stream outward from the middle (its microphone), resembling waves at first and tree rings once at the outer edges of the tabletop display.



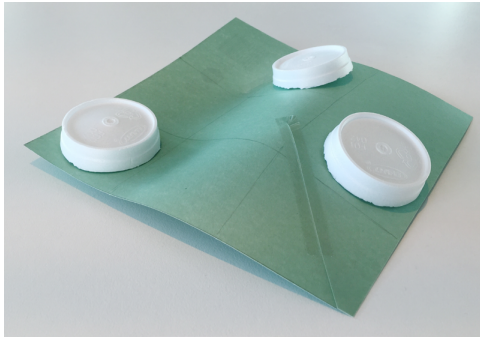
Wearable locket



This wearable mini-photo display shows personal media (photos) in a very public manner.

The locket would randomly show an image from one's collection (or perhaps limited to a set of predetermined favorites). It cycles through several images a day.

Pebble Arrangement



A square 3x3 grid of personal images with three pebbles on some of the positions, this concept is an attempt at a passive image viewer.

Alternate position of the pebbles mean an alternative set of images to be shown. It is possible to choose which images are shown for a particular arrangement. This allows someone to have a set of images at the ready without that collection being obvious to others.



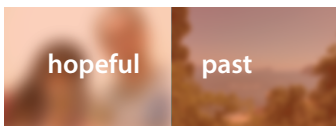
Word:Play



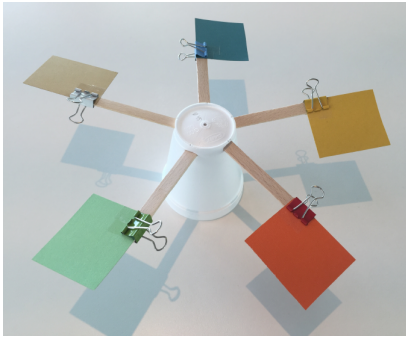
To be placed in someone's living room or kitchen, Word:Play is a concept stemming from studies that show people may be better helped by ambiguous memory cues. This 'display-on-a-stick' thus shows words in pairs, in the hope those are evocative, rather than explicit personal photos or other visual material.

If images are shown, this is used as a background: blurred or otherwise altered to keep people one step from directly fitting their story or memory onto the shown imagery.

When people draw closer, the display may reveal the underlying images, by deblurring or reducing any of the applied effects. This offers some means of interaction or perhaps relief from the question of what the device depicts.

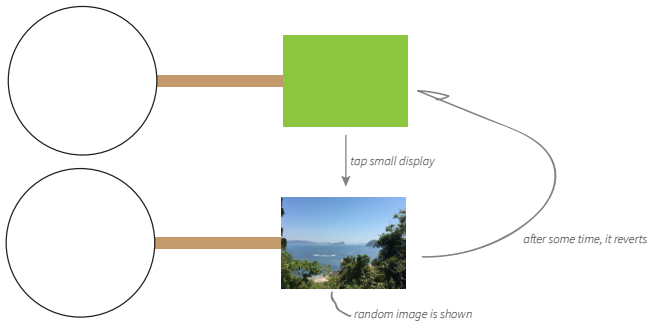


Alter to View



Originally labeled 'destroy to view,' this device expects its user to give up something. Viewing an image comes at the cost of not being able to see this image again for some time. Rather than physically destroying something, the 'death' of an image after viewing comes through its random replacement with another image.

It is however possible to select the next image using the user interface of the central display. This way, one person can set up images for another person to enjoy. How exactly people will derive value from this concept is therefore left open.



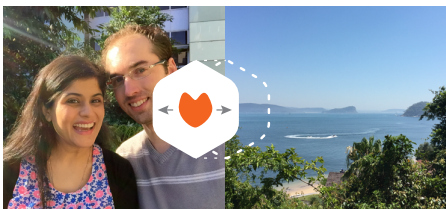
Watching For You



Why watch all your photos when this device can do it for you?

Its camera-equipped head watches your images so those are not forgotten. It is possible to watch along, as new images are brought up once watched in enough detail by the device.

The split display offers some interaction opportunities as the two images represent a possible choice. The head can move slightly and it's possible for someone to nudge the device to watch one image more closely than the other by moving the head.



Appendix 8.1 – Phototype study consent form

I _____ (*participant's name*) agree to participate in a study of longitudinal use of a digital media device with UTS HREC approval reference number 2015000629 / ETH16-0797. This study is being conducted by Doménique van Gennip (contact info omitted) of the University of Technology Sydney for his Philosophy Doctorate (PhD). This study is part of the Materialising Memories research programme and funding for this research has been provided by the University of Technology Sydney and a NWO-STW VIDI grant (The Netherlands, granted to supervisor).

I understand that my participation in this research will involve a three-week deployment of the device in my home, followed by an interview (lasting approximately 1 to 1.5 hour). The first visit will primarily focus on explaining the device and setting it up. The final interview will explore my experiences of having the device in my home. I understand I may be asked to relate personal memories, and (if willing) answer questions about these memories. In addition, some of the members of my household may be exposed to this device as well. I might be inconvenienced by the time required to be involved in this study, but no other harm is likely to result from my participation. The prototype device does not expose a risk beyond that inherent to other comparable electronic devices.

I am aware that I can contact Doménique van Gennip or his supervisor Prof Dr Elise van den Hoven, MTD if I have any concerns about the research. I also understand that I am free to withdraw my participation from this study at any time I wish, without consequences, and without giving a reason. I will not be penalised in any way for declining to take part in any stage of the research. I agree that Doménique van Gennip has answered all my questions fully and clearly. I agree that the research data gathered from this project may be published, if so it will be done in a form that does not identify me in any way.

Signature (participant)

Signature (researcher or delegate)

NOTE: This study has been approved by the Human Research Ethics Committee of the University of Technology Sydney. If you have any complaints or reservations about any aspect of your participation in this research, which you cannot resolve with the researcher, you may contact the following independent persons, who will treat your complaint or reservation in confidence, investigate it fully and inform you of the outcome. When the researcher's primary affiliation is with the University of Technology Sydney, you can contact: the Ethics Committee through the Research Ethics Officer (contact info omitted), at the University of Technology Sydney. Please quote the UTS HREC reference number. When the researcher's primary affiliation is with the Eindhoven University of Technology, you can contact: (contact info omitted). Please quote the names of the project and researcher.

Appendix 8.2 – Phototype manual

THANKS FOR PARTICIPATING!

This study will involve a three week deployment of a device in your home, followed by an interview (1 to 1.5 hour).

For this study we are interested in learning about how people respond to having the prototype interactive device in their home. That's also what the final interview will focus on.

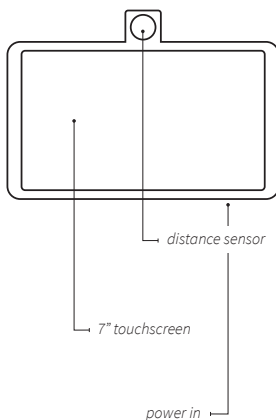
WHAT IS EXPECTED OF YOU

1. You will add a reasonable number of personal photos to be shown on the device. A few hundred is good enough, its storage will probably run out after several thousands.
2. The prototype is placed in a location where you spend time everyday or walk by several times a day.
3. Everyday, you aim to spend at least a minute or two interacting with the device.

CONTACT INFO

You are welcome to contact the researcher at any point if you have questions or concerns. Call Doménique van Gennip on 0416119485 or email domenique.vangennip@student.uts.edu.au.

THE DEVICE



HOW IT WORKS

Turning on the device

Plug in the power. Make sure to use the supplied power adapter as the device requires more than what a regular phone/tablet charger can provide. Make sure nothing is close to the distance sensor on top when turning it on. Its calibration on power up would prevent proper functioning. When booting, you get a lot of text rolling over the screen. Once that completes, the software should automatically start after a brief delay.

Turning off the device

Please hold the on-screen power button for two seconds (on the status screen). The device will commence shutdown, which takes about ten seconds. During this, you will see onscreen text once more (the device is then still stopping things in the background). After the screen goes dark, it will only switch on when the power is disconnected and reconnected.

The different screens

The device automatically picks which screen to show and will change that every once in a while. By tapping the screen with ten fingers at the same time, it will also go to the next one.

BLANK SCREEN

Just black, nothing to see. This will be shown at night until you press the screen.

STATUS SCREEN

Gives some information on the number of photos and how much room is left for more, along with a few other things. The device will switch away from this after a couple of minutes.

DUALDISPLAY

Two photos are shown next to each other. Once you press the screen, a divider shows up. Slight it all the way to the left or right to 'downvote' that image and replace it with another one. The other side gets an upvote. A photo's rating determines how likely it is to be shown in the future.

PHOTOSOUP

Several images gently move about the screen. You can drag them around and swipe them away. The latter may affect the image rating. Images are not replaced if you swipe them out, however, the remaining images can now be seen better as those get more space.

UPLOADING PHOTOS

Putting new images on the device is

done through a web interface. The idea is that you point your web browser to the device's IP address on the local network. The status screen tells you the IP to use. For example, if the status screen gives the IP as 192.168.1.9, you would enter that on your computer's web browser in the address bar. Once the upload page has loaded, you can drag and drop photos and those will start uploading. Soon after, those images will start to show up.

TECHNICAL INFORMATION

This device is a prototype. While we have attempted to make it work well without intervention, it's not as solid and well tested as a regular consumer product. So there may be bugs and other minor issues. A restart should fix most of it. In fact, the software should automatically restart after a short moment if it quits for some reason.

POWER CONSUMPTION

The maximum power usage is 12.5 Watts. Under normal circumstances, it should stay well under that. At times, a lightning icon might show up on screen, indicating it's close to maximum power usage. It's annoying but harmless otherwise. At night, the device turns off most visuals and adjusts the brightness to a low setting to further avoid power consumption.

WHAT DATA IS COLLECTED?

The device tracks several things to allow us to analyse when, how often, and for how long people interacted with the device. We do not keep a second to second record on whether something or someone was standing in front of the device. Your photos are also not collected or analysed. Filenames are converted to a generic string of characters (for example, 1c3dd135e0ca.jpg). While the data shows the rating for that image and how often it has been shown, it's not possible to know what was shown in that image.

RISKS

During the interview, you may be asked to relate personal memories, and (if willing) answer questions about these memories. In addition, some of the members of your household may be exposed to this device as well. You might be inconvenienced by the time required to be involved in this study, but no other harm is likely to result from your participation. The prototype device does not expose a risk that inherent to other comparable electronic devices.

Appendix 8.3 – Technical details of Phototype

This appendix provides a high-level overview of the technical steps required to make Phototype work. This complements the text in Chapter 8. The device was made using readily available materials, with a minimum of modification for ease of replication and reduction of build time (as five copies were assembled). The notable exception is the 3D-printed casing, which was custom for this device and tailored to just fit the components and allow access after installation. Using this custom casing reduce the need for specialist tools and time dedicated to crafting an alternative case. Naturally, yours truly flunked the 3D design at least twice and had to start from scratch to negate some of the potential time savings.

All 3D design files and source code are open and available online under a liberal license to allow reuse. Please visit <https://github.com/dvangennip/Phototype>, [Materialising Memories](#), or my personal website (<http://www.sinds1984.nl/>) for these files.

LIST OF MATERIALS

- Raspberry Pi 3
- 7" multi-touch LCD display
- LX-MaxSonar LV-EZ1 ultrasonic rangefinder
- 16 GB μ SD-card
- Copper heatsink (attached to RPi processor)
- 5V 2.5A power adapter
- Polyamide casing
- 4x M3 bolts and nuts

The approximate cost of one Phototype is AU\$315. A significant portion of this can be attributed to the RPi (\$54), display (\$108), rangefinder (\$34), and 3D-printed casing (\$81).

Hardware choices and wiring

We used Raspberry Pi 3 systems but our interactions could equally work on other hardware (early versions of the code were developed and tested on a laptop). Additional hardware used includes a Pi Foundation 7" Touchscreen with a proprietary way of reading touch input, which may not translate well to other systems without changes. However, mouse input is also supported.

The electrical wiring of the device is relatively simple, as shown in Figure A8.2.1. Most notable is the connection to the ultrasonic rangefinder. Because Raspberry Pi systems do not feature an analog-to-digital converter (unlike the popular Arduino platform), it is not

possible to read the distance sensor using analog signals. We opted to under-sample the pulse-width modulation (PWM) signal of the sensor via a digital input. This is suboptimal, trading accuracy for speed or vice versa. In practice, it made the sensor slow to respond to changes in situations.

Code in Python

All important programming was done in PYTHON 3, for its good support on the Raspberry Pi platform, familiarity, and generally 'good enough' performance. A complete overview of the program logic cannot be given in a reasonable amount of space. However, the link provided earlier includes all code files and an explanation to get started with the software. That resource also includes a list of suggestions for future improvements to be made to the software and overall functioning of the device.

The code consists of a number of classes, each dedicated to the management of one aspect of the device's function. Where possible, logic was separated to ease development and transparency of its functionality. For example, the distance sensor reading, touchscreen input, user interface, and data logging each were separated into their own class.

The two modes, DualDisplay and PhotoSoup, were implemented as two 'programs' within the core code. Each program, if active, would be tasked to do a logic update and finally a drawing update to render its state to the display. If no changes were necessary, no redrawing was done to ease load on the system. A status screen and a blank screen were added to operate in a similar way. Every few hours, the system would swap between programs. At night, the blank screen would be preferred unless the device was interacted with.

Uploading of photos was handled through a web interface. The main Phototype program would run both a web server for the uploading interface and a scanner/optimiser to take in newly uploaded images. The web interface relied on standard HTML, CSS, and JAVASCRIPT capabilities to provide users with a familiar interface to upload their photos. Similar to social media and cloud storage platforms, dragging and dropping of images into the website window would start the upload process. Any non-suitable files would be ignored.

Finally, the Phototype software is capable of over-the-air updates if the device is connected to the internet. This was implemented for my sanity in case serious bugs would manifest themselves. However, this ability remained unused during the deployments discussed in Chapter 8.

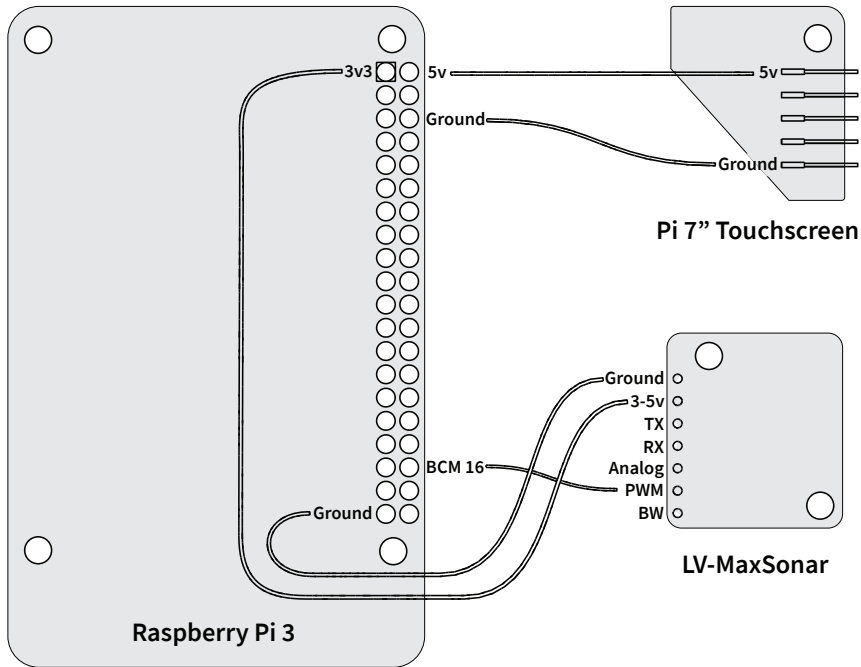


Figure A8.3.1. Wiring schematic for the device. The external power supply connects to the Touchscreen board, which relays the power to the Raspberry Pi itself.

Performance

For performance reasons, the code relies on multi-threading such that sensor readings, touch input, and program logic can operate separate from each other. This ensures a smooth user experience. In addition, the images shown were all cached in memory to improve performance. Nonetheless, having a number of images onscreen at the same time did affect the performance such that interactions would lag somewhat. A desirable increase in performance could come from switching the display drawing (and necessary image resizing) from the CPU-based PYGAME to something GPU-based like OPENGL. At the time of development this direction was only available as an experimental option on the Raspberry Pi and thus not pursued further.

Please note that the documentation on the [GitHub repository for this project](#) has additional information on the configuration, known issues, and enhancements.

Appendix 8.4 – Phototype interview protocol

Practical matters

- Recording equipment ready (phones: set to flight mode/silent to reduce disturbances).
- Bring a consent form for the participant to sign.
- Have some means of keeping time (watch?).
- Have a notepad for the single purpose of keeping interview notes.
- Have the prototype available if possible, so it may be referred to during the interview.

Introduction (~5 min)

Thank you participating over the past three weeks. The plan for this final session is for us to discuss your experience with the prototype device. What follows is a loosely structured interview. The goal of this session is for me to try and understand you and your views in your own terms, so there are no right or wrong answers. I would like to point out this is not a test in any way, it is really about learning from you.

This interview will last for approximately 1 hour.

In addition, I'd like to remind you that you are free to not disclose or discuss anything you are uncomfortable with. Some or all of the things disclosed may be published, but this will only be done in such a way that it cannot be linked back to you individually.

Before we start I would like to indicate that I'll be recording this interview to help me keep track of everything being discussed.

- Ask for permission to record the interview; if granted, start the recording.
- Ask the participant to sign the consent form.

Part 1: Experience with the device (~25 min)

In the first part of the interview I would like to go back to your experience having the device in your home. I hope keeping the device was an interesting experience for you.

- Check with the participant whether they made use of the supplied diary.
- Could you relate some of the experiences you've had during the weeks you kept the device?
 - *[probe]* Was it enjoyable? If (not) so, why?
- How much attention did you pay to the device?
 - *[probe]* Do you feel this changed over the course of the three weeks?
 - *[probe]* If so, may there be a reason for that?

- How often would some image attract your attention?
 - *[probe]* What is it about these items that triggered the memories?
- How active were you in interacting with the device?
 - *[probe]* What motivated you (not) go up and interact with it?
 - *[probe]* Was it something about the device (e.g., what it showed) that made you notice?
 - *[probe]* Could that be improved or were you happy with the way it is?
- Did others in your household respond to it? And if so, in what way?
 - *[probe]* Did it ever lead to (interesting) conversations or storytelling?
- Some days may have seen less activity from you than others. If so, why?
 - *[probe]* Have you noticed any changes in sensitivity to the device during the time it was in your home?
- Did you experience any technical issues that prevented you from using the device?
 - *[probe]* Where there some hard to understand mechanisms that could be improved?
- Questions appropriate to each mode:
 - *About DualDisplay:*
 - *Did* you make use of the swiping action? If so, what made you (not) do it?
 - *[probe]* What about an image made you up or down vote?
 - *[probe]* Do you feel it's a valuable way to express a preference?
 - *About PhotoSoup:*
 - *If* you used it, what made you swipe away images?
 - *How* did you feel about the 'natural' behaviour of images floating around?
 - *How* well does the behaviour of this design idea match with how you would like to deal with your personal media (photos)?
 - *[probe]* Which (dis)similarities do you see?
 - *Do* you think that some of your personal media would go better than other types with what this idea does?
 - *[probe]* Would you be comfortable with the device picking from all your personal media, or would you prefer to filter ahead of its active use?
 - *What* do you think of amount of control you'd have over this device's operation?
 - *As* it offers (little) opportunity to interact with it, do you see yourself doing/missing that?

Part 2: Comparing the two modes (~10 min)

Now we have seen and discussed each mode, I have some questions to compare them.

- Do you have a general preference for either of the two modes?

- *[probe]* Does it vary by the purpose you see for it?
- Which mode seems to fit better with how you would like to deal with your personal media?
 - *[note]* This is a repeat from part 1, in case it was skipped before.
- Between the demonstrated ideas, do you feel the different way these modes would work could have any influence on thoughts that come to mind for you, such as memories of past events?
 - *[probe]* If so, how? And why?
- Would you say any differences in your responses are more a result of the different ways in which the modes operate, or in the way you would *interact* with these?

After these comparisons, I have a few general questions about the device.

- Let's say you could keep this device, what would you do with it?
 - *[probe]* Is there something you particularly (dis)like?
 - *[probe]* Would you move its place in your home? Why?
- What kind of value do you think you may get out of this device?
 - *[probe]* If (not) so, how and why?
 - *[probe]* What would you want to get from it?
 - *[probe]* If you could change something about this device, what would you change?
- What would you tell someone who visits your place and asks about it?

Part 3: Personal media and everyday reminiscing (~10 min)

Note: These questions were to be used in addition to the earlier parts, and are probably better used in the context of those parts. In practice, this part was never used as is.

In this last part, I would like to move the discussion by asking what role things, such as physical objects, digital photos, etc., play a role in remembering your past or are otherwise important to you.

I'm especially interested in how digital technology may be of help or be influential otherwise to support the way you would interact with your past.

- What role do items (such as objects, songs, or personal photos) play for your remembering practices?
 - *[probe]* In what way do you interact with those, if at all?
 - *[probe]* Is this different for different social situations?
- In what ways do you use your personal media, such as a photo collection?
 - *[probe]* When do you look at those?

- [probe] Are such files or items stored in a specific place?
 - [probe] What about digital items?
- [probe] How often are these encountered?
- Do you ever actively go over a collection for the purpose of remembering?
 - [probe] Or is remembering more something that happens while sorting through stuff?
- How do you think a device like this fits into those practices?
 - [probe] Would you say it brings benefits or puts your personal media in an interesting place?
- Do you have any ideas (besides this prototype) for how you would like to interact with your photos?
 - [probe] What makes that idea worthwhile?

Wrap-up (~5 min)

- Briefly summarise the key points of the discussion.

Before we wrap-up, do you have any things you would like to add to what we have discussed so far, or perhaps missed in the discussion?

We have reached the end of the interview. I would like to thank you for your participation and contributions, it has been very helpful for my research.

- Disable the prototype script from running so data can be extracted later.
- Discuss whether it is acceptable for me to look at the photos during my analysis. If not, remove the photos on the device.

From here on, I will use the input from several interviews together to understand what value could or want to get from such a design. My research is looking at how remembering in everyday life can be supported through (interaction) design, and this final study helps me to understand experiences while remembering. My intention is to take all the feedback and come to conclusions about how some of the ideas I've toyed with work out in practice.

If you'd like I can inform you once this study's data has been synthesised and written up.

Finally, if in the next few hours or even days you think of something that might be helpful, I'd be glad to hear about that.

- Don't stop recording until after the discussion has truly completed.
- Pack up the device and the power adapter and take this back.

Summary

Throughout our lives, we use the past to maintain a sense of who we are. Whether this happens through individual reflection and reminiscing or by telling others about our past, remembering provides an opportunity to connect with other people's experiences, find common ground, and increase understanding of oneself and others. Remembering also helps to identify useful ways to deal with future situations. In everyday life, reminiscing often happens amid other activities such as cleaning, having a conversation, or browsing one's documents on a computer. A particular thought may inspire someone to relate back to a moment in the past, or this may come about when someone encounters something that cues their memories (for example, personal photos, souvenirs, keys left on a table, an old jacket, or a familiar but not recently visited area could all bring back memories once noticed).

These encounters may be predictable because people have seen, heard, or felt that thing before. For instance, a digital photo used as desktop wallpaper on one's computer is likely familiar to the point of going unnoticed. However, if some time has passed, or if upon seeing something one makes a sudden realisation, that encounter may well stand out. An old jacket, for example, which is found after several years, may cause someone to reminisce about a near-forgotten time. With digital possessions becoming more numerous and more ubiquitous in our everyday lives, the chances of such unanticipated encounters increase. However, previous research on digital photos has shown that people tend to undervalue their digital collection and not look at them often. This under-appreciation has caused interest from interaction designers in how our digital possessions, and digital photos in particular, can be appreciated more.

This thesis takes a closer look at reminiscing in everyday life. It concerns itself with the unanticipated, involuntary way memories may come to mind in everyday life. For this reason, we develop the notion of serendipitous reminiscing to describe the casual recollection and reliving of past experiences, for enjoyment, restorative, and social purposes, brought about by chance encounters with things that remind of one's past. A key element of serendipity is the realisation – whether through a gradual drift of one's attention or a more sudden leap of thought – that changes (perhaps subtly) how one thinks and feels about a thing or an event from one's past. These kinds of spontaneous encounters are so easily afforded to physical things but (without technological intervention) out of reach to digital photos.

The motivation underlying this work concerns how people could deal with large amounts of personal photos such that these may contribute to meaningful experiences. In this thesis, we address this interest through four research questions: (1) how do people relate

to external memory cues in everyday life, (2) whether remembering can be defined as a kind of experience, (3) how serendipitous reminiscing can be characterised, and (4) how interactive technology may support serendipitous reminiscing through the use of personal digital photo collections.

Part I of this thesis places the presented research in relation to prior work and relevant approaches to research. Chapter 2 provides an in-depth discussion of the methodological background. The research in this thesis is exploratory in nature. We aim to develop an understanding of both the area of interest and potential design solutions. For this reason, we have combined a design-oriented approach with research-through-design. Chapter 3 highlights related work on the topics of memory, reminiscing, and how ethnographic and design-oriented work has addressed the challenges around reminiscing using personal digital media. This part concludes with a set of characteristics of serendipitous reminiscing, namely it being responsive to context, in service of a personal or relational goal, and dependent on the perceived shift of one's perspective on the matter cued by an encounter.

In Part II, we follow an ethnographical and phenomenological approach to remembering. Chapter 4 describes a study on involuntary remembering in everyday life, which illustrates what kind of things bring back memories, of which some encounters may indeed be serendipitous. We observed a paucity of digital items relative to objects, other people, and environments. We put forth several considerations for design as it may use digital items to cue memories. For instance, we reason that meaning may develop over time and could be cultivated through interactive systems. However, such systems are preferably sensitive to undesired interactions. Thus, in our discussion, we argued that the experience of someone while reminiscing is an important aspect for the design of interactive systems. Therefore, in Chapter 5 we discuss a study that set out to qualify remembering as an experience. Using repertory grids based on participants' unique memories, we derived a categorisation of how people discuss their remembered experiences.

Part III of the thesis continued with research-through-design by reviewing prior design work (Chapter 6) and developing new concepts. The review of 70+ design efforts on personal media displays highlights these displays have been conceptualised as primarily a domestic technology. Aspirations across the corpus are to make the digital present, to employ personal media for social uses, and to inspire deeper consideration of one's past. Also, designs have started to consider the passage of time, both for individual use and across generations. We continued in Chapter 7 by developing a design-oriented model for the design of interactive photo displays. From this, we developed and evaluated several concepts that could initiate serendipitous encounters with digital photos. The use of mock-ups allowed us to study people's perceptions towards such technology. For the

final study reported in Chapter 8, we used the insights from the mock-ups to design an interactive prototype. Phototype was deployed in the homes of participants to see how technology could feasibly bring about serendipitous reminiscing in the everyday domestic environment. Our findings show that Phototype's interactive features were used less often than we had expected. Instead, its value seems to reside in the ability to situate personal photos in the everyday environment, ready for inclusion in one's awareness. This non-interactive use also highlights the importance of the photo selection process itself as a proxy for the later enjoyment of serendipitous encounters.

This thesis concludes that encounters with personal media and other things that remind one of one's past are welcome. Also, the research suggests that the primary value of interactive photo displays rests in the ability to let people passively enjoy their photos, without the need for interacting. At the same time, the work suggests remembering is an experience that is sensitive to context, and thus, can be desirable and undesirable. A challenge remains for designers to explore how interactive systems may tune into desirability and perhaps capitalise on this to inspire serendipity. The findings contribute to design research on remembering by furthering the understanding of remembering as experience and the evaluation of several novel concepts that facilitate serendipitous reminiscing in everyday life.

Publications by Doménique van Gennip

Publications from this thesis

- van Gennip, D., Hoven, E. van den., Markopoulos, P. (2015). Things that Make Us Reminisce: Everyday Memory Cues as Opportunities for Interaction Design (pp. 3443–3452). *In Proceedings of the 33th Annual ACM Conference on Human Factors in Computing Systems 2015 (CHI'15)*, 18-23 April 2015, Seoul, Korea, ACM Press.
- van Gennip, D., Hoven, E. van den., Markopoulos, P. (2015). Intermediate Knowledge: A Bridge for Interaction Design to Other Disciplines (pp. 1–3). *Presentation and paper in online proceedings of the CHI'15 Workshop on Knowledge Production in Interaction Design*, 19 April 2015, Seoul, Korea, ACM Press.
- van Gennip, D., Hoven, E. van den., Markopoulos, P. (2016). The Phenomenology of Remembered Experience: A Repertoire for Design (pp. 1–8). *In Proceedings of the 34th European Conference on Cognitive Ergonomics (ECCE'16)*, 6-8 September, Nottingham, UK, ACM Press.

Other publications

- Koppel, ten, M. A. J., Walmlink, W., Amiralis, Z., Ruiter, H. J., & van Gennip, D. (2005). Semotion: Mediating urgency through mechanical movement. In L. Feijs, S. Kyffin, & B. Young (Eds.), (pp. 103–109). *Presented at the Design and Semantics of Form and Movement Conference (DesForm 2005)*.
- de Kort, Y. A. W., Haans, A., Geerdinck, L., van Gennip, D., Horst, M., & Servaes, J. (2010). Psychological building blocks for dynamic road lighting: Understanding light's role in feelings of safety at night. In M. Haverlag, G. M. W. Kroesen, & T. Taguchi (Eds.), (pp. 529–530). *Poster at the LS-WLED conference, Eindhoven, the Netherlands*.
- Haans, A., van Gennip, D., Ham, J., de Kort, Y. A. W., & Midden, C. J. H. (Eds.). *Proceedings of Environment 2.0: The 9th Biennial Conference on Environmental Psychology*, 26-28 September 2011, Eindhoven University of Technology, Eindhoven, The Netherlands.
- van Gennip, D. (2013). Externalising memories: designing for digital mnemonic cue embodiment (pp. 1-4). *Presented at Doctoral Consortium of OzCHI 2013*, 25-29 November, Adelaide, Australia.
- van Gennip, D., Orth, D., Imtiaz, M.A., Hoven, E. van den., and Plimmer, B. (2016). Workshop on Tangible Cognition: Bringing Together Tangible Interaction and Cognition in HCI (pp. 1-4). *In Proceedings of the 28th Australian Conference on Human-Computer Interaction (OzCHI'16)*, 29 November – 2 December 2016, Launceston, Tasmania, ACM Press.

Curriculum Vitae

Doménique van Gennip was born on the 6th of October 1984 in Breda, the Netherlands. In 2003, he obtained his VWO (secondary school) diploma at the Mencia de Mendoza lyceum in Breda. In the same year, Doménique started the Bachelor of Industrial Design at Eindhoven University of Technology. Upon completion in 2010, he studied the Master of Human-Technology Interaction at the same university. His degree, including a thesis titled “Social Pulse: The effects of mediated heartbeat communication on social connectedness, liking and pro-social behaviour,” was awarded cum laude in 2012. The year after, he started his joint degree PhD research at the University of Technology Sydney and Eindhoven University of Technology. This thesis represents the outcome of four years studying the interaction design for everyday remembering.

