CURATION-IN-ACTION

DESIGN FOR PHOTO CURATION TO SUPPORT SHARED REMEMBERING

MENDEL BROEKHUIJSEN

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DESIGN FOR PHOTO CURATION TO SUPPORT SHARED REMEMBERING

DOCTORAL DISSERTATION

by

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This thesis is the result of a research candidature conducted jointly with Eindhoven University of Technology and University of Technology Sydney as part of a Joint PhD degree.

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 part of the collaborative doctoral degree and/or fully acknowledged within the text.

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“Deftness and speed in working do not impart to the work an abiding weight of influence nor an exactness of beauty; whereas the time which is put out to loan in laboriously creating, pays a large and generous interest in the preservation of the creation.”

Plutarchus in *Life of Pericles* (p. 41)

ABSTRACT

Nowadays people deal with unprecedented quantities of personal digital media. This thesis focuses on digital photos, one of the most prevalent digital records people keep. The photos that people capture or collect for their personal collections often acquire personal value as external representations of experiences that can cue autobiographical remembering. The autobiographical value of photos can support remote and especially collocated interactions with others.

As a result of technological developments in capturing moments and experiences, people have too many photos to manage, and they lack the time, tools and motivation to curate them effectively which hinders them from using their photos. This thesis aims to inform the design of photo curation tools to support the use of photos, specifically for collocated shared remembering practices.

Through three qualitative user studies with a focus on design, we have explored several aspects of the curation challenge. We gained insights into current photo practices, social sharing practices, multi-user interaction, shared remembering, and requirements for curation. Based on these insights this thesis contributes a different perspective on design for curation that specifically focuses on collocated social practices: we introduce our approach to photo curation that we call *Curation-in-Action*, which by definition integrates curation tasks into the social practices that motivate them.

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

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CHAPTER 1.
INTRODUCTION

Chapter Summary

This chapter introduces the topic and the background of this thesis. To understand what we mean with the title *Curation-in-Action: Design for Photo Curation to Support Shared Remembering,* we will introduce the core terms in the first part of this chapter, including our definition of photo curation. In the second part of the chapter, we will introduce the challenges and the research questions and the design-oriented research approach used in this work. We conclude with an outline of the chapters in the thesis.[1]

[1] Throughout the thesis, "we" refers to myself and my supervisors, prof. dr. Elise van den Hoven MTD and prof. dr. Panos Markopoulos. If "we" refers to other collaborative efforts this is indicated in a footnote at the start of a chapter or where appropriate.

1.1. INTRODUCTION

Nowadays most of us deal with unprecedented quantities of personal digital media, such as photos, instant chat messages, status updates, and e-mails. Some of these media we create ourselves, and some we receive from others or result from our use of technology. Digital photo collections are one of the growing archives for personal use. Van House (2011) defined personal photography as "that which is done by non-professionals for themselves and their friends and intimates. It subsumes but is not limited to family and tourist photography" (Van House, 2011, p.125). Throughout this thesis we will use the term photos, digital photos or personal photos interchangeably. We refer to digital photos within personal photo collections, even though those can also consist of non-personal photos, such as saved internet images, screenshots of flight times, snapshots of receipts, photos of a whiteboard with notes, boarding passes.

1.1.1. Photo Collections

The advances in photo capturing technologies make it possible to record and collect enormous numbers of photos (for example, Van House, 2011). To illustrate the growing collections, Figure 1.1 shows my own photo collection, which consisted at the start of this research project of a little over 40.000 photos from the years 2002 – 2013, and at the time of writing this in October 2017 it grew to just over 70.000. It consists mostly of photos that I took myself but also photos taken by others, screenshots, and photos related to work or coursework. Many of the photos from before 2008 were captured by others, and I collected them in the years after. Getting my first digital camera in 2008 had a massive influence on my photo capturing behaviour, as did spending a semester abroad as an Industrial Design undergraduate student in 2009, and especially the latter is visible in Figure 1.1 as a spike in the number of captured photos.

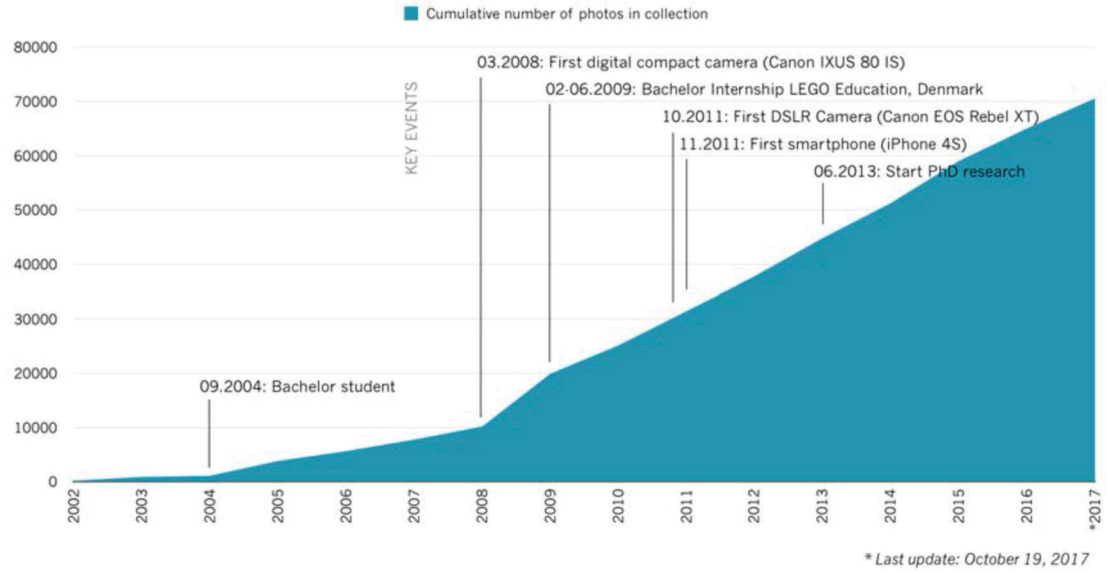

Figure 1.1: Statistics of my personal digital photo collection, showing its growth between 2002-2017. Some key events that had or are expected to affect my collection growth are indicated in the diagram. Here the cumulative growth is displayed, with the number of photos on the y-axis and the years on the x-axis.

The overall number of photos I took has been constant since 2009, averaging around 6.600 photos per year (18 per day). While the addition of a Digital Single Lens Reflex (DSLR) camera and a smartphone with a good quality camera to my capturing tools (both in 2011) had less impact on the overall number of photos taken than I expected, my capturing behaviour did change. I have taken more photos of mundane events throughout the years since I got a smartphone in 2011, a transition more smartphone users notice (Van House, 2011).

We can only expect the number of digital photos in our collections to increase since technological development enables us to take photos of everything we are doing. Apart from our own capturing behaviour, we also have to deal with all the media that is created by others during events, or media that is (automatically) generated around events we attend. Great leaps have been made in the technology for capturing moments and experiences and creating digital records (e.g. see Frohlich & Tallyn, 1999; Hodges et al., 2006; Sarvas & Frohlich, 2011), and at the same time mobile and online storage services, such as photo sharing platform *Flickr*[2], can potentially offer people on-the-go access to their entire photo collections, allowing the on-demand use of personal photos for various purposes. While that sounds promising for increasing the use of photos, e.g. during social interaction, the use of photos for any given purpose only works well if the appropriate content for the given context can be found easily within the collection. Even though long-term retrieval is the major motivation for people to capture photos (Whittaker, Bergman, & Clough, 2010), Whittaker et al. found that their participants were not successful in almost 40% of photo retrieval tasks.

Finding the right photo is often inhibited by a lack of *curation*, which from the tradition of librarians, archivists and historians means deciding which information should be preserved and in what formats, as well as methods of capture, (re)presentation and reproduction (Van House & Churchill, 2008). In the context of digital photos, curation involves, in short, the need to decide for every set of photos what to keep, how to keep it and how to present it. Photo curation remains a burden for any photographer, including casual holiday photographers, serious amateurs and even professionals, although for professional photographers, curation is part of their job routine and they are typically more skilled in using the tools that are available for managing and editing photos. One of the missed opportunities that many non-professional photographers face with the increasing collection size and curation lacking is that they do not look at their photos as often as they like, except when they have some time to spare on their smartphones (e.g. when they are bored, see Van House, 2009; Zürn, Damen, Leiden, Broekhuijsen, & Markopoulos, 2017). With the increase in the number of media items, people are more aware of the lack of curation, but the situation is still very similar to what it was decades ago when collections were smaller and print-based: people lack the time, the tools, and the motivation to organise the many photos that they have effectively (Bergman, Tucker, Beyth-Marom, Cutrell, & Whittaker, 2009; Kirk, Sellen, Rother,

[2] www.flickr.com/about, retrieved October 17, 2017

& Wood, 2006), which hinders them from fully enjoying their photo collections. Whittaker et al. (2010) showed that even though there is support from a range of software and hardware tools, people are still reluctant to curate. The result is that most digital photo collections are badly organised and scattered across multiple devices (Whittaker et al., 2010). The challenge that emerges is how to help people to curate their photo collections better, and instead of precious photos getting lost on dusty hard drives enable people to make use of their photos.

1.1.2. Photos as Memory Cue

To further underline the importance of research into photo curation, let us consider the value of photos for different purposes. In the analogue era, personal photos mainly served to remember, and archiving the family history (e.g. van Dijck, 2007, 2008; Sarvas & Frohlich, 2011). In the last two decades, the purposes of photos have changed along with the advances in digital photography and camera phone use. Especially for the younger generations, the use of photos for communication and identity formation are more prevalent than using photos for remembering purposes (van Dijck, 2008). Also, the online representation via social networking sites is an important function of modern digital photography (Van House, 2011). In her work, Van House even warns that photos might become more effective as objects of communication than objects of memory because digitisation has made photos more public and less durable (Van House, 2011). However, we follow the arguments of van Dijck (2007, 2008) that the remembering purpose of digital photos is still the prime reason for capturing them. Photos are valued for autobiographical narratives and personal memory (Van House, 2009), which can support social interaction with others, e.g., telling the story of one's holiday while viewing a slideshow of pre-selected photos.

When photos are used to augment or support an individual's memory reconstruction, the photo can be referred to as a *memory cue* (for example, van den Hoven & Eggen, 2014). With a *memory cue* or a *cue,* we mean what is referred to as *external memory cues*, as opposed to *internal memory cues* that are (thought) processes within the brain that are part of memory construction (Berntsen, 2009). Items that can potentially be used as memory cues include souvenirs from holiday trips, personal digital media such as videos, chat messages, emails, social media entries and, of course, digital photos. Despite the many differences between tangible souvenirs and digital photos, the personal value of these items is based on the association that the individual has with them, and every interaction strengthens the connection between the item and the memories. These items can also be referred to as *mediated memories*, a term coined by van Dijck (2007) because through technology mediated objects allow us to (re)create our experiences, and thus a sense of past, present and future in the context of our identity and culture (van Dijck, 2007). Especially photos that we capture or collect for our collections often acquire personal value as external representations of personal experiences that can cue memories from events in our own lives, which are reconstructed from our *autobiographical memory* (see for example Conway &

Pleydell-Pearce, 2000; Tulving, 2007). According to the *constructionist approach* to memory (Guenther, 1998) memories are reconstructed every time they are recalled. Therefore, memories themselves cannot be stored as a digital or any other kind of record. What can be stored, are the external items that can cue the reconstruction of memories (Sellen & Whittaker, 2010; van den Hoven & Eggen, 2009).

In this thesis, we approach photos as memory cues. Photos can also be approached as, e.g. aesthetic works of art created by (hobby) photographers, as objects of communication used on social media platforms (Van House, 2011), or to signify social gatherings (Sontag, 1977), e.g. by taking group selfies. However, approaching photos as memory cues helps us to focus on their relevance for remembering, without the need to consider e.g. the aesthetic or technical quality of individual photos. The significance of cues can change over time (Zijlema, van den Hoven, & Eggen, 2016), just as the relevance of a photographic cue can change, potentially making it more valuable later in life.

1.1.3. Shared Remembering

Conway & Pleydell-Pearce (2000, p 261) described autobiographical memories as "transitory dynamic mental constructions generated from an underlying knowledge base", which is sensitive to cues that activate and influence the knowledge structure of autobiographical memory (Conway & Pleydell-Pearce, 2000). Autobiographical memory has some important functions in our lives. There are several lists of functions published throughout the years, but here we follow Bluck, Alea, Habermas, & Rubin (2005) who describe three functions: a) a directive function, making plans for the future based on past experiences; b) a self-preservation function, including construction and maintenance of self-concept and self-history; c) a social function, for example bonding, making new friends and maintaining existing relationships. In this thesis, we are interested in the use of photos to support this social function of autobiographical memory, especially around shared remembering.

Part of shared remembering is the notion of *cross-cueing*, or *interactive cueing* (Wegner, Giuliano, & Hertel, 1985), where one person's memory and conversation triggers the memory of others. Remembering, and especially shared remembering is a complex process involving many contextual factors, e.g., the timing of cues, the social and physical context, the social situation and emotional state of the person (Harris, Rasmussen, & Berntsen, 2013).

Sharing memories has been an essential part of people's social interaction for 100.000s of years[3]. For example, anthropologist Wiessner (2014) looked at storytelling practices around the fireplace of Ju/'hoan (!Kung Bushmen) of southern Africa, and identified that night talk around the fire allowed them to understand the thoughts and emotions of others more accurately, to

[3] The origin of speech is difficult to determine because there is no material trace. https://en.wikipedia.org/wiki/Origin_of_speech. Retrieved Augustus 18, 2018

bond within and between groups and to generate, regulate and transmit knowledge about their culture and their society, including e.g. the procedures and rites around marriage (Wiessner, 2014). Through stories and the discussions that followed, the Ju/'hoan collected experience and accumulated knowledge of other people, and learned from others about relations with remote villages, without the need to travel there. Storytelling also provided mutual benefit, where the storyteller enjoyed and gained recognition from telling an engaging story, conveying characters and emotions[4], and the listeners were entertained and learned from others' experiences (Wiessner, 2014). These principles are also relevant for current common storytelling practices in other countries.

Storytelling, as described here, constitutes not only the collective memory of the community, but it also communicates the memory of the individual. Traditionally, shared remembering occurs when people are *collocated* (at the same place; co-located; co-present) (Frohlich, Kuchinsky, Pering, Don, & Ariss, 2002; Harris, Barnier, Sutton, & Keil, 2014). In the last decades we have seen increased opportunities for remote memory sharing via online (photography) platforms, which also shapes how (collective) memory formation is done (van Dijck, 2011). However, collocated shared remembering remains a popular activity (Van House, 2009). What occurs when sharing photos can be viewed as *reciprocal interaction*, a term from social psychology referring to a bidirectional action or exchange between two or more people (Nettle & Dunbar, 1997). Looking at photos together, especially face to face, is relevant for the construction and maintenance (perhaps even re-enactment) of relationships (Van House, 2009). Durrant, Frohlich, Sellen, and Lyons (2009) conceptualised photo sharing, which they referred to as act of *photo display*, as a socially contextualised activity. We agree with this point of view, but we will use the term photo display for a technological solution – usually a screen – that allows the rendering of a digital photo to be viewed. When people engage in shared remembering using photos as memory cues, Frohlich et al. (2002) made the distinction between the conversation types *reminiscing talk* and *storytelling*: reminiscing talk occurs when all individuals were present at the original event; storytelling occurs if a person shares memories of events the others did not attend. The purpose of sharing memories in modern Western society is similar to the practices of the Ju/'hoan. Memories are still used to share others' and our own experiences, to understand other people and their behaviour better, to bond with each other, and to reflect on society and discuss its procedures and rites. Remembering and sharing stories can intensify peoples' social bonds and ultimately leads to a sense of belonging, valuing and re-valuing relationships, friendships, building self, and overall happiness (Bluck et al., 2005).

[4] The performative nature of storytelling, including self-expression, especially in collocated social interactions but also in remote interactions via social media, as mentioned by e.g. Van House et al. (2005), is out of the scope of this thesis, although we briefly touched upon this with the work we did with MSc graduate Luc Hermans, see:
Hermans, L., **Broekhuijsen, M.** and Markopoulos, P. (2017). Memora: a Design for Teenagers to Connect Virtual and Physical Possessions. In: *Proceedings of ECCE 2017: European Conference on Cognitive Ergonomics*, September 20 - 22, 2017, Umeå, Sweden. ACM, New York, NY, USA. pp. 121-128 DOI: https://doi.org/10.1145/3121283.3121312

While a curated sub-set of personal photos can support collocated shared remembering because the photos can cue the memories, a poorly curated collection with many duplicates and irrelevant photos might not contribute to the conversation because it gets in the way of the social interaction. The challenge for designers is to develop photo curation solutions to enable the use of photos to support collocated shared remembering.

1.1.4. Photo Curation

To position our work, this section will briefly summarise the different views on what curation is. Through the research described in this thesis, we gained a better understanding of what photo curation is – as a concept and as a practice.

Curation: on-going care and responsibility

The Oxford Dictionary of English (version 2013), defines the verb *curate* as an activity to 1) "select, organize, and look after the items in (a collection or exhibition)"; 2) "select the performers or performances that will feature in (an arts event or program)"; 3) "select, organize, and present (online content, merchandise, information, etc.), typically using professional or expert knowledge". In the latter definition, curation is also used as an adjective (e.g. curated content). The noun *curator* refers according to the dictionary to 1) "a keeper or custodian of a museum or other collection." 2) "a person who selects acts to perform at a music festival". Both words originated from the Latin *curare* ("take care of"), from *cura* ("care"). The original noun senses were "care, concern, responsibility".

These dictionary definitions emphasise a certain dedication to the activity of curation and long-term dedication of the person who is in charge of preserving and taking care of collections or items.

Data curation: adding value and maintaining access

A similar notion of long-term preservation is also part of the definition of *data curation,* coming from Library and Information Science.[5] For example, Cragin, Heidorn, Palmer, & Smith (2007) refer to data curation as "the active and on-going management of data through its lifecycle of interest and usefulness to scholarship, science, and education; curation activities enable data discovery and retrieval, maintain quality, add value, and provide for re-use over time". In this definition, there is also a notion of on-going effort that is required for curation, suggesting that data collections can be dynamic. Moreover, it states that data management is done to stay of interest and useful for various purposes continuously. The result of the process is to be able to retrieve and discover data, re-use data, maintain quality and add value. Miller (2014) made a

[5] In the practice of cultural heritage management (CHM) there is also a strong notion of long-term preservation and retention of heritage assets, and to provide access to those assets. However, we will not consider CHM practices here, because they come from areas unrelated to our research, such as cultural conservation, restoration, museology, archaeology, and history.

similar point, be it within the context of Big Data, that curation deals with the processes needed for principled and controlled data creation, maintenance, and management, together with the capacity to add value to data.

In the realm of Information Technology (IT) or computer science, data curation is also referred to as *digital curation*, pointing more specifically to the selection, preservation, maintenance, collection and archiving of digital assets (Rusbridge et al., 2005) using software and other digital technology. In digital curation, there is a focus on the data lifecycle, from creation and initial storage, to when it is archived or becomes obsolete and is deleted. This definition also refers to the need to update data collections to prevent digital obsolescence because of changing file formats, thereby keeping the information accessible to users indefinitely.

Sheer curation: embedded in practice

One approach to smoothen the process of digital curation is called *sheer curation*, where the curation activities are seamlessly integrated into the workflow of dealing with digital assets. "Sheer" refers to the lightweight nature of the curation activities, which can be embedded within any interaction a person has with the digital data, including creation. Sheer curation depends on curators being engaged with the data during creation and primary use, and curation during these interactions can also benefit preparation for sharing, publication or long-term preservation.[6]

Sheer curation offers a different point of view compared to the other definitions in this section because the activity of curation is not restricted to a certain moment in the life-cycle of digital items but instead can happen throughout the creation and use of the items.

Content curation: thematic reuse

Content curation is a term from online marketing and refers to platforms that gather, organise and present existing content related to a particular theme or topic[7]. They reproduce some of the original content, with or without interpretation or commentary, and provide links to the full entry. It provides people with an overview of a selection of items, which can be helpful given the amount of content that appears online every day. The practices of organising existing content to form a new narrative or alternative overview are very similar to what museum curators and library professionals have been doing for centuries.

Content curation related to social media content follows the same principle as content curation but is focused only on channelling the best news, articles and videos on social media channels (e.g. *Facebook*).[8] Content curation can be done by individuals or by small groups. When the groups become bigger, the collaborative content curation is referred to as *social curation* (for

[6] https://en.wikipedia.org/wiki/Digital_curation#Approaches, retrieved August 19, 2018
[7] whatis.techtarget.com/definition/content-curation, retrieved December 5, 2017
[8] www.huffingtonpost.com/stefan-deeran/what-is-social-media-cont_b_3383706.html retrieved December 5, 2017

example Hall & Zarro, 2012): the collaborative effort to collect and organise Web content around types of content, e.g. images on *Pinterest*.

Media curation: making decisions

Specific to photography, curation of media involves deciding on what to keep, how to keep it and how to present it, as we have mentioned earlier in this chapter as a simplification of what was described by Van House and Churchill (2008). This emphasises that the activity of curation includes a set of decisions.

The definition from the Oxford Dictionary described at the beginning of this section mentions that curation typically involves professional or expert knowledge. We can interpret the need for expert knowledge as vital to making proper decisions: when it comes to photo curation, every person is expert when it concerns their own personal photo collection.

1.1.5. Defining Photo Curation

Our definition of photo curation echoes several elements from the definitions that we described in the previous section:

> **Digital photo curation is the creative activity that is intended to add value to an accumulation of photos by means of purposive triaging, organising, editing and managing.**

Explanation of definition

The definition concerns *digital photo curation*, deliberately excluding analogue collections. Even though the definition could also serve other curation practices, we focus on dealing with digital files, which is different from curating printed film photo collections.

Creative "relates to or involves the imagination or original ideas" (Oxford Dictionary of English, version 2013), and is part of our definition because when dealing with activities such as triaging or organising, one has to imagine what content would be appropriate, or come up with a structure that would work for them. A clearer example of curation as a creative endeavour is selecting photos to support storytelling, where imagination and crafting original storylines are required.

Activity is part of our definition because the actions are conscious, require active engagement from the owner. From the definitions we described earlier, we gathered terms such as *active*, *on-going*, as well as *maintenance*, *preservation*, which all indicate that curation is an activity that requires attention and effort.

In our definition, we echo the previously described definitions that curation *intends to add value* of some sort to an accumulation of photos. Value is not a constant but depends on the

purpose. For example, photo triaging for a holiday album adds value to the photos as support for a storyline, organising files within a collection can add value for easier future retrieval, photo editing can change the representational and artistic value of a photo, and file managing and backup adds value by enabling long-term preservation of a collection.

We decided to use an *accumulation of photos*, instead of a collection of photos. *Accumulation* is defined as "a mass or quantity of something that has gradually gathered or been acquired" (Oxford Dictionary, 2013). The definition of a collection, on the other hand, can be as broad as "a group of things", "an assembly of items such as works of art, pieces of writing, or natural objects, especially one systematically ordered." (Oxford Dictionary, 2013). Especially that last part suggests that a collection already has some organisation. Most digital photo accumulations already have some level of organisation, dictated by the tools that are used to create and to store the photos (e.g. file structures, naming). Even though we use *accumulation* in the definition, we will use the term "personal photo collections" or variations of that throughout the thesis as a synonym.

We add the word *purposive*, meaning "having, serving, or done with a purpose" (Oxford Dictionary, 2013), because curation activities are motivated by underlying purposes, as we will argue in Chapter 3. The purpose can be social, e.g. to show to a future audience, but curation can also happen with the purpose to secure or preserve photos for personal recollection ten years from now.

Triaging[9]*, organising, editing* and *managing* are the activities that we associate with photo curation, based on our research into digital photo practices. These activities are explained in detail in Chapter 3.

Blurred lines of curation

In our definition, we do not specify the nature of the value that is added to the accumulation of photos. Traditional managing activities can involve several different interactions with photos, e.g. selecting photos, giving photos a star-rating, sharing them on social media, or dragging them to a folder for future editing. These actions can result in alterations to the *permanent* structure of the collection, e.g. creating subfolders based on specific themes. However, the result of photo curation, as we define it here, can also be a *temporary* structure without a permanent effect on the collection's archival structure. For example, selecting photos to send to social media will in most cases only affect the online collection without affecting the collection's local organisation structure.

Most definitions that we described in the previous section have a separation between the activity of curation, where the decision and interaction take place and the action of using the

[9] *Triaging* is "the process of determining the most important people or things from amongst a large number that require attention" (Oxford Dictionary, 2003).

curated result. This separation is often amplified by the tools that are used for curation (see Chapter 2 for examples). Echoing the approach of *sheer curation*, our definition does not dictate this divide between the activity of curation and the use of the result. Moreover, in Chapter 6, we will argue that curation should not be separated from use and that the activity of photo curation might need to be moved closer towards the action of using the content for social purposes.

1.2. CHALLENGES FOR PHOTO CURATION

There appears to be an increasing relevance for design to support personal photo curation. Technology will most likely not be limiting the influx of both created and generated media that people need to deal with since the technological advances make it possible to store more data on ever smaller devices. Instead, we will have to deal with an increase of data-gathering objects and 'connected' everyday products that record our lives. That information needs to be curated too if we want to use it to support future remembering. As mentioned before, media curation involves deciding on 1) what to keep, 2) how to keep it and 3) how to present it. Based on these elements we see three challenges for curation tools:

Photo storage

One of the challenges is how and where to keep the digital collection. Even if storage is becoming more affordable, people must still make choices where and how to preserve their collections. If we look towards the near future, existing models and systems that address file systems are limited. We already see happening with online cloud storage services that it is difficult to locate single files, because it is not completely clear in what file structure our media exists, who created it, and who owns it (Harper et al., 2013). An example from my personal experience: if I were to remove a photo that I just took with my smartphone, I have to delete a copy of the same photo from three different devices because they are connected through an online platform which creates a backup of every file added to either of those devices. This is a good solution for collecting all photos in a single repository, but less practical if one wants to get rid of unwanted items. If the collection resides somewhere that can be easily accessed by the owner of the collection, still some challenges remain.

Photo management

Another challenge is adding structure and organisation to facilitate (future) use. Currently, this is a laborious process that requires a decision for individual photos to keep or delete, often by comparing them with similar photos. Managing is considered to be a chore, part of curation that people feel they need to do but for which they do not take the time because it requires work (examples include Frohlich et al., 2002; Kirk et al., 2006; Whittaker, 2013). The increased size of collections plays a role in the effort it takes to manage them, but even if people would be able to

reduce the number of media items in a given collection to 10% of its size (in my case from 70.000 to 7.000 photos), the remaining collection still requires the owner to attend to all three challenges.

Photo use

The third challenge is how to use curated photos, or what the purpose is of photo curation. To compare: museum curators make exhibitions using a sub-set of the material that is available to the museum, usually covering a specific theme or targeting a specific audience. In our case, we are specifically interested in photo curation with the goal to support shared remembering. Some research prototypes deliberately support shared remembering. Examples include the work on photo displays by Durrant et al. (2008, 2009) and by Taylor, Swan & Durrant, 2007; *Living Memory Box* by Stevens, Abowd, Truong, & Vollmer (2003), and *The Family Archive* device by Kirk et al. (2010), see Chapter 2 for examples. However, research into photo browsing typically approaches photo collections as databases rather than cues for remembering, thereby ignoring activities such as shared reminiscing and storytelling, and instead focusing on media retrieval tasks. However, from the perspective of photos as memory cues, the experience of remembering might even be more important than accuracy of retrieval.

1.3. RESEARCH QUESTIONS & SCOPE

The primary focus of this thesis is on the last challenge, concerning the use of curated photos to support shared remembering. With that in mind, there are three research questions that this thesis addresses:

1. **What kind of tools and practices exist around personal photos?**
2. **What do people want to do with their photos to support collocated shared remembering?**
3. **What kind of curation tools can support the use of photos during collocated shared remembering?**

This work aims to offer a better understanding of current and desired practices concerning the use of photos to support collocated shared remembering. The work described in this thesis builds on related work from several fields of research. Within *Human-Computer Interaction (HCI)* research, researchers have investigated interactive systems to support photo handling and organising (e.g. Frohlich et al., 2002; Kirk et al., 2006; K. Rodden & Wood, 2003; Whittaker, 2013). Related prior work concerning, e.g. collocated and remote interaction, collaboration technologies and design for groups comes mainly from research into the HCI-related field of *Computer-Supported Cooperative Work (CSCW)* (e.g. Crabtree, Rodden, & Mariani, 2004; Erickson & Kellogg, 2000; Lundgren, Fischer, Reeves, & Torgersson, 2015). Lastly, the psychological foundation of

this research comes from both HCI and *cognitive psychology* looking at the mechanisms and functions of remembering, and the role (interacting with) memory cues play in mediating remembering (e.g. Bluck, 2003; Conway & Pleydell-Pearce, 2000; Guenther, 1998; Tulving, 2007; van den Hoven & Eggen, 2014).

This thesis contributes a new perspective on design for photo curation, specifically focused on collocated shared remembering practices. The intended audience of this work is designers of interactive technology for the domestic environment and HCI practitioners (e.g. software architects, usability engineers, software developers), working in the field of multi-user interaction, digital media or personal information management. Next to interaction designers, this work is intended for HCI researchers interested in design for remembering, reciprocal exchange, everyday life, or design for user experience. This thesis could also be relevant for cognitive psychology researchers working on extended cognition and the influence of (media) objects on (impaired) memory; sociology and philosophy researchers interested in evolving social practices and influence of technology on these practices; media history researchers interested in an overview of current media technology and the (desired) practices that evolve around them.

1.4. APPROACH

> "Most of us agree that the practice of making is a route to discovery, and that the synthetic nature of design allows for richer and more situated understandings than those produced through more analytic means." - Gaver (2012 p. 942)

Being educated as a designer of interactive products, I tend to look at problems as design challenges that can be solved with technological innovations that result from a process of design thinking. The setup and execution of the research described in this thesis reflects that tendency, with the ultimate aim to make the work relevant for both design practitioners and academic researchers.

The approach of our research is in line with what Fallman (2003) defined as *design-oriented research*, also referred to as *research-through-design*, or more general as *design research* (for example, see Stappers & Giaccardi, 2017; Zimmerman, Forlizzi, & Evenson, 2007). Design research within the design practice community typically means field research or market research with the aim to gain consumer insights to inform the development of commercial products and services. Within the design research community, design research is not focused on product development, but has the production of knowledge as the main contribution of the research process (Fallman, 2003; Zimmerman et al., 2007). However, the kind of knowledge that comes from design-oriented research could in most cases not have been gathered without the use of designed probes or artefacts (Fallman, 2003).

Our design research approach shares its underlying philosophical orientation with *pragmatism*, as outlined in a recent article by Dalsgaard (2014). In his work, Dalsgaard summarises that the field of design research is not as well articulated as many other paradigms, and that the design discourse and practice can benefit from using concepts from pragmatism, especially because of the reciprocal relationship between theory and practice that pragmatism describes. Analogue to design research, pragmatism poses that theories come from practice, but theories (and interventions based on those theories) also shape practices (Dalsgaard, 2014). Moreover, pragmatism is useful for design research as a paradigm of inquiry because it perceives all human activity as *situated*, and observing emerging practices and interactions between people and their environment is therefore essential to understanding the challenges and testing design solutions (Dalsgaard, 2014).

Design research does not study phenomena in isolation but studies a combination of a number of phenomena, which can be referred to as *wicked problems* (Rittel & Webber, 1973). As proposed by Rittel and Webber (1973), some of the characteristics of a wicked problem are that 1) the problem can only be fully understood by thinking about possible solutions ahead of time; the problem cannot be defined until a solution is found; 2) there is no final (re)solution to problems that are wicked; 3) because of the complex and connected nature there is no ultimate test of the solution to a wicked problem; 4) there are no criteria that can prove that all possible solutions to a wicked problem are explored; 5) all wicked problems are unique; 6) wicked problems are symptoms of higher level problems, which might be too broad to tackle.

Design adds a holistic approach to addressing these under-constrained problems (Zimmerman et al., 2007). Within the process of design research, design is used for user interventions, inquiries and evaluations, to test assumptions, formulate guidelines for design and to inform theory. The outcome of this process can also be artefacts as vehicles for embodying a preferred state, and can contribute to both research and practice communities (Zimmerman et al., 2007). These designs, even if they are presented as the result of the process, are not commercially viable products, but can be referred to as *physical hypotheses* (Koskinen, Zimmerman, Binder, Redstrom, & Wensveen, 2011): examples of the temporary vision and used to embody the current understanding. Zimmerman et al. (2007) call them *design exemplars,* research artefacts that make it easier to transfer knowledge from researchers to practitioners. To address the research questions in this thesis and to also contribute to the curation challenges formulated in the previous sections, we followed the design research process that Zimmerman et al. (2007) described, which can be found in Figure 1.2.

The knowledge that comes from design research depends on the process and focus. Fallman (2003) stated that design-oriented research should have *truth* or *knowledge* as its main contribution. We identify with the view of Höök & Löwgren (2012), who call the knowledge that can result from a design research process *generative intermediate design knowledge,* which is more

abstracted than particular instances yet does not aspire to the generality of a theory. Instead, the knowledge plays a direct role in the creation of new ideas.

Using the model in Figure 1.2 of Zimmerman et al. (2007), design researchers can integrate models and theories from behavioural scientists with the technical opportunities demonstrated by engineers, and ground their explorations in knowledge produced by anthropologists. Design researchers produce precise problem framing, requirements for desired solutions and example artefacts embodying a preferred state. They arrive at these results through design thinking: applying design processes to reframe the problem and to iteratively ideate potential solutions (Zimmerman et al., 2007).

The first motivation to follow a design research approach is that the research into photo curation is a wicked problem (Rittel & Webber, 1973), because of its complexity and embedding within social practices. Following the first characteristic of wicked problems that we described previously, we determined with our approach that the design of new tools could help us understand and solve the problems around photo curation. With design skills as an addition to the research methods and processes, we can, for example, address under-constrained problems, identify opportunities for new technological innovations, integrate ideas from art, design, science and engineering, bring empathy for user needs and desires into the process, through reframing to help identify gaps in current behavioural knowledge, and create artefacts that demonstrate gained knowledge and novel opportunities (Zimmerman et al., 2007).

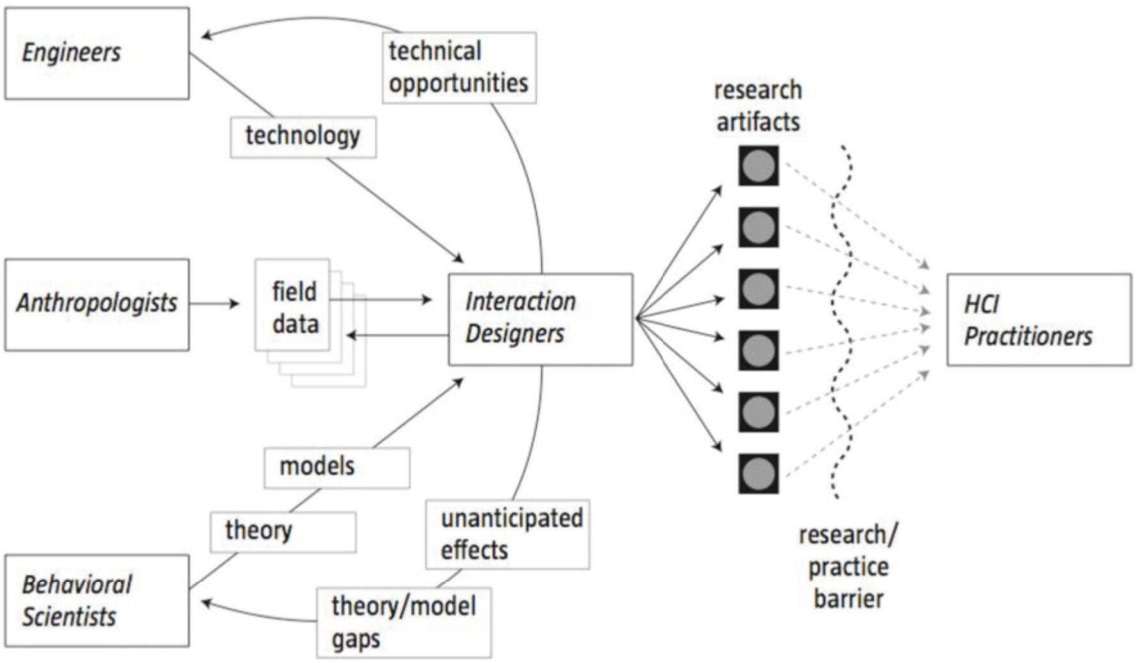

Figure 1.2: Visual interpretation of the process of design research as presented by Zimmerman et al. (2007), with interaction designers borrowing and contributing to knowledge in various related fields, and producing design artefacts as vehicles to translate the knowledge between researchers and design practitioners.

We chose to follow the process described by Zimmerman et al. because in our research, we did not only want to address the research challenges that surround photo curation, but we also wanted to engage in an iterative design process to design a curation tool to support the use of photos for collocated shared remembering. In the process of Zimmerman et al. (2007), the design researcher works similar to design practitioners and can apply its design skills to address under-constrained and wicked problems.

Moreover, this design research project aimed at informing design that supports photo practices around shared remembering. Earlier this chapter, we have described the role of (photographic) cues in the process of autobiographical memory reconstruction. Direct manipulation of the experience of remembering is not possible, similar to designing for the *user experience* (UX): designers cannot design the experience someone has while interacting with a product, they can only design *for* the desired user experience and evaluate the effect of their design choices afterwards (Hassenzahl & Tractinsky, 2006). The design research approach enables us to use our skills as designers to manipulate external influences, such as interaction with cues for remembering, or orchestrate memory sharing using interactive systems. Design research methods allow us to study the effects of our design interventions on humans interacting with them and with each other.

Another motivation for the process of Zimmerman et al. was because of the anticipated exchange between academic research and design practice. The gap between academic researchers and practitioners, in Figure 1.2 illustrated by the *research/practice barrier,* requires some form of translation between research knowledge and design practice. Our interest in and critique of commercial tools for digital photography (see Chapter 2) obligates us also to address designers of commercial solutions with our research. In the process of Zimmerman et al., the designed artefacts play a role not only in advancing knowledge in the related research fields, but they are also aimed at informing design for the interaction design and HCI practice (Zimmerman et al., 2007).

This section so far has only described the approach of this thesis as a whole. For each of the studies presented in the chapters 2-6, we used a mix of methods that are commonly used in design research. The first part of Research Question 1, concerning existing tools, will be answered by design ethnography, which included a review of developments in the consumer electronics industry and a literature survey of related research prototypes (Chapter 2). The second part of Research Question 1, concerning existing practices, will be addressed with contextual interviews in the homes of participants (Chapter 3). Research Question 2, concerning desired usage of photos to support remembering will be answered by ethnography (Chapter 3) and research-through design (Zimmerman et al., 2007), which included the development of (early) prototypes and evaluations which led to knowledge about what is desired around photo sharing (Chapter 5 and 6). Research Question 3, concerning the tools needed to support the desired use of photos,

will be partly answered by generative techniques in a co-design session that explored what people need by studying what they make (Sanders & Stappers, 2008), which led to requirements for design (Chapter 4). Moreover, concept development and evaluation generated knowledge about the design process (Chapter 5). Lastly, through *design-driven research* (Stolterman & Wiberg, 2010) we manifested our current understanding of the tools that are needed in a designed artefact and evaluated the artefact and its use in a lab study (Chapter 6).

1.4.1. Project Context

This PhD project was funded by a 6-year STW VIDI grant, number 016.128.303, of *The Netherlands Organization for Scientific Research (NWO)*, awarded to prof. dr. Elise van den Hoven MTD. Soon after the start, this PhD project became part of a larger research program titled *Materialising Memories*[10]. The overarching goal of the research program was to use design-research to improve reliving of personal memories. The project started as a collaboration between Eindhoven University of Technology (TU/e) and University of Technology Sydney (UTS), which expanded to more partners in the years after. During the project, there was a close collaboration between the first PhD students within the program located at UTS (Doménique van Gennip and Annemarie Zijlema) and located at TU/e (Ine Mols and myself), and with our supervisors prof. dr. Elise van den Hoven MTD, prof. dr. Panos Markopoulos and prof. dr. ir. Berry Eggen. The PhD students held weekly meetings to discuss their research topics, study setup and design ideas. The larger team met regularly to discuss shared publications, goals of the research program and to engage in workshops organised around a topic relevant to the theme of everyday remembering.

This thesis also makes use of the knowledge gained from those workshops, discussions and collaborations. If a chapter is based on work done with others, this is indicated at the start of the chapter in a footnote.

1.5. ETHICAL CONSIDERATIONS

As part of this research, it was necessary to involve people to participate in studies about media supported remembering. During the studies, it was possible that participants were asked to answer questions that were about personal events, or that they were reminded of personal events when participating. There was also a chance that participants experienced emotional impact, or that they might have been embarrassed about personal things that they did not want to share with the researcher. These risks were no bigger than in their everyday life. However, to cope with these risks, it was made very clear that the participants were always in charge of what they wanted to share, what stories they wanted to tell and what personal material they wanted to show. It was clear for the participants that none of the material that they showed would be published in any way without their explicit consent, and that they would not be identifiable in publications.

[10] www.materialisingmemories.com, retrieved August 24, 2018

Besides interview studies and observational studies, we also involved participants in co-designing concepts for photo curation. There was a chance that the creative nature of the co-design session would make the participants shy or embarrassed to share their opinion out loud, or even be made uncomfortable by the contribution or remarks from others. One way to cope with these specific risks was the selection of participants that knew each other well. Moreover, before and during the meeting we mediated the conversations in such a way that it was clear to all participants that everyone was equal, that there were no wrong concepts or wrong opinions, and that all conversations in a creative process should be without condemnation.

The studies in which participants were asked to use prototypes required a more elaborate assessment of the ethical issues, also concerning the safety when working with prototypes. To make sure that there would be no additional risks, we made use of commercially available, battery-powered (max. 9v) technology in our prototypes, and if there were any additional risks from the use of electronic components, those were assessed by an expert from the Department of Industrial Design, TU/e.

Our studies did not involve deceit. However, some studies required limited disclosure to the participants before the study. At the start of the session they were briefed in general terms about the aim of the research and partially briefed about the aims specific to our research questions, especially concerning, e.g. user needs. In those cases, prior knowledge of the researcher's interest could have influenced the participants and limit them in expressing their (un)satisfied needs and (un)met goals. All participants were fully briefed after the sessions about all the research objectives, and the bigger objective of the overarching *Materialising Memories* research program.

The UTS Human Research Ethics Committee (HREC) assessed all the study proposals for this research. The project leader of the *Materialising Memories* project (prof. dr. Elise van den Hoven MTD) was granted program approval (filed under HREC 2012000570 and renewed under HREC 2015000629). For each study that was part of or related to this thesis, we filed for an amendment to the program approval. In the course of this PhD research, we filed, on behalf of myself or my students, for ten ethics approvals, ranging from interview studies with adults to prototype evaluations with under-aged children, which were all granted. Three of these studies are described in this thesis, in Chapters 3, 4 and 6.

1.6. THESIS OUTLINE

This thesis is set up as a description of a design research process, using scientific methods to build an understanding of the challenges and the opportunities to design interactive photo curation tools to support collocated shared remembering. **Chapter 2 provides a review of commercial and experimental tools for photo curation** with solutions for photo capturing, sharing, storing, organising and use. **Chapter 3 presents a model of current photo practices**,

which we identified through contextual interviews in the home environment. **Chapter 4 identifies design opportunities** for mediated shared remembering, which were developed by analysing a co-design workshop. **Chapter 5 addresses how to design for reciprocal interaction**, which we illustrate with several concepts that support reciprocal interaction. **Chapter 6 describes the design and evaluation of the Curation Arena**, a concept for collocated photo sharing that was developed to explore our approach to photo curation within a social context, which we termed *Curation-in-Action*. Finally, **Chapter 7 discusses the contributions** and reflects on the research as a whole.

Every chapter will conclude with a summary of its contributions, and in between brackets, e.g. **[RQ.1]**, the contributions are matched to the research question that they address.

1.7. CONCLUSIONS

In this chapter, we have introduced the topic of the thesis and the motivation for this research. We outlined the methodology our design-oriented research and formulated design challenges and research questions that will be addressed in this thesis. Finally, we have provided a short outline of the chapters in this thesis. In the next chapter, we present a review of design examples from research and design practice.

CHAPTER 2.
REVIEW OF TOOLS FOR PHOTO CURATION

Chapter Summary

In the previous chapter, we introduced the focus of this thesis on photo curation to support collocated shared remembering. We outlined our design research approach and formulated design challenges and research questions that this thesis addresses. In this chapter, we present a review of concepts from research projects as well as commercial design solutions that either capture, store, manage or otherwise use digital photos. The review marks a point in the ever-progressing technological context, deliberately dating this thesis. Moreover, our review illustrates that current commercial tools are often supporting photo capturing and remote sharing on social media platforms using mobile devices, while little development is geared towards interactive solutions for collocated sharing. In Human-Computer Interaction research projects, we find more examples of collocated photo sharing that can inspire our research.[1]

[1] The first iteration of the design solution review was a team effort within the *Materialising Memories* team in Sydney, November 2013. Together with fellow PhD students Ine Mols, Annemarie Zijlema and Doménique van Gennip I gathered examples, described them and printed them on small cards. We then clustered them together with prof. dr. ir. Berry Eggen and prof. dr. David Frohlich. In the course of the project, the team kept a shared online folder (using *Evernote*) where we continuously added design examples from research and industry. This chapter made use of that shared resource, however the text and structure of the chapter was written by me, in consultation with my supervisors. The use of "we" in this chapter refers therefore to myself and my supervisors.

2.1. INTRODUCTION

The next section provides an overview of the commercial offerings for supporting digital photography and related concepts that appeared in the academic literature. Because technological offerings are changing so rapidly, we think it is important to provide the technological context of the years 2013~2017 in which our insights have been gained, and to provide a benchmark to which our design contributions can be measured.

2.2. A REVIEW OF COMMERCIAL AND EXPERIMENTAL TOOLS

We want to provide an overview of efforts in academic and commercial design, to understand the kind of solutions that exist commercially, and the directions that researchers have already looked into. In this section, we first present a selection of tools that support photo *capturing*, then we describe relevant *social media platforms* – which can be considered as a collection of photo curation tools – followed by an overview of what was referred to as *PhotoWare* by Frohlich et al. (2002): offerings to support the storage, sending and sharing of photos. We have structured the PhotoWare in the same way as the challenges presented in Chapter 1, starting with tools for photo *storage*, then tools to *manage* photo collections, and lastly, tools to support photo *use*.[2]

2.2.1. Tools for Photo Capturing

Digital cameras

Even though the focus of this thesis is on photo curation, we would like to start this overview by briefly mentioning the tools that are offered for *capturing* digital photos, because their rapid evolution has led to the current situation regarding curation and the abundance of digital photos. There are many different kinds of Digital Single Lens Reflex (DSLR) cameras available, such as the Canon *EOS Rebel XT*[3]. DSLR cameras offer interchangeable lenses and many advanced capturing preferences. The different models from dozens of brands can serve all photographers, from serious home photo enthusiast to professionals. For those looking for a simpler device to operate there are digital compact cameras on the market, also referred to as point-and-shoot cameras because of the ease of operation, such as the Canon *DIGITAL IXUS 80 IS*[4]. They are small and easy to carry around, but they also have smaller lenses and fewer configuration options. A category of cameras that sit in between DSLR and compact cameras are the Mirrorless Interchangeable Lens Camera (MILC, or ILC), such as the Sony *NEX-3N*[5]. An ILC does not use mirrors to relay the image to the photographer as the DSLR does. Instead, an electronic viewfinder

[2] Note that I have been a *participant-observer* during this research, using many of the tools described in the next sections myself extensively, and drawing from personal experience when describing them.
[3] en.wikipedia.org/wiki/Canon_EOS_350D retrieved October 3, 2017.
Released in February 2005, superseded in August 2006
[4] en.wikipedia.org/wiki/Canon_Digital_IXUS, retrieved October 3, 2017.
Released in January 2008, superseded in February 2009
[5] http://www.sony.co.uk/electronics/interchangeable-lens-cameras/nex-3n,
retrieved via the web.archive.org, version: July 17, 2015

displays the image received by the sensor. The cameras are easier to carry around and still offer interchangeable lenses and high-quality image sensors. While DSLR and ILC devices are still gaining popularity as the technology progresses, the biggest competition for the compact camera started in 2006 with the introduction of the *iPhone* by Apple, the first model smartphone with a high-quality display and a "soft keyboard" that appears on the screen when needed. Especially the development in the quality of the displays and the camera lenses have made most high-end smartphones, such as Apple's fifth-generation *iPhone 4s*[6] with its 8-megapixel camera and large screen for instant photo viewing, a worthy alternative for the compact camera. The added benefit of a smartphone, when looked at as a camera, is that it can be connected via the mobile Internet to cloud storages where photos can be uploaded as a backup, and to social media platforms where the photo can be directly shared. It is no wonder that online photo platform *Flickr* shows in their online statistics that there are currently more photos being uploaded with iPhones than there are with Canon devices.[7]

Figure 2.1: Photo capturing devices f.l.t.r. Canon Digital Rebel XT; Canon IXUS 80 IS (source for both: www.canon.com); Sony NEX-3N (source: www.sony.co.uk); Apple iPhone 4S (source: support.apple.com/HT201296)

Lifelogging devices

Since the introduction of digital capturing devices such as the ones described above, the accumulation of photos has become easier. One of the trends that have tried to push the boundaries of personal data collection is lifelogging, which extends beyond capturing photos to automatically capturing all possible data concerning the individual or the environment, with researchers such as Bell and Gemmell who aim at total recall where everything can be recorded (Gemmell, Bell, & Lueder, 2006). However, echoing researchers such as Sellen & Whittaker (2010), one can wonder what the practical purpose is of collecting all this personal data. They base their critique on their research with the Microsoft *SenseCam* (Hodges et al., 2006; Sellen & Whittaker, 2010; Sellen et al., 2007), one of the earliest wearable lifelogging cameras created for research purposes. A commercial example of a *SenseCam* equivalent is called *Narrative*[8]*,* a wearable camera (the Clip) with an accompanying smartphone app that logs the wearer's life and intelligently

[6] support.apple.com/HT201296, retrieved October 3, 2017.
Released in October 2011, superseded in September 2012
[7] Combined total of photos taken with any of the 27 iPhone models compared to the combined total of photos taken with any of the 262 models of Canon DSLR, ILC, compact cameras and video cameras.
Via www.flickr.com/cameras, retrieved October 4, 2017.
[8] www.getnarrative.com, retrieved May 22, 2017

breaks up the days into 20-30 events, which can be browsed via the app on the smartphone. The Narrative Clip is always on and takes a photo automatically every 30 seconds. The lifelogging trend has some implications for media curation, which is apparent just by calculating the amount of data that come from a single capturing device such as Narrative. Without intelligent algorithms that help people to curate and prioritise the data it would be somewhat impractical: scrolling through previous events and reminisce seems similar to what people do with holiday albums, but when a particularly active day of 16 hours is captured with a frequency of 1 photo every 30 seconds, it will result in 1920 photos, which would take an estimated 64 minutes to look back at.

Figure 2.2: Lifelogging devices. Microsoft SenseCam (Sellen & Whittaker, 2010) (left); *Narrative* (right, source: www.getnarrative.com)

Photography innovations

Some cameras attempt to innovate the way we make photos, by offering more playful or more experimental capturing or resulting photos. One of the features that are currently gaining popularity on the smartphones is the creation of moving photos such as *Live Photos* within Apple's mobile operating system *iOS*[9], or Microsoft *Pix*[10]. Moving photos are not to be confused with videos, because the clips are very short and without sound, intended to give just a little bit more context to a photo, for example moving waves in the background or hair blowing in the wind. The increased hardware performance of smartphones opens up possibilities that require more complex calculation at the time of capturing and more graphical power when viewing the photos.

Figure 2.3: Playful capturing. Dual Shot on the Samsung Galaxy S4 inserts a selfie into a group photo (left, source: www.samsung.com); Behind the Camera (Güldenpfennig, Reitberger, & Fitzpatrick, 2012) captures two photos at once (B and F), which are printed on two-sided cards to allow for a memory-like card game (right).

[9] www.apple.com/ios/photos/, retrieved October 4, 2017
[10] www.microsoft.com/en-us/research/product/microsoftpix/, retrieved October 5, 2017

A playful capturing feature called *Dual Shot*[11] was included in the Samsung *Galaxy S4* smartphone software. The dual shot mode allows the person who is taking the picture to insert themselves into the photo, sometimes with a comic effect, creating a picture-in-picture result. This playful feature (part of the "#fun" part of the product website) was targeted at the teenage market.

Dual Shot shows similarities to a concept from research called *Behind the Camera* (Güldenpfennig et al., 2012). The concept also uses both the front facing and the rear camera on a smartphone to capture photos from two sides simultaneously. The resulting sets of photos can be viewed as double-sided prints, or as sets for a memory-like matchmaking game. Where commercially available applications for digital photography typically lack a direct connection between means of capturing and means of use, *Behind the Camera* shows an interesting direction for playful use, connected to the playful capturing interaction.

Figure 2.4: Context Photography (Hakansson, Gaye, Ljungblad, & Holmquist, 2006), with the moment of capturing on the left and the resulting photo on the right

An experimental example of photography innovation is the project Context Photography (Hakansson et al., 2006), which allowed participants to capture photos that are visually influenced by contextual factors, such as sounds and movement. The evaluation shows how the interaction influences the way people experience photo capturing. Although the use of these more abstract photos might also differ from traditional photos, the concept did not include an evaluation of that aspect, possibly because viewing was done using the traditional screen-based interaction with the photos.

[11] www.samsung.com/global/microsite/galaxys4/fun.html#page=dualshot, retrieved via the web.archive.org, version January 12, 2016; product released in March 2013, superseded in February 2014

Figure 2.5: Example 360° photo from Ricoh Theta V (left, source: *Swing*, by Philip Bloom, United Kingdom from theta360.com/uk/gallery/); Microsoft Hololens (right, source: www.microsoft.com)

One example that aligns the media that comes from the capturing device and with the opportunities of experiencing the media can be found in the Ricoh *Theta V*[12], an (action) camera that captured 360° photos with a spatial audio file. If paired with a Virtual Reality viewer, such as the as Microsoft's *HoloLens*[13], with headphones and head tracking function to link the 360° photos, viewers get a 360° visual and audio experience for a you-are-there feeling which is similar to the moment of capturing.

We see two trends in current media technology that might influence the lack of connection between the means of photo capturing and the means of use. The first trend is a general over-presence of technologies that offer media capturing, but that do not specifically address to what purpose the media is captured and thus what should be done with them. The second trend is that tools intended to support photo use often fail to address what kind of photos should be captured to best support the desired viewing experience (we will show examples in the next sections). There are some exceptions, e.g. the *Theta V* paired with the *HoloLens*, but the exceptions are typically not developed by the same companies because most companies also need to focus on specific markets. For example, Canon has a strong presence in both digital cameras and colour printing solutions, thus appear to address both photo capturing and photo use. However, with the digitisation of photo use, other tools than printers might be desired.

2.2.2. Social Media Platforms

One of the first things that come to mind when talking about digital photo use is social media platforms. Social media platforms can be considered a collection of tools, including, e.g. storage, organising, sharing, annotating and storytelling features. In this section, we will briefly describe the major social media platforms that can be used for sharing photos. *Facebook*[14] is by far the

[12] theta360.com, retrieved October 4, 2017
[13] www.microsoft.com/microsoft-hololens/, retrieved October 4, 2017
[14] newsroom.fb.com/products/, retrieved October 6, 2017

most popular social network with over 2 billion active users since the start in 2014.[15] The platform is used for exchanging online information with friends (e.g. personal update, chats, news, events, photos, videos, etc.). As a photo sharing platform, it has been popular with more than 350 million photos uploaded to their servers every day.[14]

Instagram[16], founded in 2010, in October 2012 bought by *Facebook*, is an online photo sharing, video sharing and social networking service that enables users to take photos and videos, edit them by applying digital filters (to, e.g. alter the colours), and share them on a variety of social networking platforms, including Instagram's own website. At the time of writing, the service has over 700 million active users.[15]

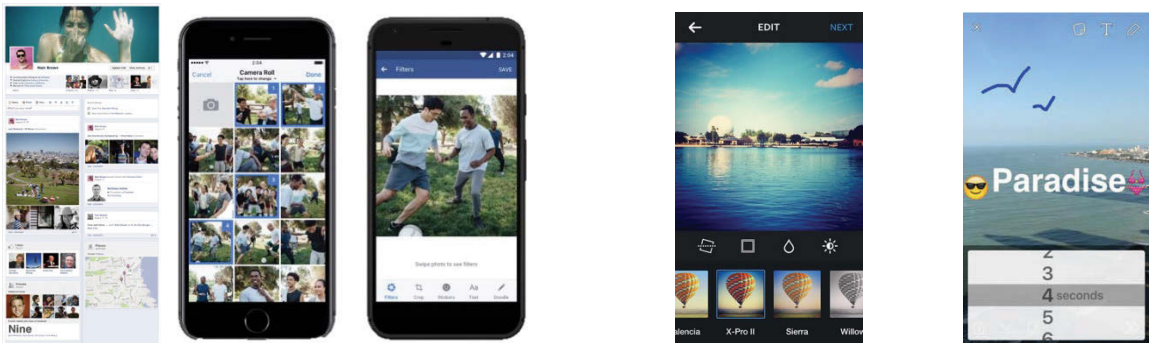

Figure 2.6: Social media platforms. f.l.t.r.: Facebook Timeline; Facebook camera roll on mobile device; Facebook photo viewer on mobile device (source: newsroom.fb.com); Instagram photo editing with filters (source: www.instagram.com); Snapchat short-term sharing of annotated photos (source: www.snapchat.com)

More recently, *Snapchat*[17] launched its platform, a playful chat-app based around photos, with currently 255 million active users. Photos are sent to one or multiple friends but not saved and can only be viewed for a few seconds, also eliminating the need to curate the received media. The premise of the app is a sense of privacy and pureness. As stated on their website: "the image might be a little grainy, and you may not look your best, but that's the point. It's about the moment, a connection between friends, and not just a pretty picture". It was arguably also developed in reaction to Facebook, which is often used as a platform for self-presentation and identity formation (Hogan, 2010; Mendelson & Papacharissi, 2010) where many users try to present the best possible versions of themselves online.

Whatsapp[18], with 1,2 billion active users one of the most popular instant messaging apps, also owned by Facebook as of February 2014. Users can chat with contacts from their address books, but the most innovative feature that makes most users abandon texting (SMS) is the ability to create group chats easily. These can be temporary (e.g. for a dinner party) or long-term, addressing different social groups such as family, flatmates, high-school friends. Photos can be

[15] www.statista.com/statistics/272014/global-social-networks-ranked-by-number-of-users/, retrieved October 4, 2017
[16] www.instagram.com, retrieved August 28, 2017
[17] www.snapchat.com, retrieved October 3, 2017
[18] www.whatsapp.com, retrieved April 29, 2017

sent to a group or an individual. Other popular instant messaging platforms are *Facebook Messenger,* with similar features as *Whatsapp* and also 1,2 billion active users, and *Telegram*[19], with only 100 million active users a smaller part of the market, and is targeted at users who do not want to buy into the big corporations to be able to communicate with each other. The benefit for users of Telegram is that, unlike *Whatsapp*, all the content that is sent and received is stored online, so the phone's storage space does not get filled with photos and videos.

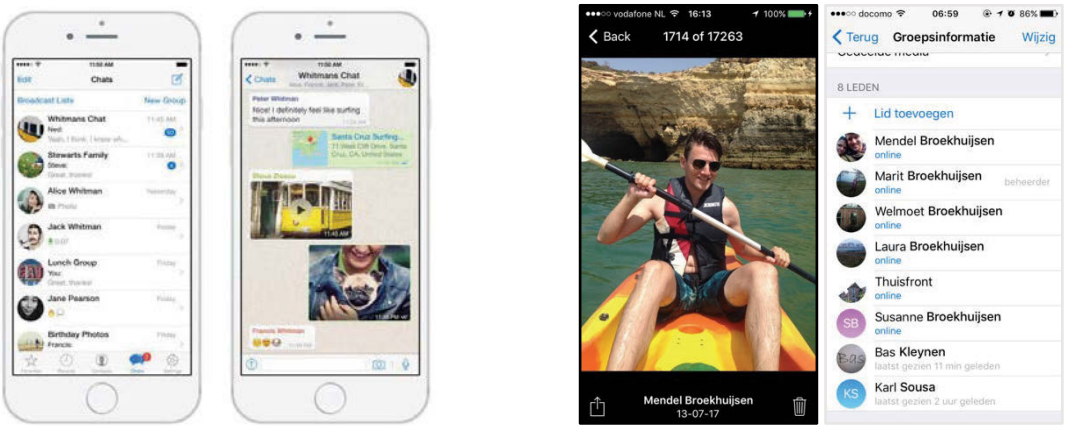

Figure 2.7: Instant Messaging platforms, which are often used for photo sharing. f.l.t.r.: Whatsapp list with group chats and individual chats; Whatsapp chat with photo sharing (source: www.whatsapp.com); Event photo shared via Telegram; All family members are online in the Telegram family chat (source: Telegram Messenger iOS app)

The worldwide adoption of mobile Internet-connected smartphones with good quality cameras provided the opportunity for social media platforms such as the ones described here to emerge, with the power to bring people closer together who would otherwise not have been able to share experiences, stories and especially photos, both in good and bad times. The ability of *Telegram*, as an example, to enable social engagement with remote family members via long-term group chats is captured in two screenshots from personal experience: second from the right shows a screenshot of one of the 17.263 media items that were shared among my family members between January 2015 and September 2017 (average over 520 per month, 17 per day). Photos such as these are also referred to as *event photos* (Vyas, Nijholt, & Veer, 2013). On the right, a screenshot of a particular event where one of my sisters was in the hospital, and even though at that time we were distributed over four different countries, with up to ten-hour time difference, the whole family managed to be online to support her. Through sharing photos and events, everyone stays up to date and continues to learn about each other's lives, which is valuable for a sense of connectedness.

2.2.3. Tools for Photo Storage

We will continue with the hardware that is used for digital photography, referred to as *Photoware* by Frohlich et al. (2002). With the photo capturing tools described before, people can create vast

[19] telegram.org, retrieved September 20, 2017

quantities of media, almost without having to worry about storing them because the options for storing have become more affordable.

Internal storage

Internal storage refers to storage built into desktop computers, laptops and mobile devices. The popular internal storage solution of a 128 gigabyte (GB) Solid-State Drive (SSD) now retails between $38 (US) and about $49, and a 250GB SSD, such as Western Digital's *WD Green PC SSD*[20] between $52 and $81[21]. The price difference between a 128GB SSD, and 500GB Hard-Disk Drive (HDD), such as the Western Digital *WD Black*[22], was expected to shrink to less than $3 in 2016[23]. SSDs are more reliable because they changed from moving elements (found in a HHD) to a chip-only configuration but for the same storage capacity SSDs are 4 times the price of HHDs.

Figure 2.8: Internal hard drives. Western Digital WD Black (left); Western Digital WD Green PC SSD (right) (source: www.wdc.com)

Moreover, the storage space available on an entry-level smartphone is typically 8 GB, which, compared to the 3,5-inch HD floppy disk with 1,44 megabyte (MB) of storage introduced in 1986 sounds like a massive increase. However, the storage increase is relative as those smartphones have operating systems that sometimes take up half the space, most apps that are installed by default on the system also weigh heavily on storage space and every photo that is taken with a 12-megapixel camera is also of considerable size. Therefore, especially people on a budget such as teenagers have constant storage shortage on their mobile devices and are forced to remove applications and to curate photos to free up space (Zürn et al., 2017). With 22-megapixel DSLR cameras, the photo files are even larger, easily reaching 6,5MB per photo in compressed (JPEG) format and even 66MB for uncompressed (RAW) format photos.[24] In Figure 2.9, the number of photos that can be stored on typical storage sizes is plotted for 8, 12, and 22-megapixel JPEG formats. It is clear in these graphs that the number of photos that can be stored on a common hard drive is increasing, even if the files themselves are much larger than before.

[20] www.wdc.com/products/solid-state-drives/wd-green-ssd.html, retrieved October 5, 2017
[21] www.computerworld.com/article/3040694/data-storage/ssd-prices-plummet-again-close-in-on-hdds.html, retrieved October 5, 2017
[22] www.wdc.com/products/internal-storage/wd-black-desktop.html, retrieved October 5, 2017
[23] press.trendforce.com/press/20160303-2359.html, retrieved October 5, 2017
[24] kb.sandisk.com/app/answers/detail/a_id/69/~/number-of-pictures-that-can-be-stored-on-a-memory-device, retrieved January 12, 2018

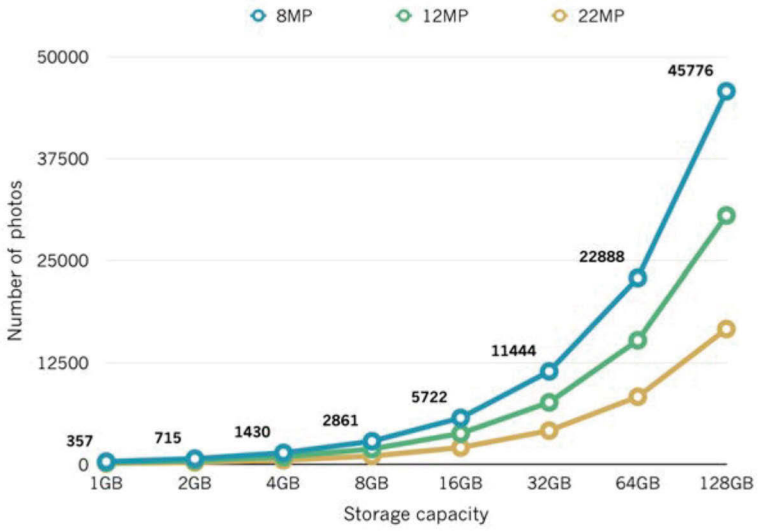

Figure 2.9: Number of photos (y-axis) that can be stored on popular storage sizes (x-axis), plotted for the average JPEG photos sizes from an 8, 12 and 22-megapixel camera (information for the graph via kb.sandisk.com).

External storage

External storage can be described as stand-alone storage solutions that are connected wired or wirelessly to personal devices. These solutions make use of either SSDs or HDDs. A typical example is a mobile hard drive, such as the 500 GB LaCie *Starck Mobile Hard Drive*[25], which is a compact and portable drive that can be directly connected to a pc or laptop and is powered via the USB connection. Larger versions of the same principle are referred to as desktop hard drives, which usually need their own power supply but offer more storage capacity and are used to backup data. A more flexible solution for the home is a Networked Attached Storage (NAS) device, such as the LaCie *Network Space 2*[26], which offers storage of 1 to 6 terabyte (TB) with access to the local network to all devices so that the whole family can add content to the same drive. Most NAS devices offer remote access over Internet, so personal files can also be viewed in a browser, either on a smartphone, tablet or computer.

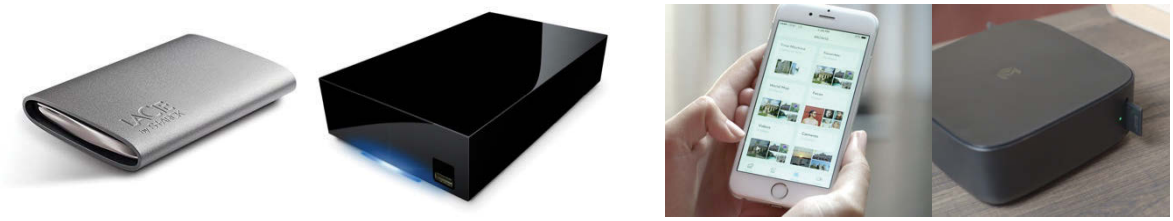

Figure 2.10: External storage, f.l.t.r.: LaCie Starck Mobile Hard Drive; LaCie Network Space (source: www.lacie.com); Monument smartphone app interface; Monument storage device (source: getmonument.com)

[25] www.lacie.com/products/product.htm?id=10447, retrieved via the web.archive.org, version 23 August, 2011. Product discontinued in August, 2011

[26] www.lacie.com/products/product.htm?id=10451, retrieved via the web.archive.org, version May 11, 2013. Product discontinued in May 2013

Specifically developed as a solution for storing photos are devices such as *Monument*[27], which essentially is a NAS but with the added functionality of analysing and organising personal photos. Where the mobile, desktop and NAS solutions are usually just storing the files exactly as they were put onto the drive, *Monument* analyses the photos and organises them based on the content (date, location, event, objects in the photos, etc.). The accompanying app allows users to browse the photos, and every new photo that is taken with the phone is automatically uploaded via the Internet to the *Monument*.

Online storage

To store data without being dependent on hardware that will eventually stop working, files can be stored online, in what is referred to as the cloud. Cloud storage is the same principle as a NAS, with the difference that data is stored on servers in data centres, such as the one owned by Google in the Netherlands[28], with various security and redundancy measures to make sure that the data will always be available. When stored at home, data is less secure. Another reason to store data in one of the cloud services is access to files, photos and videos from anywhere. Remote access to a NAS at home is dependent on the outbound internet connection of the house (upload speed), which is not always capable of processing the data at the required speed. Here we list some of the currently available cloud services for online photo storage.

One of the first services that offered storage for free (5 GB) was *Dropbox*[29], and the service that started in 2007 is mainly used to synchronise all the files from a dedicated folder on a computer to the Dropbox cloud and to maintain shared folders with files from multiple friends or co-workers. With applications for all platforms, Dropbox is very popular, with 500 million users.

A cloud storage that is specifically targeting photographers is Yahoo's *Flickr*[30], which is a cloud storage solution for photos and videos (with 1 TB of free space), but it is also a platform for sharing and showcasing personal photos online. Viewing and browsing the photos can be done on any device within a web browser or using the dedicated app.

Figure 2.11: The "Cloud": storage servers from Google (source: www.alpharailkoker.nl)

[27] getmonument.com, retrieved October 4, 2017
[28] www.alpharailkoker.nl/projects/project-2/, retrieved August 5, 2017
[29] www.dropbox.com, retrieved August 28, 2017
[30] www.flickr.com, retrieved August 28, 2017

Figure 2.12: Online photo storage and management solutions: Apple iCloud Photo Library (left, source: www.apple.com); Google Photos (right, source: photos of UTS buildings, from my personal collection, stored at photos.google.com)

Some of the major technology companies that build both hardware and software offer a hybrid solution, offering a cloud-based storage for all types of files, like *Dropbox*, with an online photo platform, like *Flickr*, with the added content analysis similar to the ones found on *Monument.* Popular examples include Apple's *iCloud*[31] with *iCloud Photo Library*[32] that synchronises the entire library and all the edits between the Apple hardware, and *Google Drive*[33] with *Google Photos*[34] which provides a platform-independent online-only overview of all the photos that are stored on Google's servers. The great benefit of these online solutions for photographers is that the data is safe and the collection enjoys the newest innovations in the fields of image recognition, computer vision, and other photo analysis innovations that are based on machine learning. However, for many people a drawback of these – often free – solutions, is that personal photos from an individual are stored at one of these multi-national companies and that the data is being used at their discretion, adhering to the legislation of the country in which the company is registered.

2.2.4. Tools for Photo Management

Automated management

With the development of computer vision technology there is a growing number of systems that offer automated management and organising of photos in, e.g. smart folders of people, events, and trips; videos based on a selection of photos, collages, enhancements and many more automated features – all based on metadata (e.g. location, data, time, camera settings) and image recognition technology. As mentioned in the previous section, companies like Apple and Google offer these features as long as the data is stored on their servers. The technology is promising, but still in an early stage. Although some aspects are helpful, such as searching for places, objects or people, some of the features are less helpful, because the systems are not yet capable of determining personal relevance with full accuracy, e.g. automated highlights (e.g. Facebook's *Year in Review*[35]), or automated videos with the highlights of a trip (*Google Photos*) can sometimes be

[31] www.apple.com/icloud/, retrieved October 5, 2017
[32] www.apple.com/icloud/photos/, retrieved October 5, 2017
[33] www.google.com/drive/, retrieved October 5, 2017
[34] www.google.com/photos/about/, retrieved October 5, 2017
[35] www.facebook.com/yearinreview, retrieved October 5, 2017

spot on, and sometimes come up with less relevant photos, which makes people unsure why "the system" thought that particular photos were the highlights of the trip, while they thought other photos would have been a better representation of the trip (mentioned by participants from the study described in Chapter 4 of this thesis). Although these examples are usually harmless, there are accounts of, e.g. inappropriately chosen highlights showing tragic events[36], because the automated system behind it was unable to appropriately tailor the content to the audience and the context. Facebook also offers an automated structure, in the form of the *Timeline*[37], an aggregator for online communication and media. It ties actions on Facebook onto a vertical line representing a user's time on Facebook. When given enough data it represents the user's life in chronological order, making it straightforward to scroll through social activity over time.

All the content from a personal Facebook account could also be used to view in a personalised virtual museum, using the website launched as part of a marketing campaign by Intell, called *Museum of Me*[38]. It exhibited the personal life of the viewer using their Facebook profile information. Photos of the profile owner as well as friends' photos were used to create items of interest within the virtual museum environment. It could potentially invite a person to reflect one's digital life on social media by presenting the content in a different, immersive form. However, it also automatically highlights (e.g. by enlarging) certain aspects, consequently leaving other data points out of the overview. Projects like these show potential for alternative content structuring possibilities, but with automation, there is a chance of discrepancy between system preferences and personal preferences, especially when it comes to photo management because of the personal nature of photos.

Figure 2.13: Intell Museum of Me. Example images from www.cravingtech.com/intels-the-museum-of-me.html, retrieved October 5, 2017

[36] meyerweb.com/eric/thoughts/2014/12/24/inadvertent-algorithmic-cruelty/, retrieved October 5, 2017
[37] www.facebook.com, retrieved September 20, 2017
[38] www.museumofme.intell.com, retrieved via the web.archive.org, version February 28, 2014. Service terminated in 2014. Created by Rhizomatics design.rhizomatiks.com/en/works/the_museum_of_me.html, retrieved April 4, 2017

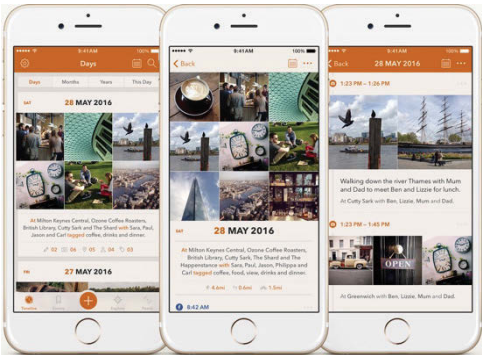

Figure 2.14: Photo diary apps for smartphones. ROOM for thought (left, source: www.roomforthought.nl); Momento (right, source: www.momentoapp.com)

Photo Journals

A variation on automated managing can be found in the various apps that help people keep a photo journal. *ROOM for thought*[39] is a simple example of an app that reminds the user to capture a single photo every day. The unique feature of *ROOM for thought* is that it triggers at a random moment each day to capture that moment in a single photo. It starts a countdown and takes the photo, which cannot be retaken. To edit the photo to be a better representation of the moment, the app includes filters, timestamps, text and location. Photos can be kept private or made public. The app creates a collage of all the photos, and at the end of the year, it offers a service to print all the photos from that year in a small physical album. It offers a well-organised overview of the year without effort from the user. A similar but more elaborate application for keeping a journal is *Momento*[40], a journal app that allows users to capture many different formats throughout the day, whenever they find time to spare. The unique feature of *Momento* is that it imports and archives all the online activity from a wide range of social media platforms (including Flickr, YouTube, Facebook), and includes this in the automated diary that it creates.

Software tools

Commercial software applications for photo management range from complex, professional tools to elementary applications. Complex applications like Adobe *Lightroom*[41] can structure collections and files, but to use the programs it requires skills most people do not have and take time to master. Moreover, most of these organisational tools do not offer an enjoyable way to view the photos while going through the process of organising them, while viewing the content is what motivates people to get organised (Whittaker et al., 2010). Applications such as the mentioned Adobe *Lightroom* have a limited photo viewer that seems to be only fitted to view whether edits to the photo are done satisfactory, or to compare two similar photos. These kind of software suites are not geared towards viewing a photo collection because the viewing options are also focused on collection management tasks. The options for shared viewing are even more complex: the

[39] www.roomforthought.nl, retrieved October 5, 2017
[40] www.momentoapp.com, retrieved October 5, 2017
[41] www.adobe.com/products/photoshop-lightroom.html, retrieved October 5, 2017

default way to show a set of photos in *Lightroom* is to design a slideshow, with options for background music and transitions, followed by an exporting process that takes time. The extra steps that are required make it less likely that people use it, to manage and enjoy looking at their photos at the same time.

More automated systems like Google *Photos* or Apple *iCloud Photo Library* are easy to use but less transparent in the way they operate, with very few options to customise the organisation. These systems do not look at photos as files, but as dynamic data that can appear in different resolutions on different devices, but the downside is that it is unclear where the photos are if they are saved, and what to do if, e.g. photos are missing or a collection becomes corrupt. With traditional file management, the files at least appear to be on the hard drives where they are put on. Examples of easy-to-use organising tools can be found for smartphones, such the app *Tidy*[42], which uses simple gestures to put series of photos in subfolders, or *Slidebox*[43], which uses similar principles to allocate photos to folders. The benefit of these apps is that they can be used on the go, the downside is that they cannot help people manage the photos that are stored outside the phone's local drive or connected cloud services.

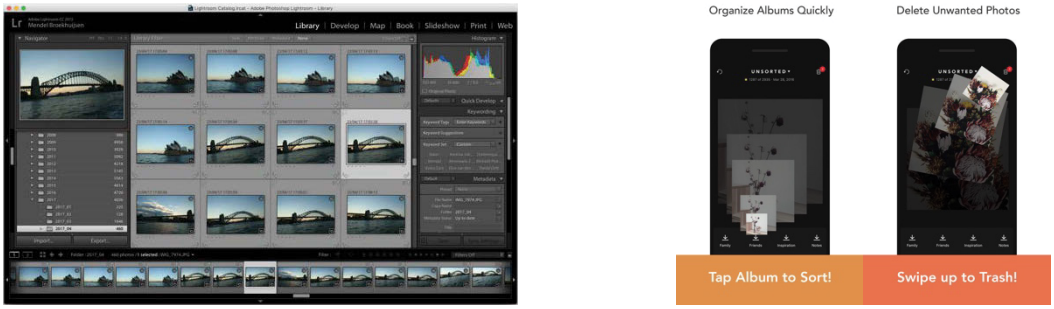

Figure 2.15: Photo management on desktop and laptop computers versus photo management application on smartphones. Adobe Lightroom (left, source: personal content, screenshot from Adobe PhotoShop Lightroom Classic CC 7.0.1 for OSX); Slidebox for smartphones (right, source: itunes.apple.com)

The ease of navigation that can be found in smartphone apps is rarely found in desktop applications, which makes managing photos that are stored on the local hard drives at home, using, e.g. default file management applications like Apple's *Finder*[44], still a time-consuming task. The interaction with files on a desktop or laptop has in general seen very little innovation since the introduction of the graphical user interface. In research, there are some exceptions, for example, the pile metaphor for displaying files in a similar way as paper files on a desk (Mander, Salomon, & Wong, 1992). Another example, more closely related to the practices of deleting unwanted files, can be found in the concept called *GrayArea* (Bergman et al., 2009), which introduces a new kind of deleting of files, called *demoting*, temporary hiding it from view instead

[42] tidyalbum.com/, retrieved via the web.archive.org, version March 4, 2014. Service terminated in June 2015.
[43] slidebox.co, retrieved October 5, 2017
[44] support.apple.com/en-us/HT201732, retrieved October 5, 2017

of throwing it away, using the metaphor of storing physical items in an attic. Projects like these, although not intended for photos only, help us to reflect on the way we interact with digital information. Demoting can be seen as curation in phases because it formalises a process where people do not delete photos right away, but place them in a digital attic for later disposal. Apple's mobile and desktop *Photos* applications are also what can be considered phased curation: *Photos* features a folder that keeps all the deleted photos for 30 days, before permanently deleting them. In that way, Apple implemented a failsafe to revert unwanted deletion, rather than to phase the curation process.

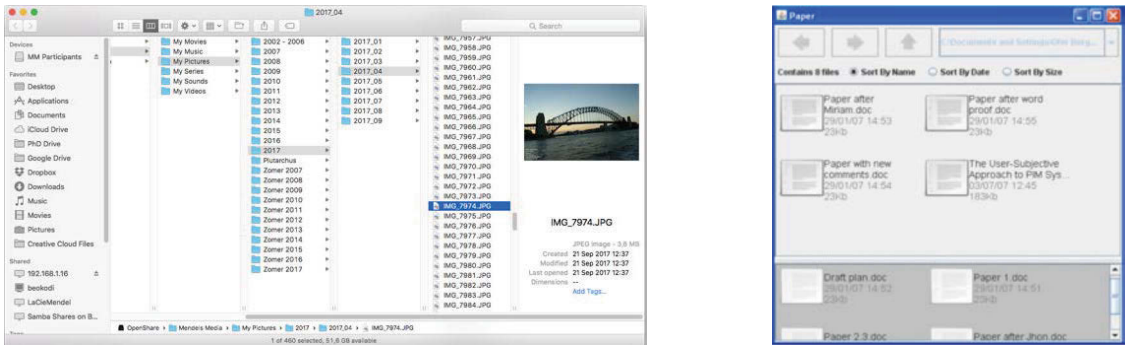

Figure 2.16: File management applications: Apple OSX Finder (left, source: screenshot with personal photo files from Finder in OSX 10.11.6); GrayArea prototype (Bergman et al., 2009) (right)

Management before capturing

Another category of management solutions that we wanted to mention here includes applications and devices that help people with managing content even before the photo is taken. Like the app *Photo File*[45], which asks the user to first pick a category before taking the photo, which could potentially make it afterwards easier to organise. However, it might also confuse the organisation, if certain shots fall into different categories or need to be relabelled afterwards.

Figure 2.17: Tools that limit capturing: Canon compact camera setting that only makes the photo if the person in the frame is smiling (left, source: www.canon.nl); Camera Restricta, a speculative design project that restricts users to take photos at touristy locations (right, source: philippschmitt.com)

[45] Via www.dopaminamob.com.br, retrieved October 5, 2017

Other devices take a different approach: in some compact cameras, there is a feature targeted at snapshot photographers, which detects if the person in the frame is smiling, and only then takes the photo[46], thus limiting the number of overall shots that need organising afterwards. The *Camera Restricta*[47] by designer Philipp Schmitt has taken capturing restrictions one step further. The camera locks its shutter in heavily photographed locations, such as iconic tourist locations. The purpose of the *Camera Restricta* is to document other locations that are less photographed.

We include these examples here to reflect on the curation problem that people face, as mentioned before, because an obvious direction to solve it would be by designing tools that support deleting abundant content. One might argue that the huge quantities of media people own are the reason that they look less at them, but that is just one way to frame the problem. Limiting the amount of media captured to make sure all media is viewed (see also, e.g. Niforatos, Langheinrich, & Bexheti (2014) for an example from research), is one approach towards ensuring its use. Another possibility is to consider how to create effective retrieval strategies for high quantities of media. Few examples are making good use of the abundance of media, such as Kuchelmeister & Benne (2014), who displayed photos taken from a lifelogging device on a projected landscape route, to enable people with a memory deficiency to recall their whereabouts. However, limiting the number of photos that go into a collection might prevent curation issues altogether.

2.2.5. Tools for Photo Use

Viewing

Commercial tools for displaying digital photos in the home are all screen-based and include computer screens, laptops, televisions, tablets and smartphones. Photo frames, such as the *Aura Frames*[48] display the photos passively without the need or possibility to interact with the photo that is showing. Photo frames were never popular (also found by Van House, 2009), even before the popularity of tablets started with the first Apple *iPad*[49] in 2010. Tablets not only feature better quality screens than most photo frames, but they can also be used for many other tasks, with the added benefit that there is one less device in the home. However, a device used for a range of tasks might also distract from the desired task of photo viewing.

[46] www.canon.nl/support/consumer_products/content/faq/?itemid=tcm:16-1145135, retrieved October 5, 2017
[47] philippschmitt.com/projects/camera-restricta, retrieved October 5, 2017
[48] auraframes.com/, retrieved October 6, 2017
[49] https://www.apple.com/ipad/, retrieved October 6, 2017. Images from the first model iPad from www.apple.com/ipad/features/photos.html via web.archive.org, version January 26, 2011

Figure 2.18: Frames for digital photo displaying at home. Aura Frame (left, source: auraframes.com); Apple (original) iPad (right, source: www.apple.com)

Taking the time to view photos has inspired various researchers. For example, as a hybrid solution between a photo frame and an external hard drive, Banks & Sellen (2009) developed *Shoebox*, a box that combines the storage and display of digital photos in one device. By combining these two functions in one, *Shoebox* attempts to bridge the divide between the location within a home where digital content is typically stored, the means by which it can be put on display, as well as provide a form factor that encourages collocated sharing of photos.

The creators of *Never Fade Away* and *ProjectoFrame* (Petrelli et al., 2014) had a similar aim with their research, as they wanted to support the presence of photos in the home environment and invite storytelling. *Never Fade Away* is an interactive photo display with more interaction possibilities than the Aura frame: the digital photo slowly appears to fade away by desaturating the colours, if it has not been looked at for too long. Some photos might be left by the owner to disappear completely, but some of the fading photos might draw extra attention. Picking up the frame registers movement, and restores the faded photo to its former quality.

ProjectoFrame, also an innovation of the photo frame, works slightly different because it builds on the ideas that a group of photos is often used as private mementoes or as a conversation starter, inspired by the photo walls with printed photos that many families still maintain in the home. When the interactive photo frame is touched, it can project a group of related photos onto the wall behind the frame to support any desired photo viewing experience.

Figure 2.19: Photo displays in the home: Shoebox (Banks & Sellen, 2009) (left); Never Fade Away (Petrelli, Bowen, & Whittaker, 2014) (right)

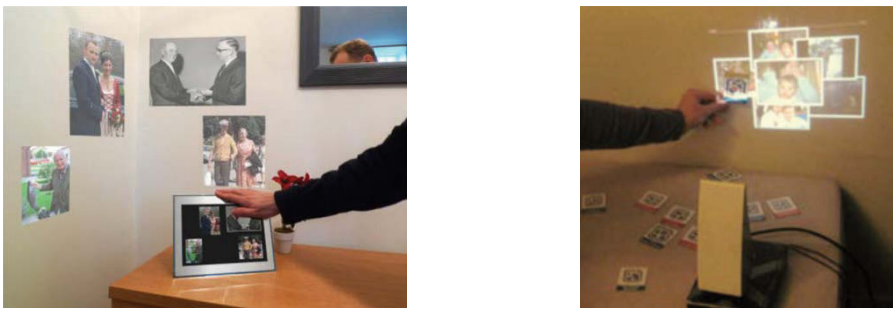

Figure 2.20: Photo displays in the home showing multiple photos: ProjectoFrame (Petrelli et al., 2014) (left); Pearl (Jansen, van den Hoven, & Frohlich, 2014)

Another example from research that uses projection as means to display a set of photos is called *Pearl* (Jansen et al., 2014), which is a display and curation device at the same time. The projection on the wall consists of "living" photos, meaning the collage refreshes every day with favourite photos. The concept also features photos that the owner has not looked at for a while, but these are displayed with less colour. Similar to the *Never Fade Away* concept, the faded photo will revive again when it is interacted with using gesture and QR tags.

Browsing

Tools for viewing that have more possibilities to interact with the photos that are on display can be used for viewing as well as browsing through parts of a photo collection. We mentioned already that tablets have more interaction possibilities than most photo frames, and the increased computational power of tablets also allow them to, e.g. play video files, search locations, faces or objects. These features are embedded in the native photos app from Apple's *iOS*[50], which is available on tablets and smartphones from the brand. Desktop photo browsers are usually shipped by default with the operating systems, but there are many third-party options available, such as *Lyn*[51], that build on the file structure of a desktop operating system but are dedicated for photo browsing.

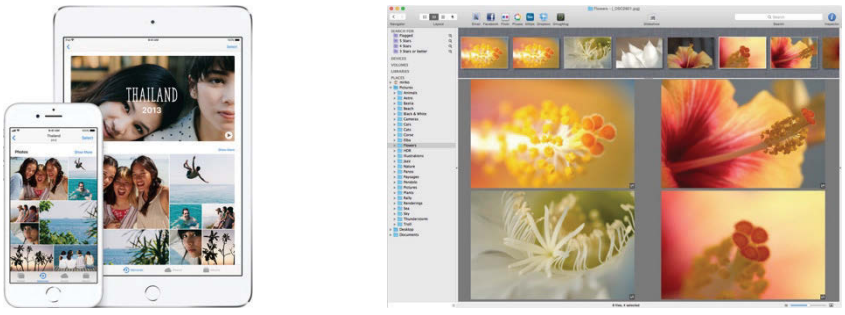

Figure 2.21: Browsing software: Native photo viewing on Apple iOS (left, source: www.apple.com); Desktop photo browsing software Lyn (right, source: www.lynapp.com)

[50] www.apple.com/ios/photos/, retrieved October 6, 2017
[51] www.lynapp.com, retrieved October 6, 2017

Figure 2.22: Interactive table top browsing with Photohelix (Hilliges et al., 2007), with the interaction showing on the left and the top view on the right

A different approach to browsing that makes use of a large interactive table top display is often used in research projects, and an example that is specifically designed for photos is called *Photohelix* (Hilliges, Baur, & Butz, 2007). *Photohelix* is a table-top interaction design with a spiral-shaped, time-based visualisation of photo collections that appear on the table. It provides tangible, gesture-based and multi-touch interaction. It has multiple functions: browsing, organising photos (e.g. by events) and collocated sharing of photos with people that gather around the table.

Collocated sharing

At the time of capturing photos, people can have a variety of purposes in mind, including formative, experiential, communicative or remembering purposes (van Dijck, 2008), and in this thesis, we are mainly interested in photos that are captured for remembering purposes. As outlined at the start of this chapter, photos have the potential to support remembering the past by serving as cues for autobiographical memories (van den Hoven & Eggen, 2014), and within HCI research there is a growing interest in design for remembering (van den Hoven, Sas, & Whittaker, 2012). Some example projects specifically looked at using photos to support remembering by augmenting tangible objects with digital content. For example, the *Digital Photo Browser* (van den Hoven & Eggen, 2003; 2007) was designed for memory reconstruction. It consists of a digital photo frame that is connected to an interactive table. When tagged tangible objects such as souvenirs are placed on the table, a related set of images appears on the tablet. To facilitate collocated sharing, the content can also be displayed on a larger screen in the room.

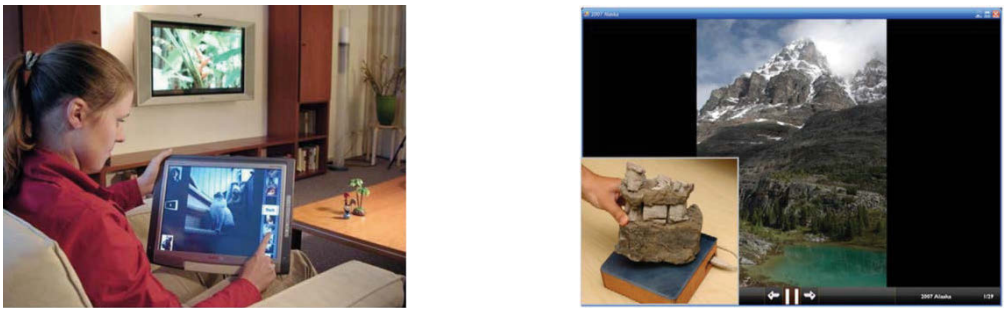

Figure 2.23: Browsing photos using souvenirs: Digital Photo Browser (source: van den Hoven & Eggen, 2007) (left); Souvenirs System (Nunes, Greenberg, & Neustaedter, 2008) (right)

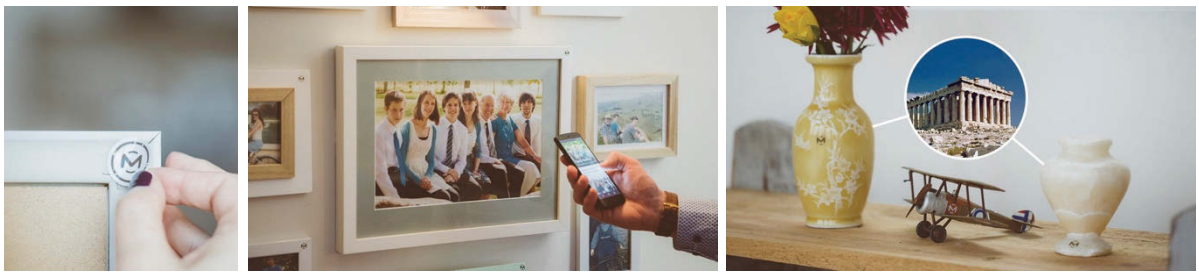

Figure 2.24: Myrins: Browsing photos on a smartphone using tagged items in the home (source: www.kickstarter.com)

Where the *Digital Photo Browser* was specifically designed for (shared) remembering, the *Souvenirs* system (Nunes et al., 2008) was designed specifically for photo sharing. It worked similarly, but it used the tags in souvenirs to trigger a slideshow of photos on a screen in the living room, such as a television, that could be presented to others.

Similar to the *Digital Photo Browser* and the *Souvenirs* system, commercial versions of systems that augment objects with digital content can be found from time to time, for example *Myrins*[52], a smartphone application that can be used to link photos to physical items, by adding Near-Field Communication (NFC) stickers to objects that are linked to the phone and can be retrieved when the phone is held close to the sticker. The aim of the project was "to take your memories out of the digital and into the physical". One of the challenges with connecting media to physical items was formulated by the creators of the *Souvenirs* system: one has to remember what media is connected to what objects to be able to deliberately retrieve the desired content during ongoing storytelling (Nunes et al., 2008).

Another take on collocated sharing makes use of the screen of smartphones. For example, *Xim*[53], created by Microsoft Research, can be used to display a photo slideshow from one device on more devices. The slideshow will simultaneously play on the presenter's device and the audience's devices. Anyone in the *Xim* can advance the slideshow or pan and zoom to see details of photos. It is even possible for the audience to get involved and add their photos to the slideshow.

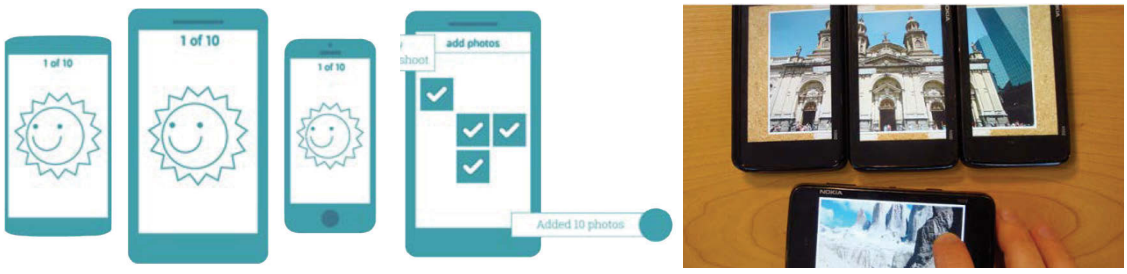

Figure 2.25: Collocated viewing on smartphones. Xim (left, source: www.microsoft.com); Pass-them-around (Lucero, Holopainen, & Jokela, 2011) (right)

[52] www.kickstarter.com/projects/1249636230/myrins-keep-your-memories-in-the-objects-around-yo, retrieved via the web.archive.org, version November 18, 2015.
Project cancelled on November 23, 2015 because of lack of sufficient crowd-funding.
[53] www.microsoft.com/en-us/store/p/xim/9wzdncrfjbjg, retrieved October 3, 2017

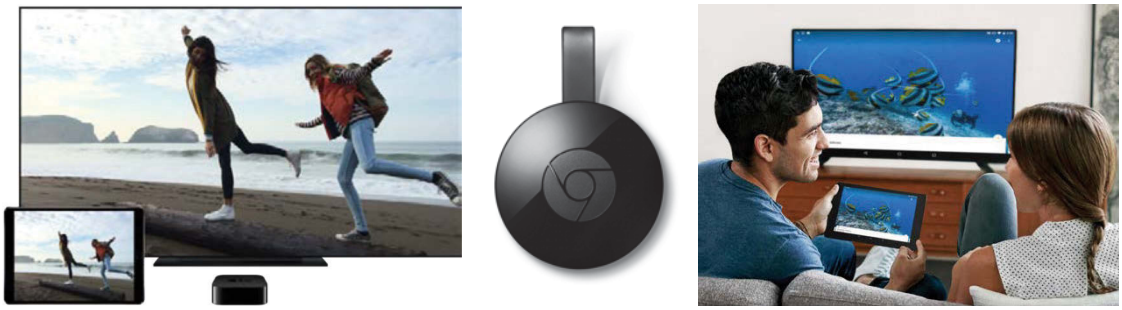

Figure 2.26: Mirroring photos from a portable device to a larger display for collocated photo sharing. f.l.t.r.: Apple TV (source: www.apple.com); Google Chromecast 2nd generation; Google Chromecast in use (source: www.google.com)

Lucero et al. (2011) created a similar concept, called *Pass-them-around*, but found that about half of the participants had trouble following the ongoing discussion when there was other content displayed on their phone compared to the narrator. *Pass-them-around* offered multiple features that all make use of multiple smartphones. One of these features uses the phones together to create a larger screen, and one of the phones can be used as a controller for the display that is made up of bigger ones. The benefit of this concept is that sharing becomes easier, both for the one who is in control and the audience who can look at a larger screen. However, the larger screen has to cope with the borders of the phones that are used.

Several commercial devices allow people to mirror (stream) content to a larger screen in a similar way to the *Digital Photo Browser,* e.g. Apple's *Apple TV*[54], Google's *Chromecast*[55]. A small device is connected to the television, and wirelessly connected to computers, laptops and smartphones, which can be used to select and navigate content, and control the music, photo slideshow or video that is playing on the TV screen. The television is made a central piece for viewing personal photo collections. Multiple devices can be connected at the same time, so people can also take turns when showing photos, but shared reminiscing with content from multiple people is not supported because the screen can only show a single photo at the time. Therefore, these examples work best when using a single person's photo collection, and their interaction with the content and the story.

In research, we find more examples of photo tools that are dedicated to social interaction with content from multiple people. For example, *Pipet* (Meerbeek, Bingley, Rijnen, & van den Hoven, 2010) is a playful version of devices like *Apple TV* and *Chromecast* but built around interaction and creativity with photos to create a collage of shared photos. A set of digital pipets enables groups to jointly create a photo compilation of a shared experience in a fun way, supporting reminiscing talk. To do this, these devices connect with phones that contain the photo collections of individual group members. With the pipet people can "suck up" a photo from the phone which can then be "splashed" onto a TV. Pressing harder in the pipet makes the photo

[54] www.apple.com/appletv/, retrieved October 4, 2017
[55] www.google.com/chrome/devices/chromecast/, retrieved October 4, 2017

bigger within the collage. The distributed control over the collage can get everyone engaged in the creation and reminiscing activity.

Figure 2.27: Playful collage creation with *Pipet*. f.l.t.r.: selecting a photo with the digital *Pipet*; "throwing" the photo to the shared screen; example of the resulting collage (Meerbeek et al., 2010)

4 Photos (O'Hara et al., 2012) is a photo-based table decoration for stimulating dinner party conversations. Content is displayed on four sides and is taken from different Facebook accounts. Twisting the top of the device gives a different set of random photos to be displayed. The idea behind the interaction is that such unexpected photo encounters spark conversation and potential reminisce about the moments depicted in the photos.

Figure 2.28: Sharing photos during a meal with 4 Photos (O'Hara et al., 2012)

Other projects have looked at the opportunities of bringing collections from multiple family members together. For example, *Photoswitch*[56] (Taylor et al., 2007; Durrant et al., 2008; Durrant, Taylor, Frohlich, Sellen, & Uzzell, 2009) is a design for deployment in family homes to critically explore tensions about family representation between adults and their teenage children. The device consists of a photo frame with a sliding door to conceal half of the frame, allowing family members to change the photo that is on display by themselves.

[56] www.abigaildurrant.com/abigail-durrant/portfolio/photoswitch, retrieved October 7, 2017

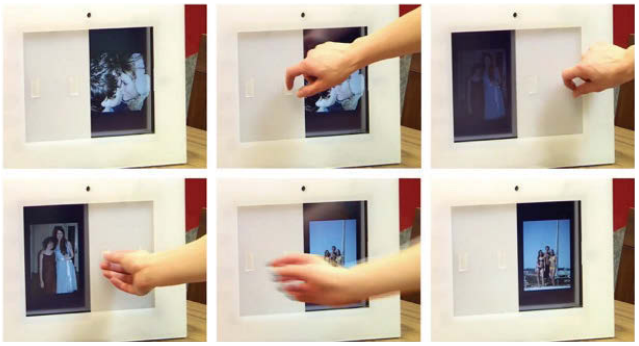

Figure 2.29: Showing multiple collections in the home with Photoswitch (Taylor et al., 2007; Durrant et al., 2008, 2009) (source: www.abigaildurrant.com)

Another example, *Caraclock* by Uriu, Shiratori, Hashimoto, Ishibashi, & Okude (2009) aims at richer communication of family history by enabling individuals to see the similarities and differences between generations. It consists of a set of digital photo frames. By connecting the frames, people can browse through multiple collections, because the system synchronises the photos based on metadata similarity, for instance, all photos at age 20, or all photos from 1982.

Figure 2.30: Collocated photo sharing with Caraclock (Uriu et al., 2009)

Similarly, *Cueb* by Golsteijn & van den Hoven (2013) focused on bonding between parents and teenagers. The goal of the project was to design a system that facilitates communicating pleasantly about the parent's past and recent individual and shared experiences. With *Cueb*, both parents and teenagers are actively involved. The project website[57] states that the cubes can be connected, to explore photos of shared experiences. The photos themselves can also be used as a filter on one cube to find related content on the other cube. Using related content, parents and teenagers can compare experiences and explore similar and different situations. The interactive cubes use meta-data to present relevant combinations of photos to spark a conversation.

Even more than the other concepts described here, *Caraclock* and *Cueb,* rely heavily on correct metadata to work properly, making curation a prerequisite to allowing photos to be appropriately filtered. Moreover, to be able to compare photos automatically, old photos first need to be digitised and enriched with the required metadata, e.g. time, location, people, correct time-

[57] www.conniegolsteijn.com/cueb.html, retrieved October 7, 2017

zone setting, compensating for wrong date-time settings in the camera, while that information is often not present in current collections.

Figure 2.31: Collocated sharing between parent and child with Cueb (Golsteijn & van den Hoven, 2013) (source: www.conniegolsteijn.com)

2.2.6. Limitations

This chapter reviews many example technologies that are used for digital photography practices. We would like to stress that this overview is far from complete since the development of both industrial and academic efforts continuously adds new examples to the body of work. Moreover, at the time of writing, some of the tools are already superseded by faster, smaller, or otherwise improved versions – as indicated in the footnotes. That illustrates that the current state of this overview is quickly outdated, but the purpose of this chapter is to provide more detail to the examples that we refer to throughout the thesis.

2.3. CONCLUSION

In this chapter, we have provided an overview of current commercial and experimental technological solutions to support photo curation **[RQ.1]**. We described various solutions for photo capturing, sharing via social media, storage, organising and use. In the examples, we see dominating presence of commercial tools for capturing media. We also see a preference for companies to develop photo applications primarily for smartphones and tablets. As also identified by Lundgren et al. (2015), in our review we saw that (mobile) tools that support remote photo sharing are dominating, often as part of related distributed social interactions. Perhaps the worldwide adoption of social media platforms has geared commercial interest towards remote sharing solutions using mobile devices, rather than collocated sharing in the home using dedicated tools. However, we do find many research projects taking on the challenge of making use of all those photos that were taken for communicative or remembering purposes, using tools that offer richer interaction possibilities than touching a piece of glass. In the next chapter, we will explore current practices related to digital photo use.

CHAPTER 3.
A MODEL OF PHOTOUSE: EXPLORING DIGITAL PHOTO PRACTICES

Chapter Summary

In the previous chapter, we have provided an overview of the tools that can support mediated remembering, and in this chapter, we will explore what people do with currently available tools. To provide suitable technologies for enjoying our expanding photo collections, designers need to understand how and for what purpose people use these collections. Contextual interviews with twelve participants in their homes explored the use of digital photos, incorporating new photo activities that are offered by new technologies. Based on the qualitative analysis of the collected data we give an overview of current photo activities, which we term PhotoUse. In this chapter, we introduce a model of PhotoUse, which emphasises a focus on photo practices and their purposes, rather than the tools to support them. We argue for the use of our model to design tools to support people's individual, social, and utilitarian purposes of PhotoUse, and discuss the design opportunities that come from our holistic view on current photo practices.[1]

[1] *This chapter is based on:*
Broekhuijsen, M., Hoven, E. van den, Markopoulos, P. (2017). From PhotoWork to PhotoUse: Exploring Personal Digital Photo Activities. *Behaviour & Information Technology*. 36 (7). Taylor & Francis. pp. 754-76. DOI: http://dx.doi.org/10.1080/0144929X.2017.1288266. My role in this publication was the setup, execution and analysis of the study, and I did the majority of the writing in consultation with my co-authoring supervisors. Therefore, in this chapter "we" refers to myself and my supervisors.

3.1. INTRODUCTION

Before the introduction of digital photography, the size of an individual's photo collection was in the order of hundreds, and now it is in the order of thousands, which changes the nature of the tools needed for using them. The study presented in this chapter describes the use of personal digital photos, one of the most common record types people keep of autobiographical content. Photos can be considered digital objects as long as they exist in digital form (Kirk, Sellen, Taylor, Villar, & Izadi, 2009), for example, on camera SD cards, computer hard drives, or on cloud storages. People use their photo collections regularly, for example, to browse them, organise them, or share them. The work described in this chapter builds on the seminal PhotoWork paper by Kirk et al. (2006) in which the activities that lead towards sharing of digital photos are described in a model. As we outlined in the introduction of this thesis, in our research, we are looking at activities that involve the personal use of digital photos, to identify opportunities for the design of novel supportive tools. In the remainder of this chapter, we refer to all the activities that involve the use of digital photos as *photo activities*, covering the time between the moment that a photo is captured or collected, all the way to the moment it is used, e.g. for formative, communicative, experiential or remembering purposes (van Dijck, 2008). In our research, we are interested in the relationship between media and remembering, so the remembering purpose is of specific interest to us.

This chapter describes an interview study, involving 12 participants, in which we examined how people use photo collections at home with the aim to identify opportunities for better supporting photo activities for remembering purposes, through interactive technology. In the next section we review related work, then we present the aims and methods of the study, and summarise its results. We introduce the term PhotoUse, which encompasses all the activities related to accumulating, curating, retrieving and appropriating photos. We want to make a distinction between the *purposive use* of photographic material, and the *work* that people associate with, e.g. managing, organising and retrieving photos. We present our model of PhotoUse specific to photo sharing purposes, with the aim to illustrate our holistic view on the personal and social use of digital photos, and discuss the implications for design and research in this field.

3.2. RELATED WORK

In this section, we discuss related work surrounding digital photo activities within the fields of Human-Computer Interaction, interaction design, information science and psychology.

3.2.1. Photo Technology

Frohlich et al. (2002) provided an inventory of activities that are related to the use of digital photos for sharing, described as *PhotoWare,* and there are many examples reported in the related literature of devices designed nowadays to enable people to display and share their photographs

(see Chapter 2 for examples). By display we mean rendering a photo on a screen, not the conceptual notion of "acts of photo display" as described by Durrant et al. (2008, 2009), by which they mean all the socially contextualised activity, involving all practices and tools. Sharing and commenting on digital photos used to be a complicated task (Frohlich et al., 2002), but many opportunities are provided by commercial technologies that enable us to share and comment on photographs instantly. Recent example tools for sharing and storytelling demonstrate the influence of such technologies with the new possibilities to share experiences and activities on our interpersonal communication practices (see Chapter 2.2.5 for examples). Notable examples of research works that deliberately support autobiographical remembering include *Living Memory Box* (Stevens et al., 2003), and *The Family Archive* device (Kirk et al., 2010). These designs incorporate the contextual and chronological information to display a family archive. They also address multiple users, opportunities for storytelling, and the need for *curation*, which is important when designing for media-supported remembering (e.g., Van House & Churchill, 2008).

Research into browsing, sharing, or viewing photographs is usually not concerned with curation, although selecting the required subset of the photo collection is a crucial prerequisite for successful viewing and sharing (Whittaker et al., 2010). Moreover, research into photo browsing typically approaches photo collections as databases rather than cues for remembering, thereby ignoring important activities such as reminiscing and storytelling, and instead focusing on media retrieval tasks. However, from the perspective of photos as memory cues, people's experience of remembering that is supported by photos is perhaps more important than the accuracy or efficiency of retrieval.

Most photo retrieval and sharing applications available currently make use of new interaction techniques that are supported by smartphones or multi-touch surfaces, to make pleasurable and efficient manipulation and access to photo collections possible. However, this does not suffice to address the difficulties of organising or retrieving of photos in its totality.

3.2.2. Photo Activities

Studies that describe how people use their collections have focused on, e.g., managing collections (Rodden & Wood, 2003), tools for efficient search, and retrieval (Whittaker et al., 2010). These studies identify design opportunities to support these activities with new tools. Kirk et al. (2006) introduced a descriptive flow-chart-model covering the most common interactions with digital photographs between capturing and sharing, which they termed *PhotoWork*. This model can be used to develop and assess new digital photo management tools. It identifies three stages between capturing and sharing photos:

- *Pre-download stage*: just after capturing a photo; includes triaging[2] on the capturing device.
- *At-download stage*: when transferring photos to the computer; includes triaging on computer, editing, organising, filing and backup
- *Pre-share stage*: work that is necessary before being able to share the photo; includes sorting, selecting a subset, simple editing, copying, printing, sending

The PhotoWork model provides a linear, waterfall-like description of the lifecycle of a digital photo file, with a clear progression and separation between capturing, organising and sharing of photos. Figure 3.1 shows the PhotoWork lifecycle by Kirk et al. (as it appeared in Banks, Duffield, Sellen, & Taylor, 2012)**.** Kirk et al. (2006) suggested that the activities listed in the PhotoWork model consume all the time that people are prepared to spend on their growing media collection, leaving no time to look at the photos or otherwise use them. Several designs (e.g. *PhotoHelix* from Hilliges et al. (2007), see Chapter 2) are based on the PhotoWork model, exploring technological solutions within the stage-based framework it provides. However, the steps described appear to be those that photo technology necessitates rather than how people want to do things. As a model, it also draws attention to user *tasks*, such as curation, and designing for efficient performance rather than opportunities to design for an enhanced *user experience*.

Although we put much deliberate effort into building photo collections that portray our lives, poor organisation can make it harder to find photos (Whittaker et al., 2010). In their study about family photography in the home, Whittaker et al. reported that software tools intended to support retrieval activities fail to aid the process of photo retrieval activities in families. They also found that, when asked to find a particular photo, their participants were not successful in retrieving them in almost 40% of the cases – although long-term retrieval is the major motivation for families to capture the photos (Whittaker et al., 2010). Other issues concerned remembering the storage location of items, and the amount of time it took participants to find items in their collection (up to 4 minutes), mainly caused by a large number of photographs to search through. Whittaker et al. concluded that there is a need for new tools to filter, evaluate, maintain, and share photo collections to enjoy their value (Whittaker et al., 2010). In their study, participants owned on average an estimated 4,475 photos, with a standard deviation of 3,039. The average collections of today's typical users have increased in size which makes the need for new tools more pressing, even though online storage has also reduced some of the hassle of storage, retrieval and especially sharing (see Chapter 2 for examples).

[2] Triaging is "the process of determining the most important people or things from amongst a large number that require attention" (Oxford Dictionary, 2003).

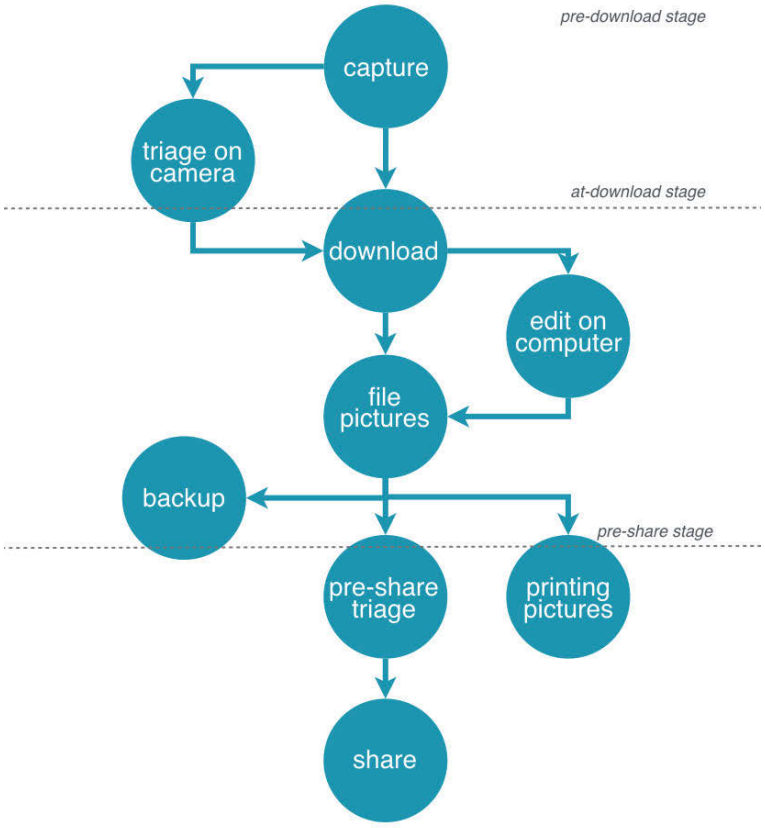

Figure 3.1: Model of PhotoWork by (Kirk et al., 2006), similar to how it appeared in (Banks et al., 2012)

Despite their intentions to get organised (Frohlich et al., 2002), on most occasions, people lack the time and motivation to curate personal photo collections properly. Existing studies emphasise that "work needs to be done" by users when it comes to organising photos, and illustrating the understanding that curation is considered unsatisfying, despite the promise of a well-organised collection (Frohlich et al., 2002).

An example of the efforts in research to specifically address the curation issue of digital photos is *Pearl* (Jansen et al., 2014), which projects multiple photos on the wall, allowing participants to select, favour and organise the content while viewing. Despite these efforts, there is as yet insufficient understanding on how to design photo tools that reduce the workload of curation and focus on the desired usage of photographic content.

3.3. FIELD STUDY

The aim of the study was to explore photo activities in the home environment, identifying what kind of photography related activities participants engage in, and in what fashion they engage with their collections. We were interested in identifying the motivations for these photo practices. Lastly, the value of photos as cues for memory reconstruction, that we discussed in the

introduction chapter of this thesis, drew our interest to the relation between the purposes of photo usage and the parallel between these practices and known functions of autobiographical memory.

3.3.1. Method

To create an overview of digital photo activities, and the opportunities for supportive tools, we conducted in-depth contextual interviews in the homes of 12 participants about their use of personal digital photography and analysed the results using thematic analysis (Braun & Clarke, 2006; Corbin & Strauss, 2008). The study described in this chapter focused primarily on the home environment, because in their homes, people typically have the possibility to access their entire personal collection, and have the opportunity to demonstrate their usual practices to the researchers. We explored all possible photo activities of our participants in this context, including all existing technologies used as retrieving devices – such as the use of smartphones, laptops, smart televisions and tablets.

3.3.2. Participants

The participants were recruited based on their photo use and social situation. The sampling started with selecting people from the personal and professional network of the authors that were known to have affinity with digital photography. To balance the final sample, we continued to look for participants after the first interviews, that had a different background and e.g. less affinity with photography, or only used mobile phone, or were much older or younger than the participants so far. We also asked participants to suggest people to include in the study. The selected participants (see Table 3.1) differed in age, profession, demographics, social situation, and interest in digital photography, to provide a broad overview of personal photo usage. Participants were selected based on whether they were acquainted with digital photography, whether they owned a digital camera or a smartphone, whether they lived with a partner (and children), and whether they owned a collection of at least 2,000 digital photos. The latter requirement was formulated to make sure that the participants would have experience with curating digital media. The selected participants (N=12, 6 female) were Dutch citizens between the age of 18 and 69 (M=39.2 SD=15.9). They owned minimum 2,000, maximum 300,000 photographs (M=42,083 SD=82,627). The participants reported that they were socially active, both online (social media) and ‘off-line' (e.g. friends, sports clubs, societies.). Three participants were not living with a partner at the time, but shared an apartment with friends; eight of the participants lived with their partner, from which four had children. The youngest participant still lived with his parents.

Table 3.1: Participants study 1, with for each participant the gender, age and occupation. This table also lists the years in which the participants got their first compact cameras, digital compact cameras, single lens reflex (SLR) cameras, digital SLR and camera phones. If a participant did not own such a device there is no year listed. In the right column, the total number of photos that the participants have in their collections is listed.

#	Gender	Age	Occupation	1st Analogue compact	1st Digital compact	1st Analogue SLR	1st Digital SLR	1st Camera phone	Photos in collection (2014)
S01P01	Male	32	Business Project Manager	1994	-	2002	2005	2009	50.000
S01P02	Male	29	Marketing Consultant	1994	2003	-	2009	2007	25.000
S01P03	Female	30	Eye surgeon	-	2010	-	-	2011	18.000
S01P04	Male	28	Online fraud reviewer	1995	2011	-	-	2013	2.000
S01P05	Female	31	Notary candidate	-	-	-	-	2011	14.000
S01P06	Female	69	Retired insurance advisor	1953	2003	-	-	-	7.000
S01P07	Female	66	Retired secondary school teacher	1968	2001	1980	-	-	40.000
S01P08	Male	40	Photographer and school teacher	-	2004	1988	2004	2009	300.000
S01P09	Female	38	Post-doctoral researcher	1990	2003	1994	2006	2010	28.000
S01P10	Female	34	ICT advisor & part-time student	1994	2005	-	-	2011	3.000
S01P11	Male	55	Energy coach & therapist	-	-	1978	2005	2008	16.000
S01P12	Male	18	Secondary school student	2003	2006	-	-	2010	2.000
Averages		**39.2**							**42.083**

3.3.3. Procedure

Participants took part in a semi-structured interview with open questions, lasting 1 to 1.5 hours. The interviews were held at the homes of the participants, to give us a clear understanding of the context, the practices and tools, and the issues that were encountered by them. In the first part, the interview focused on understanding how participants used photos. We asked participants to talk about their photo activities, how often they used their photo collections and how much time they spent on it. The explorative nature of this research required an open interview approach, in which participants were asked to describe as many photo activities as possible in detail. When the participants mentioned usual practices, they were invited to demonstrate a typical photo activity by showing a few digital photos, using the tools and procedures they would normally use to browse and view them. The demonstration was a way to stimulate the participants to talk in more detail about these practices. After the demonstration, participants were asked to describe the purpose of their photo activities, with questions such as *"Why do you want to share these photos on social media?"*. By elaborating on the purpose of using photos, participants were invited to reflect on whether current activities facilitated the purpose adequately, and to think about possible improvements. All the interviews were audio recorded, and the photo activities that participants

demonstrated were captured on video for later reference. At the end, the participants received instructions to estimate the size of their entire digital photo collection, across devices (external hard drive, laptop, PC, Mac, smartphone and tablet). The estimation was based on the file counters in the software they used (Google's *Picasa* (for Web)[3], Apple's *Aperture*[4] and *iPhoto*[5], native photo applications on smartphones and tablets), or the file count property for the appropriate folders in Microsoft Windows' *File Explorer*[6]. The estimation was made based on the total count, rounded to the nearest thousand. We used the counts to provide a more honest report on the participants' experience and behaviour, because we anticipated that different collection sizes invite different behaviour.

3.3.4. Analysis

All the recorded interviews were transcribed in full. The choice of semi-structured interviews allowed us to gather details about current practices using follow-up questions. The interview transcripts were then analysed with a focus on identifying the activities described by the participants, and, where possible, identifying the purposes. The qualitative data analysis was aimed at identifying interesting patterns in the use of photo collections and problems that participants experienced with their photo activities. To find the codes for the categories, we used thematic analysis (Braun & Clarke, 2006; Corbin & Strauss, 2008) following the operational approach discussed in Braun & Clarke (2006). We made use of thematic analysis as it aligns with our aim to study the practices around photo tools: we were interested in understanding and hypothesising about what motivates people to engage in photo activities, by relating behaviours to needs and motives, rather than describing activities at a phenomenological level. Although this method is not naturally linked to our design research approach, the method has been used often in HCI research for its usefulness in discovering underlying themes across data gathered from different sources using different techniques. After analysis, the quotes that were relevant to illustrate our findings were translated from Dutch to English.

3.4. RESULTS

The participants provided descriptions of 171 photo activities. In this section, we will provide an overview of those activities and our classification based on the thematic analysis. We will describe the activities per activity type, by giving a description and examples from the participants.

[3] picasa.google.com, retrieved December 1, 2017.
Support stopped in 2016 in favour of Google Photos
[4] support.apple.com/aperture, retrieved December 1, 2017.
Support stopped in 2015 in favour of Apple Photos
[5] support.apple.com/en-gb/HT204655, retrieved December 1, 2017.
Support stopped in 2015, in favour of Apple Photos
[6] https://en.wikipedia.org/wiki/File_Explorer, retrieved December 1, 2017

3.4.1. Photo Activities

The photo activities that participants described were summarised based on several characteristics: where possible, we listed the social context (who) and the described goal or motivation (why) for the activity. Next, we looked at the content of the description and selected a primary label, and where needed a secondary and tertiary label that best described each activity. Based on the primary labels, the 171 activities were divided into 13 activity *categories* and then divided into four activity types: *accumulating, curating, retrieving and appropriating*. The accumulating type contains all the activities that are responsible for expanding the photo collection; curating is done in order to manage and edit the existing collection; the retrieving type is the largest and contains all the activities that are done in order to find, browse or view photos in an existing collection, which is needed for most other activities; appropriating consists of all the activities that are done in order to share or show photos, either digital or physical. An overview of the categories, types of activities, examples and occurrence in our data can be found in Table 3.2.

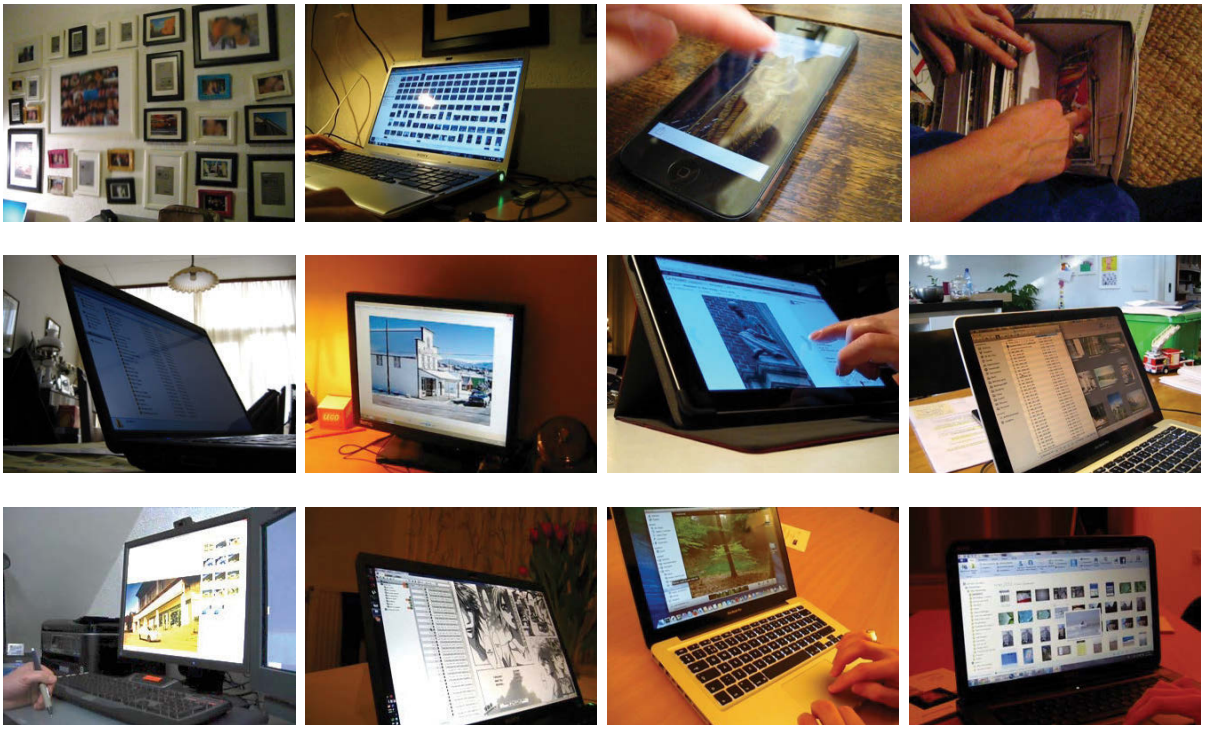

Figure 3.2: Overview of different photo activities, as demonstrated by the participants. This includes the use of printed photos, and a wall of framed photos. Other technologies include desktop computers, various laptops, smartphones and tablets.

Table 3.2: Three-level classification of photo activities, based on the descriptions of the participants. Based on their characteristics the 171 activities from 12 participants were divided into 13 categories and the categories were then divided into 4 activity types: *Accumulating*, *Curating*, *Retrieving*, and *Appropriating*.

Photo activity type	Activity category	Activities	Occurrence	%
Accumulating	Capturing	Taking pictures; on-device quality triage to determine to retake photo	13	8%
	Collecting	Adding photos to your collection, which you did not capture yourself	8	5%
Curating	Triaging	Assessing, selecting with a specific purpose in mind (e.g. sharing)	26	15%
	Organising	Tagging, moving, categorising, renaming, captioning, archiving, deleting	13	8%
	Editing	Retouching, cropping, combining, correcting, changing	7	4%
	Managing	Filing, backup, downloading, uploading	3	2%
Retrieving	Browsing	Casual viewing of pictures while interacting with them	35	20%
	Viewing	Passive viewing (e.g. of a slideshow)	20	12%
	Searching	Goal-directed retrieving, searching	19	11%
Appropriating	Sharing	Remote sharing (online, on social media, sending postcards), collocated sharing	13	8%
	Printing	Printing photos, a poster, or family albums	10	6%
	Tinkering	Tinkering with printed photos, cutting and pasting printed photos	3	2%
	Collaging	making a collage from (printed) photos, making (digital) booklets	1	1%
		Total	**171**	**100%**

Accumulating

People engage in activities that are part of the process of expanding a personal photo collection, starting with *capturing* the photos. The activities that are part of *accumulating* photos are the following:

- *Capturing*: taking pictures; on-device quality triage to determine to retake the picture
- *Collecting*: adding photos to your collection, which you did not capture yourself

On-device triaging is done as part of the capturing: camera phones and digital cameras have the feature to assess the picture quality immediately and discard and retake in case the quality is insufficient:

> *"Sometimes [I do the selection] on the camera (...) if it is clear that the picture is not usable" – S01P10 (female; age 34; 3,000 photos)*

The other accumulative activity is *collecting*. It involves getting e.g. images from friends or family members, images from the Internet, scans from newspapers. S01P09 explained the trouble she had with getting images in her collection that other people took:

> *"My brother, my father and my husband all make pictures which need to be added. I curse them for throwing away the EXIF data (...) [because] I have to add this manually (...) and that takes way more time" – S01P09 (female; age 38; 28,000 photos)*

Curating

There are many different activities that people do to curate their collection. Participants were engaged in *triaging*, *organising*, *editing and file managing* photos in their collection. The activities are listed below, with examples from the participants:

- *Triaging*: assessing, selecting for a specific purpose (e.g. sharing, decorating, presenting)
- *Organising:* tagging, moving, categorising, naming, captioning, archiving, deleting
- *Editing*: retouching, cropping, combining, correcting, changing
- *Managing*: filing, backup, downloading, uploading

Triaging is reported to be one of the most burdening parts of curating unless it is done when the participants require a specific subset of their collection:

> *"Only if I want to start a new project or a photo album or a collage (...), but otherwise I would not browse through [my photos]" - S01P03 (female; age 30; 18000 photos)*

> *"It depends (...) especially after traveling, everything goes onto the computer, and then there will be a round of selection, and a selection round for the photos that I want to be able to see more often, which I put into a Dropbox folder to be able to view them on another computer. And [some go] into the shared folder with my boyfriend. So, then I am in fact selecting three times" - S01P10 (female; age 34; 3,000 photos)*

Some of the participants took organising of photos more seriously:

> *"I have several scripts [on the computer] that rename the photos based on year, month, day, minute, second. And then they are automatically moved to a folder, which is imported into Aperture, per year. And recently I sometimes create a* smart folder *with a specific start and end date" - S01P09 (female; age 38; 28,000 photos)*

Editing occurs when multiple copies are generated for editing, and thus the collection is expanding. E.g., S01P01 and S01P09 had many copies of pictures that they had retouched or had changed into black/white, but of which they had kept the originals. Some participants particularly enjoyed editing:

> *"[after the holiday] I will do some editing, yeah, for a couple of days" – S01P02 (male; age 29; 25,000 photos)*

> *"I love crafting the picture (...) creating a good result (...) is very satisfying" - S01P08 (male; age 40; 300,000 photos)*

Managing includes all the activities that are done with the digital files, for example copying photos from the camera to a computer, moving photos onto an external hard disk, and backing up photos to cloud storage.

The curating activities are crucial because they are key to the success of the rest of the activities. The variety of activities in our study revealed that for different occasions a different subset of the collection is required:

> *"These [Picasa] folders are to show to other people (...) And I sent these photos to the manager of a museum shop, for inspiration." - S01P07 (female; age 66; 40,000 photos)*

> *"After my children were born I made folders for sharing and especially the grandmothers liked that. In Picasa, I had a shared folder with a few people (...) in which I put the most beautiful photos. I did that until 2012, and after that, I did not have time for it anymore. Which is a shame because those are the folders that I actually look at." - S01P09 (female; age 38; 28,000 photos)*

From the interviews, we got the notion that the participants were overall satisfied with the way they view and browse their collection, as well as the technologies that they use for capturing, sharing, viewing, and browsing their media. However, especially curation does not seem to be intrinsically motivating: all the participants reported that they had curation-related activities in mind that they wanted to do, but that they were postponing, such as organising, printing, sorting, and sharing printed images. One participant explained that she had been determined to do the curation at the start of her retirement eight years ago, but she still had not done it:

> *"My only consolation is that I know hardly anyone who has everything in flawless order." - S01P06 (female; age 69; 7,000 photos)*

Another participant felt the need to organise her photos on the computer, every time she saw an organised collection from someone else:

> *"A friend of us (...) makes printed albums from every event (...) one for herself and one for her child. (...) And then I am thinking "Wow!" but I will never have the patience for that; there will always be other things that need to be done..." - S01P05 (female; age 31; 14,000 photos)*

Other participants also expressed their discontent with the way their collection was organised.

Retrieving

The retrieving type consists of all the activities that are done to interact with the file system:

- *Browsing:* e.g., browsing (casual viewing of pictures while interacting with them)
- *Viewing:* passive viewing of slideshows
- *Searching:* e.g., goal-directed retrieving, searching

Participants enjoy browsing, and especially on mobile devices to pass the time:

"I guess just on the couch, being bored. Or when I am bored, on the train or something. When you have nothing to do and are sitting alone. (...) I really forget (...) many situations you know, and when you see the photos, you start to think about it, which brings back the memory. And that is, of course, nice when you are bored because then you think about pleasant moments." - S01P02 (male; age 29; 25,000 photos)

"[Browsing happens] on my phone sometimes. When I am thinking "I am going to browse through my photos, that'll be fun" ...actually when I am bored." – S01P12 (male; age 18; 2,000 photos)

"The only moment I look at my photos is when I connect my iPhone to my computer because then iPhoto opens and then I look at the photos for a while. (...) if it is just in front of me, that is more likely to happen than that I think of a specific moment and start to search for that specific photo." - S01P03 (female; age 30; 18,000 photos)

Searching was reported to be cumbersome, especially when participants own large collections and do not access them very often. Many of the activities of other types start with accessing the file system.

Appropriating

By appropriating we mean to cluster the activities that are part of modifying and sharing (physical) instances of the digital collection:

- *Sharing:* remote sharing (online, on social media, sending postcards), collocated sharing.
- *Printing*: printing photos, a poster, or family albums
- *Tinkering*: tinkering with printed photos, cutting and pasting printed photos
- *Collaging:* making a collage from (printed) photos, making (digital) booklets

Sharing was by far the most popular activity for these participants (see also Figure 3.3), and most of the participants engage in some form of sharing. Some of the remote sharing included social media, some used email, and others engaged in collocated sharing.

"[after the holiday] I sent some photos to my parents [via email], saying "I am home again, here are already ten photos; the rest will follow soon" - which never happens" - S01P04 (male; 28; 2,000 photos)

"When we were rebuilding our house, I would often open Aperture (...) that was nice, many people were interested to see what [the house] used to look like" - S01P09 (female; age 38; 28,000 photos)

"I brought the booklet that my parents made for my 18th birthday. (...) The first few days I went through it once every day. (...) I also show it to other people; everyone who comes here." - S01P12 (male; age 18; 2,000 photos)

Printing includes printing selected photographs and using online services for layout and print photo albums. S01P03 explained that she makes printed albums because in a way this frames her memory.

"You frame the memory; the album always describes a specific moment (...), and in an album, you can recreate the atmosphere (...). And it has to look nice of course (...). It is also about just 'owning' because a beautiful small album will still be the same small album in 100 years' time (...)." - S01P03 (female; age 30; 18,000 photos)

The appropriation activities that were reported by the participants are on many occasions linked to activities in the *curation* category, which illustrates that participants spend much time selecting and editing the subset to *share*, or otherwise use the result of their work.

3.4.2. Motivations for Photo Activities

We identified the purposes by looking at the complete description of each photo activity. The purposes that motivated these photo activities could be identified in 162 of the 171 activities. The remaining nine activities were described in general terms or without context, so the purpose of these activities was not clear. Figure 3.3 shows the motivations for these activities. The social purpose was the main purpose of using photos (*sharing, 36%*), but also individual use the of photos, e.g. *reminiscing (21%),* was reported as a motivator for photo activities. Apart from the motivation of the activities, Figure 3.3 provides information about the *social context* in which these activities were done. Most of the activities were done alone (73%), followed by activities with friends (14%), with family (6%), and with a partner (6%).

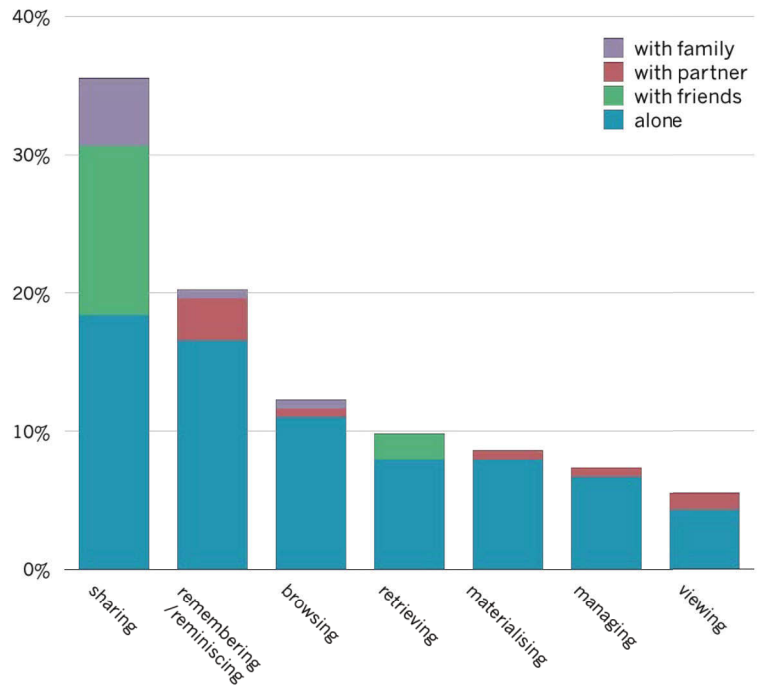

Figure 3.3: Motivations and social context of photo activities. The seven bars on the horizontal axis show the purpose of the different activities, based on 162 activities from 12 participants, in percentage. The bars are divided in the vertical direction to show if the participants reported doing the activities with these purposes alone, with a partner, with friends or with family.

The purposes of photo activities, according to the participant data, include the following:

- *Social purpose:* e.g., storytelling, viewing together with others, shared reminiscing
- *Individual purpose*: e.g., individual reminiscing, thinking about past events; browsing for enjoyment; viewing slideshows; creating collages for decoration
- *Utilitarian purpose:* e.g., optimise the organisation as part of hobby or technical interest; searching for specific information

The following example describes individual activities to reach a *social* goal, but also illustrates efforts of self-presentation:

> *"I put every now and then something on Facebook (...) when I went somewhere together with other people (...). I like (...) tagging people and the comments that follow. But also, my background and profile pictures are from my holidays, to show (...) that I have been to a nice place" - S01P04 (male; 28; 2,000 photos)*

As an example of *storytelling*, S01P01 described the use of photos to complement a story he shared with friends:

> *"It can complement the conversation, for example, the picture of, a ring, when I just proposed to my girlfriend, and I was talking about it." - S01P01 (male; age 33; 50,000 photos)*

Another participant triaged his collection specifically to support telling a story about his holiday:

> *"I thought it would be nice to have a selection with me all the time. I would be able to show it to my grandma or my friends. Because I forget many things, I can tell a better story if I have the photos in front of me." - S01P02 (male; age 29; 25,000 photos)*

Some examples revealed several photo activities with the motivation for individual *reminisce*. E.g., S01P07 described a combination of *editing*, *triaging*, *collecting*, *organising*, and *viewing*:

> *"I browse through [my] digital dairy often, to see what I did a few years ago. Sometimes I delete something (...). In there is [described] what I have done (...) and how I liked it." - S01P07 (female; age 66; 40,000 photos)*

In an example of *reminiscing*, one participant indicated that the location information on his camera phone supported his memory:

> *"Sometimes I just browse through them (...) and review what I have been doing (...). I like the GPS tracker because now I have all these pins [showing] the places I visit." - S01P02 (male; age 29; 25,000 photos)*

People are oriented towards the purpose of using their photo collection, and many activities were described by the participants that illustrated purpose such as, e.g. "sharing an experience", "revitalise friendships", "browsing to fight boredom".

3.5. DISCUSSION

The results from this study provide an overview of photo activities in which the participants engaged. Through thematic analysis, we were able to cluster the photo activities into the activity categories *accumulating, curating, retrieving,* and *appropriating*. Moreover, we identified the motivations for engaging in photo activities, with sharing being the most prevalent motivation, and individual reminiscing in second place. Lastly, we show that the majority of photo activities by these participants were done individually, even if an activity was socially motivated.

3.5.1. Limitations

The method of contextual interviews in the home allowed us to explore complete collections but also may have biased our study towards homebound media, missing out on nomadic aspects of photo activities, which is on the rise with the use of camera phones, (for example, see Kindberg, Spasojevic, Fleck, & Sellen, 2005; Sarvas & Frohlich, 2011).[7]

Of importance when trying to describe the photo activities are the differences between activities. For example, the difference between our descriptions of the activities *managing* and *organising* is very subtle, and the distinction for labelling was made on a technical level: managing in our definition includes everything that is done with the *digital photo files*; we labelled something as organising when there was an action involving the *metadata* of the files. Another example is *browsing* vs *sharing*, which in many cases coincide; sharing a story with friends usually involves browsing, and so these labels were often applied together. We made the distinction whether the focus of the activity was on the social aspects (labelled *sharing*), or on memory retrieval (labelled *browsing*).

Perhaps due to the setup of the study, some of the activities were less represented in the results than one would expect: e.g. capturing is very important, but the activities were focused on the moment after capturing, and therefore only 13 of the 171 activities were tagged with *capturing*. Instead, participants mentioned using their photos very actively for sharing, browsing, and retrieving. Also, sharing was less often mentioned as an activity than one would expect. Sharing is an essential aspect of (mobile) digital photography, and the emphasis on the other aspects might be caused by the individual setup of the interview in the home. The *collecting* activity, although appearing in only 8 of the 171 descriptions, is important when broadening the scope of 'media' beyond photographs, which poses an additional challenge: every type of memory cue that we need to curate, but is not created by ourselves, may at some point in time include media that we do not yet consider as autobiographical digital media, e.g., public transport timestamps or

[7] Curation on mobile devices is not addressed in particular in this thesis, but the topic was explored in collaboration with a team of MSc students from the Industrial Design department, which resulted in the following publication: Zürn, X., Damen, K., Leiden, F. van, **Broekhuijsen, M.** and Markopoulos, P. (2017). Photo Curation Practices on Smartphones. In: *Proceedings of ACE 2017: 14th International Conference on Advances in Computer Entertainment Technology*, December 14 - 16, 2017, London, UK. Springer. pp. 406-414 DOI: https://doi.org/10.1007/978-3-319-76270-8_28

electronic shopping receipts. These media need to be considered in future curation solutions (see Whittaker, 2013).

Although we reported the frequency of occurrence of the different activities in the results, as well as the occurrence percentages for the purposes, the goal of our study was to reveal *which* activities occur rather than accurately compare their prevalence, and how they relate to each other. In this explorative stage, we did not want to emphasise certain activities, even though they might have occurred more often in this particular group of participants. Despite the small sample size, the differences in age, demographics and life stages of the participants provided sufficient variety to consider these results for designing tools to support photo activities. To be able to generalise the results, it would be useful to extend our research to include extreme cases regarding, e.g. collection size, age, or familiarisation with technology, and different demographics.

3.5.2. New Technologies: New Behaviour

Part of the challenge of this study was to identify current photo activities and relate them to those described in the PhotoWork model (Kirk et al., 2006) that we introduced at the start of this chapter. The constraints of technologies and resulting practices have slightly changed since the work of Kirk and colleagues. New activities that come with the use of new technologies have had an impact on available photo activities: social media platforms have innovated photo sharing, and smart camera phones have changed the way we think about photography, the frequency and the context in which we capture and share photos.

> *"I have grandchildren in Italy, and one of them recently got an iPad, and I got a new washing machine. He (...) is crazy about washing machines. So, my cleaner (...) makes a photo with her smartphone, and then sends it to me via email so that I can forward the photo to my grandson" - S01P06 (female; age 69; 7,000 photos)*

As illustrated by this example, the specific stages and the strict linear workflow of previously mentioned digital photo activities seem to arise from the lack of, e.g., network connectivity for cameras, and the fact that people use personal computers to store and manage collections. Figure 3.4 illustrates three examples of the photo activity *sharing* that skip multiple parts of the PhotoWork framework. In the figure, the PhotoWork model is depicted in blue; the coloured arrows illustrate the opportunities to skip several stages within the model. The red arrow illustrates the activity of "selecting a photo on a camera phone for sharing on Facebook" (as demonstrated by S01P01); the green arrow illustrates "sharing a photo directly from the camera phone with Whatsapp Messenger" (S01P05); the purple arrow illustrates "making a postcard for a friend, using the in-app printing service from Instagram on a smartphone" (S01P03). In many occasions, the descriptions by participants indicated that they did not even seem to realise that sharing is part of a chain, as camera phones connected to the Internet enable faster ways of (remote) sharing, compared to the previous workflow that involved getting images from the camera to the computer and share it over the Internet using a desktop computer.

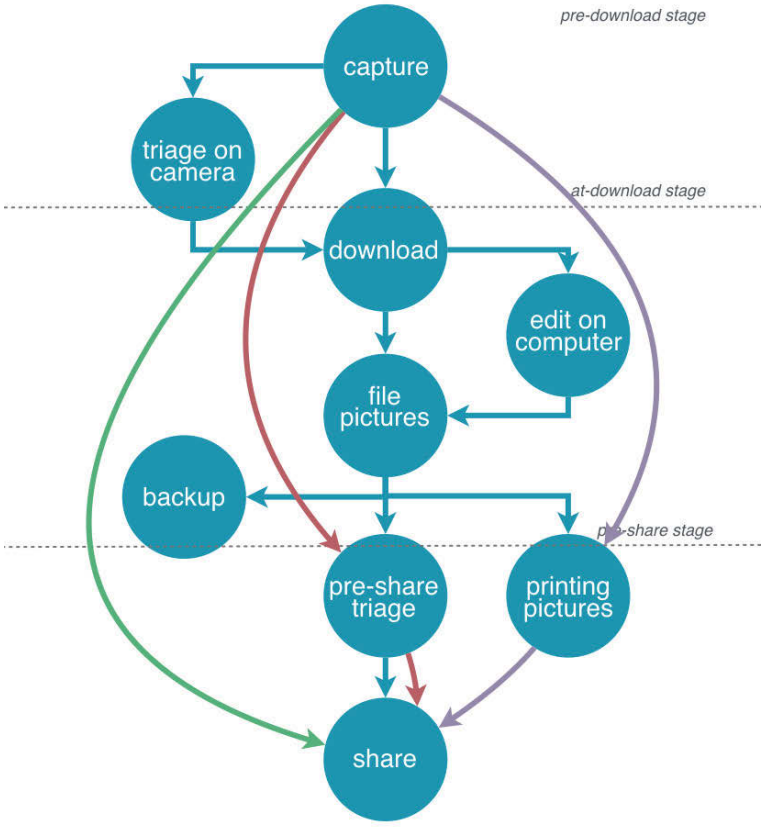

Figure 3.4: The functionality of novel software and hardware tools, such as smartphones, to the PhotoWork framework (blue) enables new interactions: the green, red, and purple arrows illustrate the photo activity *sharing* that bypass multiple stages of the PhotoWork model because technology enables it.

Although the activities that we found could all be mapped onto the PhotoWork model, their temporal sequence appears to be more varied, where the start and end of the activity are less clearly defined. The example of sharing a photo via Whatsapp Messenger can also start by capturing a photo from within the chat application, arguably *reversing* the process described by the green arrow in Figure 3.4, starting the sequence at sharing, and ending with capturing a photo to support that specific conversation.

Figure 3.5 provides an alternative way to visualise an example of the multi-threaded process of the photo activities that we found. Described is the case where browsing through your photos reminds you of a set of photos of you and your friend, which you decide to retrieve, select (*triaging*), crop (*edit*), print and send (*share*). A single activity has then moved rapidly through several activity categories. The dotted line in Figure 3.5 illustrates that the PhotoWork process is one of the possible sequences of use and that the activities from the PhotoWork model are still present in current practices, but not necessarily as a temporally bound process.

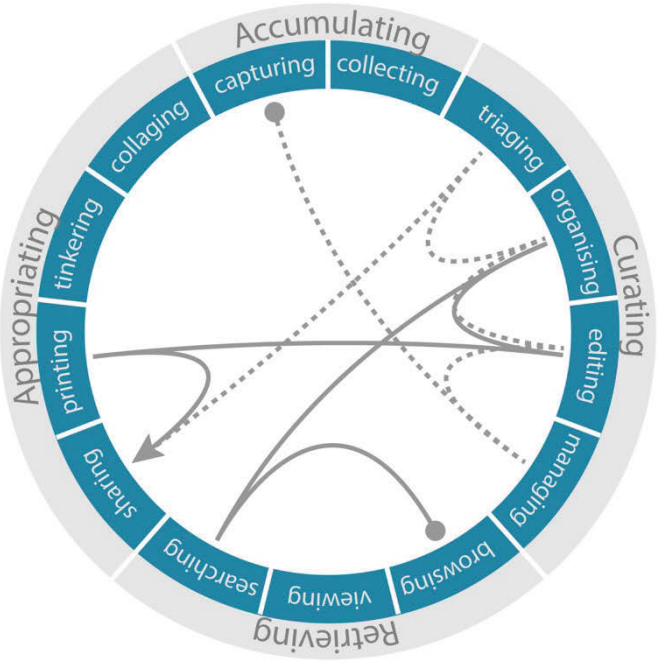

Figure 3.5: Overview of all photo activity categories and activity types identified in this chapter, displayed in a continuous model. The outer circle displays the four *photo activity types*; the inner circle displays the 13 *photo activity categories*. The solid line, starting from browsing and leading to sharing, illustrates one of the many possible photo activities that can take place. The dotted line describes the workflow of the PhotoWork process (Kirk et al., 2006), which is one of the possible sequences of use.

3.5.3. Composite Photo Activities

Moreover, our data strongly indicate that the boundary between different photo-activities is not always clearly discernible to people, which also made it hard to code the activities with only a single tag. We found that participants engaged in multiple photo activities that follow one another, or between which they alternate. As a consequence, it was difficult to determine what participants consider as a singular photo activity. In the labelling of the activities, there were 101 activities that received only a single label, 70 had two or more labels. For example, the activity *sharing* was reported as being a single activity, but in fact, the actual sharing of a photo appeared to be part of a chain of activities. In this example, sharing the photo starts with capturing:

> *"In certain weather conditions, for example, snow, I also take a photo to share on Facebook, to say "this is how it was"." - S01P04 (male; 28; 2,000 photos)*

> *“I take, for example, many photos, which are for Whatsapp – then I send a photo of where I am, what I am looking at or what I am doing.” - S01P02 (male; age 29; 25,000 photos)*

Figure 3.6 illustrates all the actual activities that were explained by the participants as a single activity but in fact consist of multiple activities and were in the analysis tagged with two or more tags. Especially triaging and sharing are typically connected to one or more other activities, while, e.g. collaging and tinkering appear to be more isolated activities.

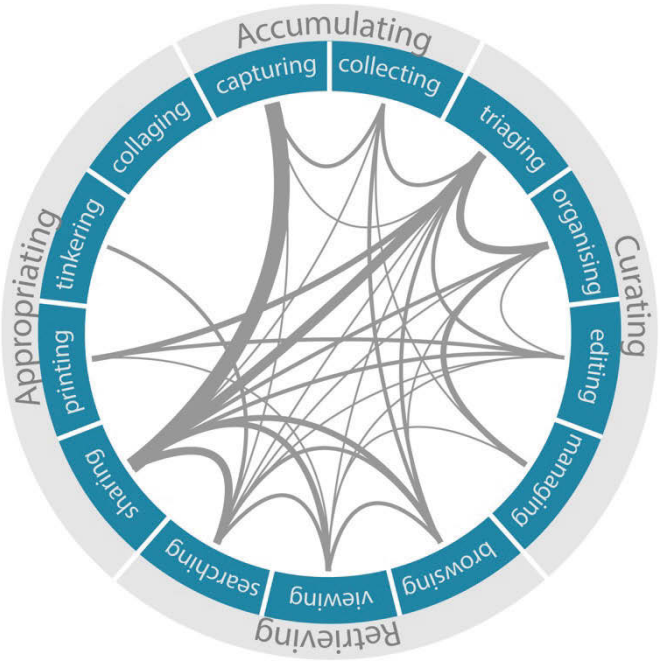

Figure 3.6: Illustration of all the photo activity categories that are linked to each other, derived from the description of the 70 photo activities that were tagged with two or more tags in the analysis. The outer circle shows the four *photo activity types*; the inner circle shows the 13 *photo activity categories*. Each line describes connected activities, from the examples given by the participants. The line thickness indicates the occurrence of the respective combination. Sequences depend on the context, and so there is no predetermined order, starting point or end. The collaging activity is the only activity that was described that was not connected to any other activity.

3.5.4. Photo Activity Motivations and AM

We made a distinction between individual and utilitarian purposes based on the data: many photo libraries of the participants contained a combination of leisure photos as well as practical photos, e.g. photographed receipts and screenshots of online purchases. The activities that had as their primary purpose to retrieve specific information from those practical photos were labelled as having a utilitarian purpose. Content-independent file management, such as moving large parts of the collection to a backup hard drive, is also labelled as having a utilitarian purpose.

Most of the reported motivations for photo activities were related to a social purpose (e.g. sharing; storytelling), using the photos as cues for our autobiographic memory. Bluck et al. (2005) summarised some important functions of AM in our lives, including a social function, a self-preservation function and a directive function. In addition to these functions, an adaptive function has been described by e.g. Bluck (2003) and Cohen (1996). Because we are interested in the relation between photos and memories, we speculate here on the relation between the purposes that motivate engagement with memory-inducing photos of photo activities, and the function of AM. The result can be found in Table 3.3. Our proposal that the purposes of photo use relate to

the functions of AM supports our point of view that people are motivated to engage with digital photos to support autobiographical remembering.

Table 3.3: Purposes of photo activities related to the functions of AM (Bluck, 2003).

Photo purpose	**Functions of AM (Bluck, 2003)**
Social purposes	*Social function* (e.g. bonding, maintaining relationships)
Individual purposes	*Adaptive function* (mood regulation) *Self-function* (construction and maintenance of self-concept and self-history)
Utilitarian purposes	*Directive function* (making plans for the future based on past experiences)

Not all the photo activities are serving a higher purpose since some photo activities are intended to be entertaining in themselves. Some of the participants in this study were photo enthusiasts, and therefore the enjoyment of photography, editing and organising were present. We want to stress the difficulty of asking participants about their motivation for behaviour, as they are generally unaware of the underlying motivation for their behaviour.

By looking at the motivations and purposes of domestic photography that are described in the related literature from, e.g., van Dijck (2008) and Sarvas & Frohlich (2011), we can relate our considerations to the purposes that they found. From their research, we understand that there is a distinction between the purposes related to a) communication, social bonding, demonstration of cultural membership; b) self-presentation, identity formation; c) preservation and retention of (family) memories (van Dijck, 2008; Sarvas & Frohlich, 2011). The purposes that we defined based on our data include the same array of purposes, although we divided individual and social purposes. In reality, the line between a social and an individual purpose is not so well defined, because, e.g. self-presentation to a social group is also part of identity formation.[8]

3.6. PHOTOUSE

To make a distinction between the *purposive use* of photographic material and the *work* of photo accumulating, curating, retrieving and appropriating, we suggest the term *PhotoUse*. In line with the suggestion of Kirk et al. (2006) that searching and browsing tools should be part of other activities within PhotoWork, designers can benefit if they focus on finding design opportunities to enhance the experience of photo work, by focusing their designs on contributing to one of the purposes of the photo activities.

[8] Although we did not follow up on the theme of identity formation in the core of the PhD research, we supervised a Master graduate student at the department Industrial Design at TU/e who worked on identity display for teenagers, which resulted in the following publication:
Hermans, L., **Broekhuijsen, M.** and Markopoulos, P. (2017). Memora: a Design for Teenagers to Connect Virtual and Physical Possessions. In: *Proceedings of ECCE 2017: European Conference on Cognitive Ergonomics,* September 20 - 22, 2017, Umeå, Sweden. ACM, New York, NY, USA. pp. 121-128 DOI: https://doi.org/10.1145/3121283.3121312

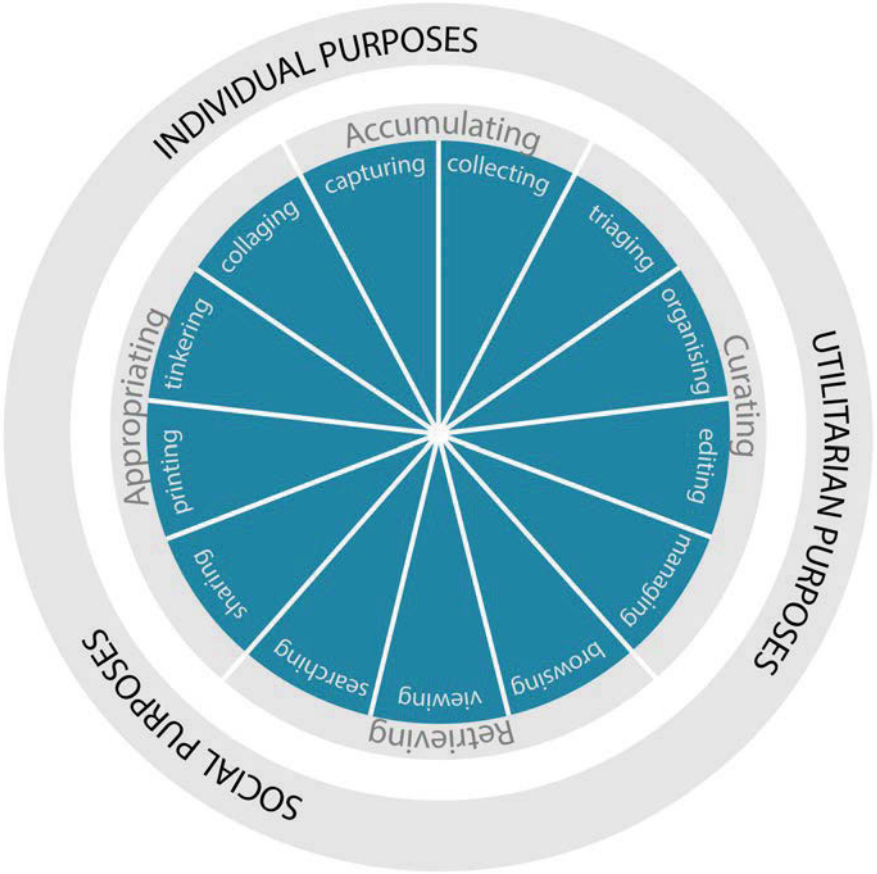

Figure 3.7: Model of PhotoUse. The outer circle displays the *social, individual,* and *utilitarian* purposes that motivate the photo activities. The purposes are not connected specifically to the activity types that are close to them. The middle circle shows the four *photo activity types*; the inner circle shows the 13 *photo activity categories*. The inner part of the model, where the activities meet each other, shows that all any activity can potentially be connected to any other activity.

To be able to base design and assessment of tools to support purposive PhotoUse constructively and to emphasise the user experience, we propose an alternative way of visualising the photo activities. By analysing the activities and demonstrations of the 12 participants in our study we were able to conceptualise a model to provide an overview of PhotoUse. The model shifts the focus away from the tasks and work involved, and their temporal ordering, to the instrumental purpose such work serves, identifying different ways in which subordinate activities relate to each other to serve different needs. All the activity categories are connected to each other in the centre, to illustrate that any activity can be connected to any other activity. This holistic perspective illustrated by the PhotoUse model forces designers to consider all aspects of the photo practices that they want to support. The PhotoUse model can be found in Figure 3.7.

The PhotoUse model contains all the activities that together describe PhotoUse. To illustrate our focus on the purposes that motivate behaviour, we placed the purposes around the

photo activities, but their location in the model should be viewed as independent from the activity types in the next layer. An example one can think of is, e.g. capturing a photo with the motivation to reminisce in the future, or capturing a photo to share an activity via social media.

The abstracted PhotoUse model represents a holistic approach towards photo activities where the different activities are not necessarily distinct but can be engaged in conjunction with each other, illustrated by the connections in the model. Furthermore, it illustrates the importance of user needs that motivate behaviour. The model might serve designers that are developing solutions for purposive PhotoUse, and researchers that focus on media supported social activities, such as storytelling and reminiscing. More detailed implications of the PhotoUse model can be found in the next section.

3.7. IMPLICATIONS FOR DESIGN

There are plenty of technological offerings aiming to support capturing, retrieving and sharing. There are technological solutions that enable people to reminisce and browse photos, but since those solutions are not specifically designed for mnemonic purposes, they are in many cases less suitable than the participants would like. Tools are often developed with a focus on productivity, and not on the user experience. Our findings suggest that people want to switch freely between different photo activities. The tools that they use should support and facilitate such freedom. The PhotoUse model can be used in the design process to keep an overview of all the photo activities, thus making sure that challenges (such as retrieving, triaging, and searching) are not addressed in isolation, but are considered holistically within the context of a complex chain of activities. In other words, we see opportunities for interactive tools that support the purposes of PhotoUse *while* engaging in photo activities, such as photo *curating*. The following recommendations are intended to contribute to the design and assessment of such tools, with the specific focus on the autobiographical purposes of PhotoUse, either individually (*reminiscing*) or shared (*storytelling*).

3.7.1. Purposive PhotoUse

We encourage designers of photo curation tools to emphasise that less enjoyable activities can be embedded in the PhotoUse activities that people can enjoy, and do not have to be designed and perceived as separate *tasks that have to be done*. We need to ensure that enjoyment becomes part of curation work. One opportunity for encouraging curation is our observation that triaging in the final step before sharing is being frequently done, because participants do not consider this as "work", but instead they consider it as gratifying. Especially social activities such as weddings and anniversaries inspire the curation and careful triaging of photos. This implies that it is possible to make curation more enjoyable if the purpose of the activity is clear. Since curation seems to be inevitable and important, tools can pay attention to emphasise for the user what the purpose of the curation activity is, seamlessly integrating into and contributing to more

pleasurable photo activities people engage in such as browsing and reminiscing. We did not specifically study which of the photo activities were the most pleasurable and which were the most burdening, the PhotoUse model can be used to identify the most promising combinations of burdening activities, enjoyable activities and purpose.

3.7.2. System-automated Curation

Supporting curation is important for a successful use of the whole photo collection. To help participants think about their curation issues, we asked how they thought about delegating the curation of the collection to an intelligent system that could do the triaging for them. Almost all participants were hesitant, and reported that they would like to stay in control of their collection:

> *"But (...) how would they know what structure I want? Perhaps you need an intake. (...). Some simple things might be nice to have done (...) but they can only do that with the items that I have not yet organised (...), but they should do it the same way as the rest" - S01P10 (female; age 34; 3,000 photos)*

> *"It is dangerous to let a program manage your database, as it went wrong when I used iPhoto, and that is not what you want. Because you don't know any more what is going on." - S01P02 (male; age 29; 25,000 photos)*

This provides designers with an interesting challenge since we found that participants do not automatically accept the support from automated photo-collection management tools to do the curation for them, but are also reluctant to do the curation themselves. The balance between automation and manual control is not a new challenge (see, for instance, Parasuraman, Sheridan, & Wickens, 2000). Even in systems that appear to have been successfully automated – e.g. online shops, helpdesks, and computer-aided learning – people prefer to have manual control over their actions. In these cases, technology has re-established opportunities for manual control via e.g. chat windows, teacher contact, and community networks. However, lack of manual control is not the only argument for avoiding complete automation: findings from the work of e.g. (Stevens et al., 2003) show that the activity of curating and annotating can also increase the value of the objects. In line with their findings, S01P03 explained the process of making an album as a way to "frame the memory", which was clearly an enjoyable process to her that should not be automated. Curation can be *aided* by a semi-automated solution, one in which the user is helped by the system but remains in control. Such systems might be more helpful to the user if they act more in line with the purposes that motivate the curation activities. The PhotoUse model can help the designer to consider those purposes.

3.7.3. Collaborative PhotoUse

In agreement with Frohlich et al., (2002), Kirk et al., (2006) and Durrant et al. (2008;2009) we see opportunities to deal with shared collections better, e.g. opportunities for curation solutions

when multiple users own a photo collection, which remain relevant and yet unresolved to date.[9] The described activities presented in this research were in many cases done by participants alone, while at the same time many of the activities were done with a social purpose. Although our research setup was geared towards individual photo use, a number of individual activities with a social purpose provides opportunities to improve the experience of media-supported sharing.

Sharing more than a single photo with friends and relatives complicates photo use. Especially the participants that are parents (3 out of 12 participants), or grandparents (1 out of 12) reported the difficulty of shared responsibility for a family collection. A similar complexity was seen where people depend on the curation skills of others, e.g., children depending on parents for the curation of their childhood. As one father said:

> *"[The children] are sloppier. (...) It wouldn't surprise me if [the pictures] have vanished at some point, so that's why I ask them to send them to me." - S01P11 (male; age 55; 16000 photos)*

> *"I try to capture the nice events (...). I got [an album] from my parents from my childhood as well (...) so it is nice to have, and it is, after all, a testimonial of your childhood, I want to have that for my daughter as well" - S01P08 (male; age 40; 300000 photos)*

Designing for collaborative PhotoUse provides opportunities for reducing the workload of collection management and is a promising direction for aiding the perceived burden of photo curation, and also provides opportunities for shared remembering.

3.7.4. Context-Dependent PhotoUse

The finding that participants want a dedicated subset of their photos for specific social situations is in line with the literature on *storytelling*, which occurs when the conversation has been adapted and tailored to a specific audience. Selection of words, topic and ordering sequences are adapted to the recipient of the story (for more elaboration on *recipient design*, please refer to Sacks, Schegloff, & Jefferson, 1974). Making specific folders for different audiences is also in line with the findings of, for example, Odom, Zimmerman, & Forlizzi (2011) that people experience the need to express themselves differently in different situations. The variety of activities that we found seemed to depend on the audience and the context. This form of identity-display in various social contexts, established using digital photographs, was also reported by Frohlich et al. (2002). Current tools do not incorporate the flexibility that is needed to support different contexts. In short: people often do not have the right picture at hand when they need it, as illustrated by S01P01:

> *"When I (...) go to my parents with the goal to view my holiday pictures, I again have to make a selection. That means extra effort because I need to make that selection before the visit" - S01P01 (male; age 33; 50,000 photos)*

[9] In this thesis, the collaborative organisation of a shared collection is not addressed, since shared collections are often still organised by a single person, or the collections are split between partners (see also Chapter 6).

Several participants commented on the need for intelligent systems that can adapt to fast-changing activity patterns, as illustrated by the comment from S01P10:

> *"I browse for 10 minutes, and then I am distracted by something on the Internet, and then I think of something funny for which I switch back to my photo library, (...) and so it goes back and forth." - S01P10 (female; age 34; 3,000 photos)*

Due to technological advances, the lifecycle of photos is becoming more complex, and more unpredictable, and people are getting more demanding. Tools that support storytelling need to adapt to the different contexts and desires of the user. We, therefore, see opportunities for context-dependent selections, to serve as a valuable contribution to storytelling.

3.8. CONCLUSIONS

This chapter has contributed an investigation into the use of photos for autobiographical purposes. Based on contextual interview data that was analysed qualitatively, we have found that there are many different activities around photos that people engage in. We also found that the activities that we identified often take place simultaneously, or are part of the same overarching activity **[RQ.1]**. Compared to printed photos that can be kept e.g. within a book in a specific location, the lifecycle of digital photos is becoming more complex and less transparent with the introduction of new connected technologies, such as smartphones, but those also afford more flexible use of photos. People using those technologies also expect that more things are possible concerning photo usage. For example, from the photo curation activities (triaging, organising, editing and managing) that we identified in this study, we saw that people tend to tailor specific photo selections to different (social) contexts, yet context-dependent selection is not widely supported in currently available photo tools **[RQ.2]**.

We identified that the photo activities are mostly motivated by a purpose, the participants often related to social interactions, such as (remote) sharing and shared reminiscing. Curation practices can be more gratifying if people have a clear purpose in mind, but most curation activities are often separated from the use of the curated photos, dictated by the curation tools that are used **[RQ.2]**. To make curation more enjoyable, novel tools could emphasise the purposes by bringing the activity of curation and its purpose (such as shared reminiscing) closer together **[RQ.3]**.

To utilise insights from this study for future research and design, we have argued for an alternative perspective concerning photo activities: from the lifecycle of a single photo (PhotoWork) to the interplay of different photo-related activities and the purposes that motivate them, which we called PhotoUse. This perspective and model of PhotoUse arose out of interviews with participants that focused on the needs, experiential goals and purposes motivating photo usage rather than just the operation of the technology involved **[RQ.1]**. We suggest that the

PhotoUse model can be used to illustrate the dynamic and flexible set of photo activities that people engage in, inspiring the design of novel technologies to support people in their social, individual and utilitarian purposes of photo activities **[RQ.3]**.

In the next chapter, we will report on a design exploration with a focus on the social aspect of photo use. Even though individual motivations for photo use provides fascinating research opportunities (e.g. using media for everyday reflection, as presented by Mols, van den Hoven, & Eggen, 2016), we were inspired by the prevalence of social motivations that we found in the study described here, and we are interested in designing curation tools to support shared remembering practices specifically.

CHAPTER 4.
DESIGN OPPORTUNITIES FOR PHOTO SHARING

Chapter Summary

In the previous chapter, we presented our model of PhotoUse activities and prevalence of social purposes that motivate them, next to individual and utilitarian purposes. We connected these purposes to the functions of autobiographical memory, and we identified connections between photo sharing activities and photo curation practices. To better understand the opportunities for designing for curation practices with a social purpose, this chapter addresses how to look back at the already curated photos, especially to support shared remembering, because people create photos often with the intention to use them for shared remembering. In the last decades, practices have changed around digital photography, along with advances in media sharing technologies such as smartphones, social media, and mobile connectivity. Although much research was done at the start of digital photography, many valuable insights that were gathered have not yet found their way into commercially available tools for media-supported shared remembering. The objective of the study presented in this chapter was to explore design directions to support the use of photos for collocated sharing better. In this chapter, we present design requirements that resulted from a redesign workshop with fifteen participants, and four design concepts that we developed based on those requirements. By reflecting on the requirements and designs, we conclude with four design challenges for design to support collocated remembering practices.[1]

[1] *This chapter is based on:*
Broekhuijsen, M., Hoven, E. van den and Markopoulos, P. (2017). Design Directions for Media-Supported Collocated Remembering Practices. In *Proceedings of the TEI'17: Eleventh International Conference on Tangible, Embedded, and Embodied Interaction*, March 20 - 23 2017, Yokohama, Japan. ACM, New York, NY, USA. pp. 21-30. DOI: http://dx.doi.org/10.1145/3024969.3024996. My role in this publication was the setup, execution and analysis of the study, and I did the majority of the writing in consultation with my co-authoring supervisors. In this chapter, "we" refers to myself and my supervisors. Although the design work was done by me, the designs were discussed often with my supervisors, I will therefore also refer to "we" in the sections about concept design.

4.1. INTRODUCTION

Sharing memories has been an essential part of people's social interaction for millennia. Traditionally, shared reminiscing and storytelling occur when people are collocated (for example, Frohlich et al., 2002; Harris et al., 2014), and despite increased opportunities for remote memory sharing, *collocated remembering* remains a popular activity. In such settings, the narratives about one's life are frequently supported by personal media, such as photos. Since the widespread adoption of domestic digital photography at the start of the century, people create many digital photos with the purpose to explicitly use them as support for sharing memories (see, e.g. van Dijck, 2008; Frohlich et al., 2002; Durrant et al., 2009; Lindley, Durrant, Kirk, & Taylor, 2009; Whittaker et al., 2010). Photos can be instrumental for memory sharing because of their ability to cue memories related to our lives, our autobiographical memories (Conway & Pleydell-Pearce, 2000; van den Hoven & Eggen, 2014). Although autobiographical memory serves several functions in our lives (Bluck et al., 2005), for our research we are interested in the social function of autobiographical memory, e.g., bonding, maintaining relationships and making friends (Bluck et al., 2005).

As we have outlined in the previous chapter, the advances in media capturing and media sharing technologies have changed the practices surrounding digital photos (e.g. Frohlich et al., 2002; Kirk et al., 2006; K. Rodden & Wood, 2003; Van House, 2009). For example, we transitioned from viewing photos in carefully curated and preserved family albums to the use of digital collections, often with chaotic structures, that are distributed over different devices such as smartphones, computers, cloud storages, and different people. While the practices change, the purpose of sharing practices is still primarily to share memories or tell stories (Whittaker et al., 2010). Frohlich et al. (2002) made the distinction between the conversation types *reminiscing talk* and *storytelling*: reminiscing talk occurs when all individuals have been present at the original event; storytelling occurs if a person shares memories of events the others did not attend. We refer in the remainder of this chapter to *shared remembering*, which can consist of reminiscing talk or storytelling, or a combination of the two. In our research, we are interested in the changing practices around the use of photos for shared remembering purposes. The objective of this chapter is to explore design directions to better support the use of personal photos for collocated shared remembering.

4.2. RELATED WORK

In this section, we will discuss related work in the fields of Psychology, Human-Computer Interaction and Interaction Design that relates to mediated remembering and collocated photo sharing.

4.2.1. Collocated Remembering

One of the primary purposes of sharing memories is to engage with each other socially. Van House (2009) argues that shared reminiscing reinforces shared past experiences, thus strengthening relationships in the present. Nelson (1993) even argues, that our autobiographical memory system only exists because of its function in interpersonal communication. Part of shared remembering is the notion of *cross-cueing*, or *interactive cueing* (Wegner et al., 1985), where one person's memory and conversation triggers the memory of others. However, as we have introduced in Chapter 1, our autobiographical memory can also be triggered by external triggers, also referred to as *memory cues* (Sellen & Whittaker, 2010; van den Hoven & Eggen, 2009; 2014). Upon encountering a memory cue, such as a digital photo, related memories can be reconstructed (Guenther, 1998). The resulting memory is influenced by, e.g., the timing of the cue, the context, (social) situation and emotional state of the person (e.g. Harris et al., 2013).

4.2.2. Media Tools

Tools to support cueing and remembering are developed to accommodate the changing media types and media collection dynamics. Especially smartphones allow people to collect high-quality photos with a device they always carry with them, while before cameras used to be taken out only for holidays or special events. The ease of which people take photos has increased dramatically in the past two decades and therefore also the volumes of photos.

Technologies for photo sharing can be distinguished by their intended purpose. First, tools for managing and organising digital photos (e.g. Kirk et al., 2006; K. Rodden & Wood, 2003), which are essential for making the right content available for sharing. Secondly, technologies for remote photo sharing (e.g. Crabtree et al., 2004; Frohlich et al., 2002; Van House, 2009). Thirdly, tools that support viewing of photos. For *remote* photo sharing, there are many commercial tools available, such as *Whatsapp* instant messaging[2], and social platforms like *Facebook*[3]. There are only a few technologies specifically designed for *collocated* sharing, e.g. streaming devices such as the Apple's *Apple TV*[4], which allows users to show content from portable devices onto a large (TV) screen (for more examples, see Chapter 2). Generally speaking, all devices with a display and some storage capability can be used to display photos, although they are not specifically designed to support shared remembering practices, but rather focus on *individual* collection management and retrieval. Even digital photo frames are used as decoration rather than for interactive co-viewing of photos, while they were intended to support collocated viewing.

In research, we have seen more promising examples of collocated photo sharing solutions. We provided an overview of these tools in Chapter 2, but here we would like to highlight a few examples that are relevant to this chapter. The range of examples includes *4 Photos* (O'Hara et

[2] www.whatsapp.com, retrieved March 6, 2017
[3] www.facebook.com, retrieved March 6, 2017
[4] www.apple.com/tv, retrieved March 6, 2017

al., 2012), a concept for shared viewing of Facebook content during dinner, and *Shoebox* (Banks & Sellen, 2009), a combination of a photo display and a storage device, placed in the living room. We have also seen tools that, for example, enable projection of multiple photos on the wall (Petrelli et al., 2014), playful interactions with photographic content (Meerbeek et al., 2010) and new software solutions that combine several existing devices to create a shared viewing experience (Lucero et al., 2011). These examples also make better use of the context and space in which they are used. Specific media tools to support storytelling can be found in research as well (e.g. Balabanović, Chu, & Wolff, 2000; Meadows, 2003). Various commercial tools offer a narrative structure: either automated, e.g. *Stories* in Google Photos[5], or Facebook's *Year in Review*[6]. These tools show promising directions for storytelling, but they also do not explicitly support collocated shared remembering, mainly because they are geared towards a single person's activities, their photos and their interaction with the story.

4.2.3. Media Practices

Along with the technology, the practices around photo sharing are changing, as we have detailed in Chapter 3. Frohlich et al. (2002) investigated the photo sharing activities that take place in the home, with the goal to identify opportunities for new photo technologies (*PhotoWare*). There they made a distinction between collocated sharing and remote sharing, and between synchronous and asynchronous sharing (See Table 4.1). A few years later, Kirk et al. (2006) introduced a model outlining routine photo activities (*PhotoWork)* leading to sharing, and more recently, Lindley et al. (2009) emphasised the influence of technology on social practices surrounding digital photos and vice versa. Moreover, Van House (2009) argued that the experience of collocated photo and story sharing enacts the relationships between owner and viewer. New photo (sharing) technologies are being adapted by users to support these sharing activities better (Van House, 2009). In Chapter 3, we emphasised that the complex set of practices, which we termed *PhotoUse*, should not be studied or addressed in isolation. Our holistic model also facilitates the design of tools that support sophisticated experiences such as media supported remembering.

Table 4.1: Dimensions of Photoware, based on the work of Frohlich et al. (2002)

	Same time (synchronous)	**Different time (a-synchronous)**
Same place	Collocated sharing	Archiving
Different place	Remote sharing	Sending

[5] www.google.com/photos/about/?page=stories, retrieved via the web.archive.org, version February 7, 2016. Service terminated in March 2016.
[6] www.facebook.com/yearinreview, retrieved March 6, 2017

4.2.4. Design Challenge

Despite the efforts in research to innovate the experience of collocated photo sharing, commercial tools appear to be limited in their support for shared viewing. Therefore, our design challenge was to identify the limitations of current tools and to explore the opportunities for tools to support collocated shared remembering better.

4.3. REDESIGN STUDY

To understand people's needs and desires for the future of collocated photo sharing, we invited participants to take part in the design process. The study aimed to provide us with information about the value of common photo sharing scenarios, as well as ideas and concepts aimed at improving the tools that support those scenarios.

4.3.1. Method

The way we investigated this started with a co-design session with 15 participants. We started our inventory of limitations and desired improvements of current tools with a redesign exercise with a group of participants, because co-creation methods allow people to express themselves through showing and discussing what they create (e.g. see the work by Sanders & Stappers, 2008, who argue that by studying what people make we can know what they need). Four separate teams of 3-4 participants analysed existing sharing tools and listed what they liked and did not like about those tools. We based the redesign method on the method described by Frohlich, Lim, & Ahmed (2014), who used a light-weight method that asks participants what they want to *Keep*, *Lose* or *Change* in existing designs. We applied this method because the participants had no prior experience with design methods. Based on their analysis, the teams redesigned the sharing experience entirely. After the session, we formulated the requirements based on the recorded discussions and co-design decisions. Based on the requirements, we developed several concepts in an iterative design process. By reflecting on the requirements and the integration of the requirements into the concepts, we realised that there are several challenges for designers. In this chapter, we formulate those challenges as tensions for designing future tools for media-supported collocated remembering practices, and we include possible ways to address the challenges. Our process is outlined in Figure 4.1.

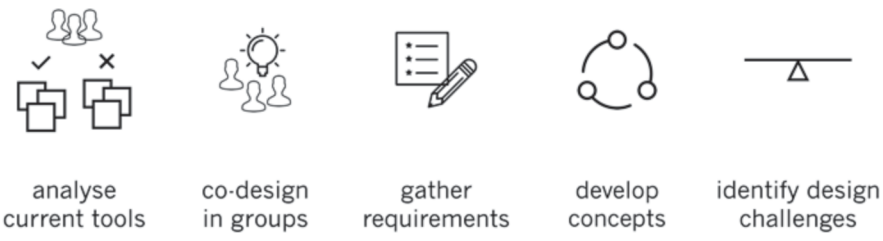

Figure 4.1: The process used for gathering requirements through a co-design session, followed by an iterative design process, which helped us to identify design challenges

4.3.2. Participants

The participants had to be familiar with each other (which was important for the redesign exercise), they had to own a digital camera or a smartphone, and they had to be well acquainted with digital photography, online sharing services and social platforms. Each participant had to own a collection of at least 2.000 digital photos, which ensured that they had experience with sharing from a large collection. The convenience sample of 15 participants were male Dutch university students, between the age of 18 and 25. We recruited participants via a student fraternity that contacted me personally because they were interested in contributing to my research. They were all enrolled in different courses (mainly law, business and medicine, none of them in engineering or design-related areas). Apart from the unbalanced gender, all fraternity members matched the requirements, and the existing social bonds between them made them especially suitable for our study.

4.3.3. Session Procedure

Supported by a member of the fraternity, we organised one redesign session lasting about 2 hours 15 minutes, roughly divided into three parts: a warm-up exercise, a team analysis of current photo sharing scenarios, and the actual redesign exercise. We held the session in a house where 4 of the 15 participants lived because it was a familiar environment for all participants.

Warm-up

The warm-up with the whole group consisted of 15 minutes to introduce the background of the research, followed by 30 minutes to practise the design process through a redesign case. We formulated the design case as *"the use of a smartphone for collocated sharing of a personal photo to support storytelling at home"*. First, we asked each participant to show a single photo to another participant using their smartphones and to tell a story related to the photo. Afterwards, each participant was asked to indicate from this sharing scenario what aspects they liked (wanted to *Keep*), what they did not like (*Lose*), and what aspects they would want to change (*Change*). They wrote these aspects down, and the participants briefly explained all the notes to each other.

Listing Photo Sharing Scenarios

After the first analysis, we asked the participants to come up with as many examples of other collocated photo sharing scenarios, to write those on notes and to discuss them in the group. This exercise was used to prioritise the scenarios that were most common for this group.

Redesign Exercise

The resulting list provided the scenarios that the participants redesigned in teams of 3-4 in the second part of the session, lasting 90 minutes. In the first 45 minutes, each team analysed the existing tools that are used in their scenario. They used the same method as they had practised before, with the goal to identify issues with the existing technologies and practices and to think of

points for improvement. In the last 45 minutes, we asked the participants to come up with new concepts that could support their improved scenarios of collocated photo sharing. They made sketches and presented the concepts to each other.

4.3.4. Data gathering & analysis

The group session was audio recorded, as was each team discussion. The audio ensured that we captured the richness of the discussion. The most informative parts of the session were the discussions of the limitations and the valued aspects of current tools and practices for each scenario. In the analysis of the recordings, we focused on identifying the issues for the different areas of interest, primarily requirements for the experience of sharing, and insights in the curation that is required for sharing. To support the audio, we encouraged participants to write all the aspects of their analyses on post-it notes, which were used afterwards to help generate an overview of the values, issues and opportunities for each sharing scenario. Selective transcription (Gilbert, 2008) was used to gather the data from the audio. We decided for selective transcription because we wanted to limit our analysis in the next phase to the recordings that contained information that was key to understanding the limitations and opportunities for improving current photo sharing tools. In the recordings we looked for details about specific aspects of the scenarios that the participants commented on (as part of the *Keep-Lose-Change* process), as well as the positive and negative aspects of the tools that were part of these scenarios. The post-it notes and the selective transcriptions were all entered in a table to separate the positive and negative remarks. We continued with a thematic analysis (Braun & Clarke, 2006) to identify the values and desires that persisted between groups. We made use of thematic analysis as it aligns with our aim to study the existing and desired practices around photo tools. Based on the findings, we formulated the first set of design requirements that addressed the desires. After the initial requirements, we iteratively refined them to make sure that the requirements were clearly defined and framed. With as little overlap as possible between the requirements, it would become more straightforward to address them in the next design iteration. We collected the quotes that best described the different discussion points to support the requirements, and translated them from Dutch to English.

4.4. RESULTS

This section reports on the findings from the redesign session. We will first give insight into the sharing scenario analysis, followed by requirements specific to curation, and then describe the requirements for the experience of sharing.

4.4.1. Sharing Scenario Analysis

After the group analysis of “sharing photos using a smartphone”, the participants came up with 34 additional collocated photo sharing scenarios. Many scenarios were mentioned by multiple

participants, bringing the unique scenarios to a total of 15. After clustering the scenarios based on the involved technology, a total of 8 unique scenarios remained. The resulting overview can be found in Table 4.2. The first four scenarios were assigned to the four teams because of their prevalence for this group and their social and interactive nature.

Table 4.2: Overview of collocated photo sharing scenarios that participants came up with, of which four were redesigned

Scenario	Example	Occurrence	Redesign
Looking together at photos on a *portable device*	Smartphone, Nintendo DS	14,7% [7]	Team A
Looking together at photos on a *fixed display*	TV, PC, laptop	23,5%	Team B
Looking together at photos that are printed in a *paper photo album*	Printed photos in an album, holiday album	20,6%	Team C
Looking together at photos on a *projection*	Projector	11,8%	Team D
Looking together at photos on a *tablet*	Tablet	8,8%	N/A
Putting a photo *on the wall* as decoration	Collage	5,9%	N/A
Looking at photos in a *photo frame*	Frame with digital or printed photo	14,7%	N/A
Looking together at *printed photos*	Printed photo, Polaroid	8,8%	N/A

The analysis that the participants engaged in resulted in a total of 109 individual data items describing either an aspect that participants wanted to Keep (39 data items), to Lose (44 data items) or to Change (26 data items). In the development of a final redesign, each team came up with 5-10 ideas and based on their preferences for specific features or issues, the final concepts that they presented integrated only the most pressing issues.

4.4.2. Resulting Redesign Concepts

The concept presentations of each team were recorded for later reference. The descriptions of the concepts are summarized based on the presentations. Team A presented the *Virtual Palace,* a concept of a virtual mind palace that is projected as a 3-dimensional holograph from a smartphone. The *Virtual Palace* resembles the house of the owner of the smartphone, and every room in the palace is used to keep specific photo selections. To get photos to the different rooms, one can swipe the photos to those rooms, making this application especially interesting for curation. The *Virtual Palace* can be experienced together because the photos are projected around the people as they move through the real space. However, there are also specific rooms (e.g. the bathroom) that are locked, contain private content and are only accessible to the owner of the photo collection.

Team B presented their concept *SpotyPhoto.* This concept made the fixed screen portable again by integrating a projector into a smartphone. The goal was to make it easy to share photos

[7] The use of smartphones was only mentioned by one participant even though that was one of the often-used means for photo sharing, because the group discussed photo sharing with a smartphone in detail prior to this exercise.

and provide an audio-visual experience by adding music that is matched automatically to fit the photographic content. The popular music streaming service *Spotify*[8] was taken as an example to create playlists, or in this case, a queue of photos to show to others, with the goal to retain privacy and to allow for censoring while presenting.

Team C presented the *VoBlet.* The title is a portmanteau of the words bravo[9] and tablet. The *VoBlet* is a digital family album, consisting of two tablets that, once opened, dynamically show content that is clustered based on different themes, such as a night out, or a specific holiday location. Inspired by the magical photographs[10] from J.K. Rowling's *Harry Potter* books, the photos in the *VoBlet* also move, and even appear as a 3-dimensional holographic photo cloud once the *VoBlet* it placed on the table.

Team D presented the *DeLorean 14.48B,* a futuristic concept with in the name a reference to the time machine from Spielberg and Zemeckis' *Back to the Future*[11] movies. An overhaul of the traditional projector, offering holographic projections, lights, sounds, vibrations and smells to photo sharing. *DeLorean 14.48B* gives perfect image quality from any distance to the screen and adaptable screen sizes to better match the content. The projector itself hovers in front of the wall and projects at an angle of 90 degrees, so the presenter never gets in the way of the image. Presentations can be stored on the device, and navigation is done with a detachable remote control that allows selecting specific content.

4.4.3. Photo Curation Requirements

The requirements in this section were formulated based on the discussions within the teams.

R1. Improve experience of curation

It seems crucial for successful photo sharing that the photo collection is properly curated. That was mostly not the case for these participants, and so most teams discussed how to improve the experience of curation, and how to make it easier. In team A, part of their concept included an easy way to swipe photos into a certain folder, inspired by the interaction used in the popular smartphone application *Tinder*[12]. Participants also found it hard to keep things organised and keep up with the number of photos that are continuously added to their collections. Most participants in the group discussion agreed that the threshold is too high for curation, and, e.g. deleting photos one by one is not feasible. One participant did not want specific photos to be visible in his camera roll, but he also did not want to delete them. Instead, he wanted to hide them from the main view temporarily.

[8] www.spotify.com, retrieved May 19, 2017
[9] *Bravo!* is in Dutch student slang sometimes abbreviated to *'vo!* and used to express approval. It can also be used to support someone during a speech, which is similar to the use of the English expression *hear, hear!*
[10] harrypotter.wikia.com/wiki/Photographs, retrieved May 19, 2017
[11] www.backtothefuture.com/delorean, retrieved May 19, 2017
[12] www.gotinder.com, retrieved March 7, 2017

A participant from Team C argued that the many options that people have to sort their photos also mean that curation itself is part of shaping the memory. He explained that it helped him to construct the story that he wants to tell with the photos, which is also why, for him, making a photo album was enjoyable. The other members of Team C agreed with him.

R2: Make automation more transparent

On a much more technical level, curation tools can be improved by supporting people to manage their collection and enabling (automated) backups. New services to automatically upload photo collections from several devices to a cloud server are perceived to be useful for extra redundancy of the photos, but there is still confusion about how it exactly works. Although some participants found the automated connections to cloud services a useful feature, others were not too happy with the fact that many different services uploaded all the photos by default from an individual's photo to their corporate servers. One experiential implication that was mentioned was that multiple copies of the photos are sent to these services even before people can decide if they want to keep the photo. Once the photo is uploaded, the number of distributed copies makes curation and deleting, in particular, a daunting activity.

R3: Simplify gathering photos from others

One participant commented in the group discussion that it is often difficult to get photos from a friend into his own collection. If he manages to get those photos eventually, they are likely to mess up the chronology of his collection. This process could be automated, but participants also complained that many photos end up automatically in their collections, even though they did not deliberately add them. E.g. photos that are shared through *Whatsapp* are by default saved automatically into the phone's collection. It is possible to disable that feature, but only a few people are aware of that possibility. In Team A, the idea surfaced that *Whatsapp* would be able to know, based on certain people or topics, what photos to save to the phone and what to exclude.

4.4.4. Photo Sharing Requirements

This section provides an in-depth description of the requirements for the desired experience of sharing that we formulated after analysing the recordings and notes from each team.

R4. Tailor content to audience

Tools for sharing should allow people to *tailor* the content to the *audience* because different contexts require different photo selections. Team D argued that the audience would lose interest if the content was not appropriated to them:

> *"[When telling a story] some people were present at the time, and others were not. So, you have to explain everything […], and so some people lose interest. […] It should be possible for the presenter to adjust what he presents while presenting" - Team D*

The need for context-specific selections also holds for individual photo viewing. Because of the growing size of the photo collections on our smartphones, not every photo is relevant, and participants were looking for more control:

> *"I want to be able to determine how [many photos] of certain events I want to see. So how many photos from India, perhaps just a few, but at some point, I want to be able to see more. They should be in [my collection], but not in my album". - Team C*

This requirement also affects the person who is sharing content: privacy is important for participants, and they specifically wanted to hide certain photos from certain audiences. Most teams suggested applying censoring, hiding or locking specific photos to address different audiences. Moreover, most teams agreed that it would be helpful if *on-the-fly* content triaging would be possible, as they had experience with accidentally showing a photo to the wrong person. A common cause was that the next photo in the camera roll was not appropriate, and people either scrolled to the next photo themselves or gave their phone to a friend who scrolled to the next photo. When showing personal photos to multiple people, this issue is even more amplified: on a big screen a photo can be exposed to multiple people at once. In team B, a private queue with "delay" was therefore introduced in their concept, to enable the presenter to preview what would show next using a second screen, a solution very similar to what is already used for, e.g. Microsoft *PowerPoint* presentations.

R5. Embed PhotoUse in narrative structure

Tools for sharing should facilitate storytelling, to support, guide and influence the narrative. Participants often want to share several photos and structure the narrative around them. Not only can the narrative be supported with better guidance from the photos, but it can also influence the narrative. When people are telling a story, it is problematic if they skip a photo that is important for the chronology of the narrative. On the other hand, because storing digital photos is cheap, people take multiple snapshots to capture a moment, to ensure that they have a good one. This creates the need for them to select the ‘best’ photo later, which they often neglect to do. In viewing poorly or non-curated photo collections it is very common to see multiple instances of the same moment. During storytelling, this can be cumbersome. As participants in team B summarised:

> *"If you want to show a holiday, you want chronology, and no duplicates" - Team B*

Moreover, tools that support the integration of photo sharing during an on-going conversation should be simple and quick. Especially for augmenting a story, showing a *single* photo should not be cumbersome or interrupt the flow of a discussion or social activity in which photo sharing is embedded. As teams A and B put it:

> *"People are looking for simple. The simpler, the better" - Team A*

"[A tool] should be easy enough so that you can show just a single photo. Because when you are with friends, that is how you tell stories" - Team B

Participants especially did not want to boot a laptop just to show a single photo. Even less popular was to connect the laptop or phone to a projector or television because too many devices are required to show the photos, and most of the time these devices need proprietary cables or are not compatible with each other. The participants provided ideas for universal applications that run cross-platform and enable instant viewing of a single photo from a mobile device on external displays. A universal interface for all devices would help to smooth the process, along with compatibility across platforms, devices and media formats.

R6. Support multi-user content and interaction

Photo sharing tools intended for multiple users should support *multi-user* content and interaction. Some of the sharing tools that were discussed also included a discussion on the collocated use of tools. One of the opportunities was to *merge* content from different users of the system.

"[Think of a] photo album that brings the content of two people together, similar to Facebook's "other people that were here as well", because a photo album is usually very one-sided, as in one guy is blabbering, and the others just listen. So, if you now want to do this with one other person, your content is merged. Not photos from random people, but from the people that you are with". - Team C

Another way to better support multiple users is through multi-user interaction with the content itself:

"Other people should also be able to join in on the presentation" - Team D

To facilitate multi-user content, photo sharing tools could provide support for *contextualised* photo viewing. By contextualised we mean showing multiple photos that are related to the same topic or event. A discussion that was mainly held in team C covered the aspects of thematic photos. In team C, all participants agreed that the value of the paper photo album was that it was possible to see multiple photos at the same time. The smartphone typically displays a single photo, which does not provide the best support for stories because judged by its size, every photo seems to be as significant as any other.

"A photo shows the situation, but without the context" - Team C.

Juxtaposing and combining photos with related content to support the narrative is a typical practice when organising a paper-based photo album, but this thematic or contextual aspect is less present in digital sharing. Although one can create digital folders or albums to group photos, their presentation is usually per single photo, and the few technologies that offer so-called *panels* for slideshows are hardly used. An automated storytelling aid, such as Google's *Stories* feature, was also mentioned as an interesting direction for the thematic display of information.

R7. Preserve intimate qualities when transitioning from physical to digital

Photo sharing should be more like a *special event*, to enhance the social experience. Sharing stories, especially after the holidays, is often part of a valuable get-together and viewing photos used to be at the heart of these gatherings. The family album used to be viewed together, in a homely atmosphere. Team C, given the task to redesign the experience of the photo album, was especially keen on ensuring these intimate qualities, despite the drive to innovate the tools:

> *"It should stay homely, intimate, not become too slick" - Team C.*

The participants also mentioned that it is important that the album is physical so it can be held and turned around and that multiple people can look at it at the same time. Here it appears that the charm of a physical photo album is partly because it is a tangible object, partly because it is a dedicated object for photo viewing, and partly because a book affords intimate sharing practices, such as sitting on the couch together. Team B shared the view of team C that in certain circumstances it is important to set the stage for sharing photos and that you need to take the time to enjoy photo sharing properly.

4.5. DESIGN DIRECTIONS

Through design, we aim to address the requirements, as formulated in the previous sections. We used the requirements as input for the development of several concepts that illustrate early, yet promising design directions for media-supported collocated remembering.

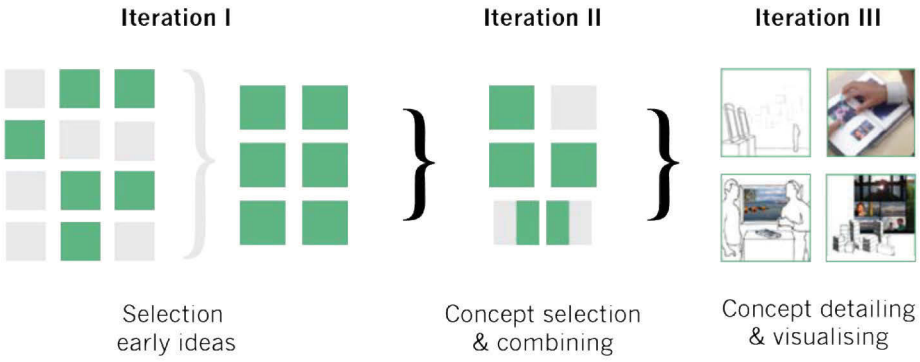

Figure 4.2: Illustration of the iterative design process

In an iterative design process (Figure 4.2), we matured the approximately ten ideas that came directly from the redesign session towards detailed concept sketches in three iterations: I) the requirements guided the selection and clustering of early ideas. Some of the concepts also addressed other photography practices besides collocated photo sharing or curation, such as remote sharing, but those were excluded from this chapter. II) we selected and combined those concepts to get to the four presented here. III) we detailed, described and visualised the four concepts.

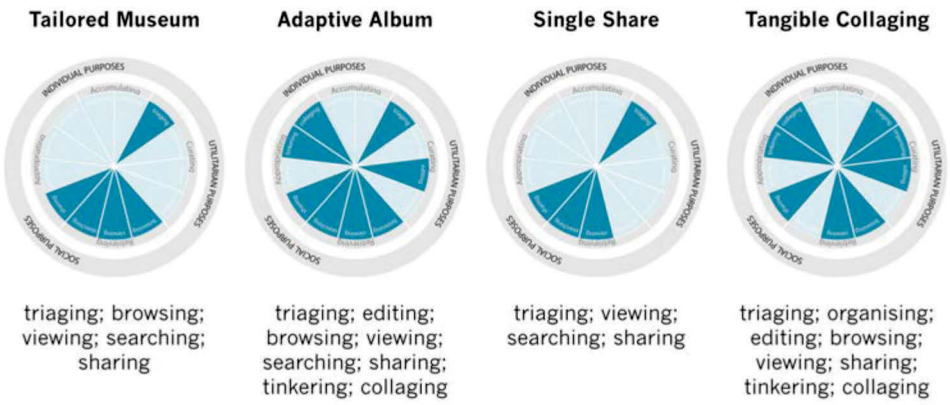

Figure 4.3: Overview of the PhotoUse activities that are addressed by each of the four concepts described in this chapter.

Because we are interested in holistic solutions for photo practices (see Chapter 3), the concepts are deliberately addressing multiple requirements, as well as multiple activities from our PhotoUse model, as we have illustrated for each concept in Figure 4.3. The next sections describe the concepts in detail.

Figure 4.4: *Tailored Museum*, a novel way of sharing photos in a museum setting, where the combined collections of the visitors who go in together are merged and contrasted

4.5.1. Concept 1: Tailored Museum

The goal of *Tailored Museum* (Figure 4.4) is to facilitate shared remembering in an interactive space with photographic content projected onto the walls. The concept is a combination of the concept presented by Team A and a website that was launched by Intel for marketing purposes in 2011, called the *Museum of Me*[13]. Team A presented a futuristic concept where personal photos from a smartphone were displayed as holographs within various rooms of a virtual house, with each room showing specific themed content. In the *Museum of Me*, all the content from Facebook was used to create a personalised virtual museum, focused on a single user's content. Instead of focusing on a single person, *Tailored Museum* focuses on the relationship between multiple individuals. The concept offers a unique, overwhelming experience: people are invited to come with their friends or family to an empty villa or an abandoned factory. Upon entering, the users will put their mobile phones on a docking station and their entire (online) photo collections will appear on the inner walls of the building. Every room displays a different period of the visitors' lives, e.g. childhood, high school, university. To support social remembering, the collections of the people that enter together will be merged in rooms that show shared lifetime periods (e.g. student years) and contrasted side by side in the other rooms to allow visitors to discuss their parallel lives. Some rooms will be private to a single person and only accessible by the owner of the content. Interaction within the *Tailored Museum* is done with a combination of motion tracking, and speech and gesture analysis to determine what photos are addressed and how they relate to the people and the narrative. The photos relevant to the storyline will be enlarged, allowing the people to view the photos afterwards and to remember the related conversation that had emerged in the museum.

4.5.2. Concept 2: Adaptive Album

Adaptive Album (Figure 4.5) is an intelligent paper photo album that adapts its content to the social situation and available time for viewing. The goal is to aim for an intimate and instant experience. This concept is primarily based on the concept that was described by Team C:

> *"It should be simple, choose a photo with the press of a button, if you open the book you want to see the photos instantly, you should not first need to select them, because it depends on the moment if you want 10 or 20" - Team C.*

> *"Selecting photos takes too long, so that should be done automatically, and if you view photos often or longer [on other devices], they should be included in the book. And those you view on your phone go automatically into the book, or even these kinds of photos are included in the book more often." - Team C*

Adaptive Album provides the users with an "old fashion" family album experience, but the content is adaptable to the situation. To start the experience, people have to trigger content

[13] www.museumofme.intell.com, retrieved via the web.archive.org, version February 28, 2014. Service terminated in 2014. Created by Rhizomatics design.rhizomatiks.com/en/works/the_museum_of_me.html, retrieved April 4, 2017.

generation via speech. E.g., by asking the book for "Holidays with Simon", or "Italy 2015", the content will appropriate itself to the audience that is viewing it, based on face recognition technology. While viewing the photos, people can easily enlarge photos (by pinching) or delete photos from the album (swiping it off the page), and the photo composition will reconfigure itself. Turning the page will change the topic within the event (e.g. the next day of the trip). Both the material sensation of a physical book that is held by multiple people and the use of high-quality pages aim to enhance the intimate setting and the perceived value of the content.

Figure 4.5: *Adaptive Album*, an interactive paper photo album displaying the combined content of the audience

4.5.3. Concept 3: Single Share

Single Share (Figure 4.6) is an easy photo sharing device for the home environment. As soon as a person puts a smartphone on a dedicated spot on the living room table, the photo that is visible on the phone's screen is shown on the wall. Crucial for the feeling of spontaneous sharing is that it is not necessary to configure anything and that any phone can be used with the system, because it makes use of the Near Field Communication (NFC) chip that is embedded in most smartphones to communicate to the screen, setting this concept apart from configuration-intensive systems such as Apple TV that use bi-directional pairing protocols such as Bluetooth.

> *"You should just put your phone somewhere and be instantly connected, no screen or wall needed, and no cables" - Team D*

The photo that is shared on the wall is of high quality, similar to a piece of art. The most important value of this design is the ease with which people can casually bring up a photo to support their narrative. Moreover, the act of putting the device down emphasises the importance of the uninterrupted face to face communication.

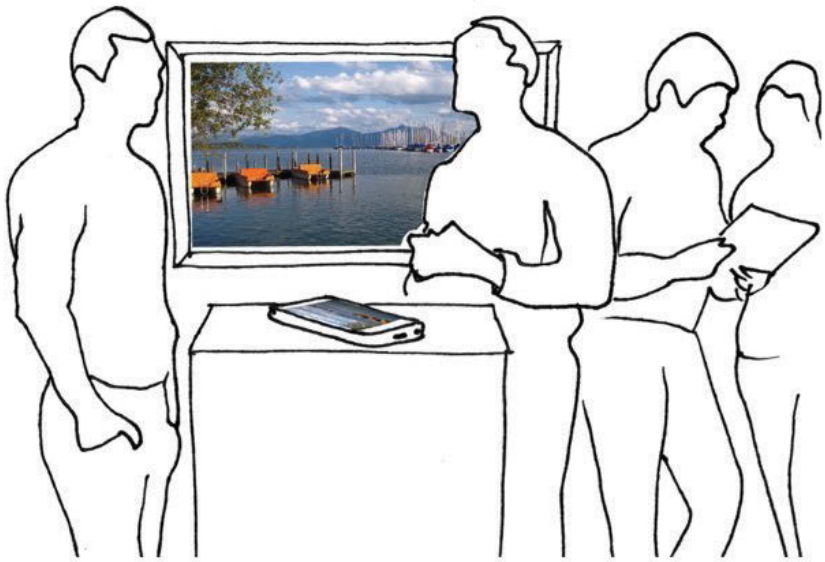

Figure 4.6: *Single Share*, a smartphone showing the relevant photo is placed on top of a dedicated dock, and the content is instantly displayed on a large screen.

4.5.4. Concept 4: Tangible Collaging

Tangible Collaging (Figure 4.7) combines the requirements of showing content within its context, with the ability to influence the content on the fly. The concept consists of a high-quality screen and a table-top with interactive building blocks that enable the user to construct a collage on the screen. The purpose of the concept is to co-construct the story with the friends that are together, but it also provides the users with an interface for their digital content, enabling them to leave out parts that are irrelevant.

The physicality of the interaction is an essential aspect of the experience because it allows for a playful way to build up the story (literally) and group photos per topic. Contextualising the content through a collage also means that every session can be tailored to the audience. The blocks can be reused, repurposed and reordered, while the story is saved for later retrieval. *Tangible Collaging* enables users to arrange and tinker in the physical space, and have the result in the digital space, enabling more control over sharing and co-constructing stories.

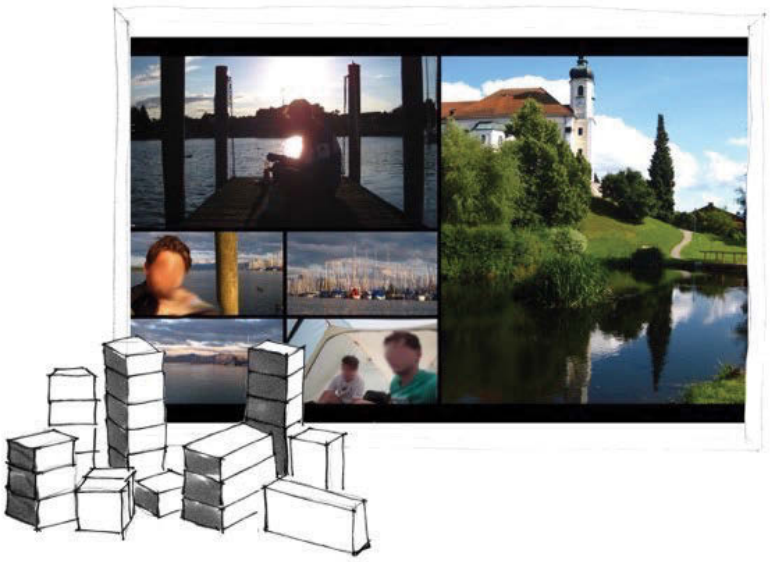

Figure 4.7: *Tangible Collaging*, tangible collaborative manipulation of digital content using interactive building blocks.

4.6. DISCUSSION

In this chapter, we have so far reported our redesign study findings (which resulted in seven requirements) and presented four concepts that address one or more of the requirements that we found, illustrating design opportunities. In this section, we will reflect on our research method and our findings.

4.6.1. Limitations

With the decision of organising a redesign workshop to actively engage participants with the evaluation of current tools also introduced a certain lack of control over the discussion, mainly because we did not fully mediate the discussions of all the teams. Instead, we chose one discussion leader per team that during the discussion with the whole group contributed at the right abstraction level for this exercise (focused on the user experience, not on the technological aspects of current tools). Even though we were able to gather insights into the limitations and opportunities to improve current tools, it is likely that the findings would be more articulated as well as coherent across teams if a design-researcher would have mediated each discussion. Moreover, since we selected a convenience sample from a specific sub-culture (Dutch male fraternity), we cannot generalise our findings from the redesign sessions, primarily because of the unbalanced gender and the affinity with photo technology of this group. The reason for an all-male participant group from a single fraternity arose out of the pragmatic choice to involve them in this research. Once the objectives of the redesign session were defined it became clear that they could play a role in gathering user insights, and what started as an exploration soon became a serious effort from all involved. To be more confident of our results and compensate for any biases specific to these participants, we could have repeated the redesign exercise with other

groups, such as all-females, groups with older participants with less affinity with technology, groups of teenagers and mixed groups. However, because we treated the study as a first exploration into the design directions of new tools, it was enough that the design directions inspired new concepts. In a follow-up study, we wanted to go more in-depth with one of these directions (see Chapter 6).

Moreover, the requirements that we found related to social sharing all resonate with prior research in this domain. E.g., in line with our fourth requirement on usability, Van House (2009) indicated that easy and spontaneous access to content is essential, as did Petrelli & Whittaker (2010). Participants in the study of Van House (2009) also requested more flexible control over who sees which photo on online photo sharing services, similar to the desire underneath our fifth requirement. Bergman et al. (2009) also worked on software tools for temporary hiding photos, which they called *demoting*. Our requirement to adapt content to audiences is also in line with, e.g. Lindley et al. (2009) and Van House (2009), who stressed the importance of flexibility in photo sharing and flexible content as a way to support the performative nature of storytelling. The fact that valuable findings from the past decades like these have not made their way into commercial tools for photo sharing also motivated us to investigate the current state of user needs. We see the novelty of our findings in the fact that these requirements still surface when talking to a group of young adults, who were all toddlers around the time of the first studies into digital photo sharing practices. E.g., Frohlich et al. did their research between 1998 and 2000, and Van House's study took place between 2005 and 2006, around the introduction of *Facebook* and the Apple *iPhone*. Much has changed for digital photography (see Sarvas & Frohlich, 2011 for a comprehensive history). However, the technological capabilities of current sharing tools and available high-bandwidth internet connections make it also *feasible* for designers to address the long-standing issues, while that was not possible two decades ago. Moreover, by listing the requirements all together in this paper, designers can also attempt to address them holistically in new concepts.

In Chapter 3, we argued that research into photo curation should also address photo viewing. Likewise, even though our study setup was explicitly addressing photo sharing, these participants also elaborated in their redesign discussions on their needs for photo curation, hence their inclusion in the requirements. One of the participants commented that curating photos for a photo album was enjoyable because it helped him to construct the story that he wants to tell with the photos. His comment illustrates that design does not necessarily need to eliminate the activity of curation, but can support the experience to be more enjoyable.

In the concepts and the discussion, many of the problems that participants faced were easily solved by hypothesising the availability of some automated feature. However, one caveat with automated collection management and curation services is that people need to understand the system, evidenced by the fact that the participants did not always understand all the features that are offered by the technology that they are currently using. Examples that the group

discussed included automated "highlights" of events that are offered by, e.g. Facebook's *Year in Review*. For the participants, it was not clear what caused a photo to become a highlight, and they did not always agree with the system's automated selection. Implementing an automated process needs more careful consideration.

The requirement to tailor content to the audience, and to filter content on-the-fly resonates with one of the interesting insights presented in the previous chapter that different purposes require different sets of curated photos. Adapting curated selections to fit ephemeral purposes of PhotoUse seems to be one of the more promising themes for our research because it forces us to change our perspective on the notion of curation and design for curation practices, from creating fixed selections to creating selections dynamically as the activity unfolds.

The requirement to support multi-user interaction might challenge the requirement about tailoring content to the audience: the desire and need to customise curation per context and recipient might be conflicting with the desire to integrate multi-user content and interaction in the design. Because any open environment is uncontrolled, the social requirements are dynamic (e.g. new people could enter the environment) and there is an apparent need to customise the content on the fly instead of a priori.

None of the concepts had been implemented or evaluated at this stage. Rather than developing any one of these ideas into a final prototype, this study aimed to step back and reflect on the requirements, ideas and the rationale behind them and to identify general design directions which we could address in follow-up design iterations.

4.7. DESIGN TENSIONS

We have learned some general lessons about current tools (presented as requirements), and in this section, we will reflect on the implementation of the requirements into the design concepts. The design process allowed us to reflect on our designs, without having to first develop each prototype. In our aim to include as many of the requirements as possible in each of the concepts, we realised that there are some tensions that we need to consider when designing for media-supported collocated remembering.

4.7.1. Tangibility vs Adaptability of Content

The need to (re-)create a personal and intimate experience around photo sharing reflects a general desire to partly model photo sharing experiences after printed photo practices. Although we agree that some of the personal and intimate sharing experience is getting lost with the digitisation of practices, designers should not aim at replicating the practices from decades ago. Instead, designers should merely understand and acknowledge the qualities from earlier practices, but use new media types to fuel the design of tools to support *new* kinds of experiences. While most current systems that support collocated photo sharing still approach photos as objects

in hierarchically managed collections (Harper et al., 2013), a different perspective is needed for designers to reinvent the practices around evolving media collections. The activities that we described in our holistic PhotoUse model in the previous chapter are also not supported by existing file structures. A first step could be to consider photo collections as flexible streams of information which are transformed dynamically to match the fluid and emergent needs of users, their context and activities.

With the concepts that we presented in this chapter, we want to illustrate that photo practices can be designed to support new kinds of intimate and personal qualities. Metadata and other features that are unique for digital photos allow, e.g. merging and contrasting photo sets in chronological order, or offering a tailored viewing experience based on face detection. Such experiences would not have been possible before and can be offered only by leveraging the features that are unique to the digital photographic material.

On the other hand, designers must also acknowledge the distraction of digital interfaces and devices in face to face interaction. Tangible interaction such as flipping pages (Concept 2) or arranging blocks (Concept 4) can reduce distraction in collocated communication because there are no notifications or other tasks that draw attention, therefore stimulating collaboration.

4.7.2. Digital Overview vs Device Mobility

We consider one of the challenges for designers to find solutions to bring better overview in the digital space, without losing mobility of the devices. Interacting with printed photos is very different from interacting on-screen with the digital photos (Frohlich et al., 2002). Especially the limited screen size makes it hard to keep a good overview of the collection, therefore in *Tangible Collaging,* we separated the interaction and the visual representation. In line with research on graspable, tangible and hybrid interfaces (e.g. Kirk et al., 2009; van den Hoven et al., 2007), the goal of the *Tangible Collaging* concept was to bridge the gap between our physical capabilities and our digital possessions.

Currently, an appropriate overview of an entire photo collection can only be achieved by considerably increasing the size of the screen. A potential short-term solution could be small projectors integrated into smartphones, such as Samsung's *Galaxy Beam*[14]*,* however, that should also include improved brightness to be able to project during daytime. Another short-term solution could be to leverage public screens to temporarily display personal content, such as interactive walls in shopping malls, advertisement screens in the street, or televisions in bars. The use of public displays has some obvious privacy implications, which designers could address. Augmented-, Virtual- or Mixed Reality technology might be an interesting next step, such as Microsoft's *HoloLens*[15], as long as designers at the same time innovate existing archiving

[14] www.samsung.com/global/microsite/galaxybeam/,
retrieved via the web.archive.org, version November 14, 2015
[15] www.microsoft.com/microsoft-hololens/, retrieved March 6, 2017

structures and folder hierarchies, to make navigating through digital files easier. Another direction for creating a better overview could be to innovate the ways to manipulate vast quantities of information. For example, by using smart clustering based on visual similarity, summarising information, overlapping elements, or stacked views (similar to what was described by, e.g. Mander et al., 1992).

4.7.3. Dedicated Tool vs Multifunctional Device

One of the main threats to media-supported remembering is that digital items are hidden behind the technology on which they are stored (Petrelli & Whittaker, 2010). Even a tablet or a smartphone usually need up to 10 steps before a specific photo can be displayed. In the age of physical photos, the family album had a dedicated function for showing these photos and opening the book instantly started the (sharing) experience. Because of their form factor, tablets and other personal devices can be used for intimate sharing, but there is also much distraction from other functionalities of the devices, both personal and professional, which might not be relevant to the experience of photo viewing.

The concepts *Adaptive Album* and *Single Share* lower the technological threshold for shared remembering, addressing the need for easy and quick access. However, one of the tensions that designers need to consider when designing photo tools like these is between developing a single tool that can support *multiple* practices, or developing devices that are dedicated to specific photo practices. A dedicated device for every type of photo activity which needs to be carried, charged, kept up to date and synchronised separately might not be desirable, but it can still be a good choice in a certain situation. In short, we see three design directions: a) dedicated tools, as some of the concepts in this paper; b) tools that extend existing devices, that need charging but maintenance is done in parallel with the main device, similar to smartwatches that are connected to a smartphone; c) applications that are capable of dedicating a device temporarily to the task at hand, e.g. similar to unlocking a typical smartphone in a certain way which renders it into a dedicated photo camera. None of the other applications or tasks on the smartphone will be able to distract the user for the duration of the activity, similar to the well-known *Swiss Army Knife*[16]. This form of what we call *ephemeral appropriation* follows trends in user interface (UI) design, such as responsive web design (RWD)[17] which implements dynamic interfaces that can change the information layout based on the device that is used to visit the site.

4.7.4. System Automation vs Manual Tailoring

Context-aware recommender systems can be interesting to introduce to collocated photo-sharing activities, to automate some of the retrieval tasks that currently encumber social interaction. Such an approach would be challenging, as the photographic content selection to support

[16] Via www.victorinox.com, retrieved December 1, 2017
[17] www.w3schools.com/css/css_rwd_intro.asp, retrieved December 1, 2017

remembering depends on, e.g. the social dynamics, context, intentions of participants. However, the alternative to letting people do this manually is not desirable either. Even automated folders based on user-defined hashtags or keywords is just a small step, because for it to work people need to be very consistent with their tagging, which becomes difficult over time.

Perhaps the solution can be found in combining the social capabilities of people to *inform* systems about required content, with technologies for automatically annotating data and retrieving photos, in response to user activities and interactions with the system.[18] Relating this to the PhotoUse model from Chapter 3, the individual will be in charge of the curation activities *triaging* and *editing,* while the tool supporting the activity does automated *organisation* (including annotating), as well as *managing* the photo files.

4.8. CONCLUSIONS

In this chapter, we have presented a co-design activity that explored design directions for tools to support collocated shared remembering practices. Based on a redesign exercise with 15 participants we formulated seven requirements, of which three related to the experience of curation, and four related to the experience photo sharing **[RQ.3]**. In Table 4.3, the requirements are listed. The requirements guided the development of four concepts to illustrate possible directions for media-supported shared remembering.

Table 4.3: Requirements for collocated photo sharing

#	Requirements
R1	Improve experience of curation
R2	Make automation more transparent
R3	Simplify gathering photos from others
R4	Tailor content to audience
R5	Embed PhotoUse in narrative structure
R6	Support multi-user content and interaction
R7	Preserve intimate qualities when transitioning from physical to digital

We concluded this chapter by presenting four design tensions that surfaced after reflecting on the design process, which supplement the requirements. To address the first tension between *tangibility and adaptability of content*, we argued that the current perspective of photos being objects in hierarchically managed collections might need to change, and instead consider photo collections as flexible streams of information which are transformed dynamically to match the fluid and emergent needs of users, their context and activities. The metaphor of printed

[18] Although we did not go into the technicalities of designing new algorithms ourselves, we acknowledge that curation tools to support collocated shared remembering requires some form of automated analysis (see also Chapter 6). We have not elaborated on design of automated annotating solutions ourselves, mainly because introducing the challenge of automation would have meant broadening our field of research beyond the intersection of design and HCI, into computing areas of interest such as big data, machine learning and algorithm architecture. Instead, we wanted to stay close to investigating and designing for the *user experience* of curation and shared remembering practices.

photos, which is often used for designing for digital photo practices, does not do justice to the qualities of digital content but can be used to consider the intimated qualities of the analogue sharing practices themselves **[RQ.3]**. The second tension between *digital overview and device mobility* invites designers to think about portability of devices that are required to display a lot of content. To address this digital overview challenge, we discussed a) portable small projectors; b) the use of public displays for temporary displaying content; b) Augmented-, Virtual- or Mixed Reality technology **[RQ.3]**. The third tension concerned the focus on either a *dedicated tool or a multifunctional device*. We described three design directions: a) dedicated tools that provide no distraction from other tasks; b) tools that extend existing devices, e.g. smartwatches; c) applications that are capable of what we call *ephemeral appropriation*, dedicating a device temporarily to the task at hand similar to a Swiss Army Knife, thus blocking distractions without the need to carry multiple devices with you **[RQ.3]**. The fourth tension is between *system automation and manual tailoring*. We found in our study that participants have very specific ideas about what to share with whom, which resulted in requirement R4 to tailor content to the audience. It appears that the individual and social requirements for what makes photographic content relevant are very subtle and dependent on the social configuration. We concluded that a solution might be to combine the social capabilities of people for triaging and editing content, with technologies supporting them with automatically organising and managing the photos **[RQ.3]**.

Acknowledging the tensions described in this chapter can help us to address our design challenges from Chapter 1, and inspire the innovation of new curation tools to support collocated shared remembering practices. For our research, the resulting requirements, concepts and insights described in this chapter formed the basis for the next iterations of the design process. In the next chapter, we will elaborate on how to design for social practices, with an in-depth exploration of multi-user interaction with several design examples to illustrate the process.

CHAPTER 5.
DESIGNING FOR RECIPROCAL INTERACTION

Chapter Summary

In the previous chapter, we found requirements for curation and collocated photo sharing, and we presented design opportunities for tools to support photo sharing. Before going into the final design iteration in Chapter 6, we will explore how to design photo sharing tools that support *reciprocal interaction* to accommodate collocated sharing using one curation system. This chapter explores this in two iterations. The first iteration consists of a selection of three concepts that were designed by undergraduate students as part of a design project that was set-up to fit the topic of this thesis. In the second iteration, we designed and reflected on our own concept. All four concepts provide new insights into the process of designing tools to support reciprocal interaction, both from a system interaction perspective and a social interaction perspective. Based on an evaluation of the concepts presented in this chapter, we were able to formulate a set of system-level characteristics that help us understand the process of designing for reciprocal interactions, providing insights into the pitfalls and opportunities for the design practice. These insights are relevant to designing curation tools that facilitate collocated multi-user interaction during photo sharing.[1]

[1] *The majority of this chapter is based on content from:*
Niemantsverdriet, K., **Broekhuijsen, M.**, van Essen, H. and Eggen, B. (2016). Designing for Multi-User Interaction in the Home Environment: Implementing Social Translucence. In *DIS '16 Proceedings of the 2016 ACM Conference on Designing Interactive Systems*, 4-8 June 2016, Brisbane, Australia. ACM New York, NY, USA. pp. 1303-1314. DOI: http://dx.doi.org/10.1145/2901790.2901808. For this publication, the first author and I contributed equally to the setup and execution of the workshops and the design exercises that led to our insights. We also contributed equally to the majority of the paper writing, in consultation with our other co-authors. Since the majority of this chapter is based on this work, "we" refers in this chapter to myself, Karin Niemantsverdriet and my supervisors.

5.1. INTRODUCTION

We are interested in designing for collocated interactions in the home environment, specifically for photo sharing practices. Chapter 4 formulated a requirement around the need to support multiple users in systems for collocated photo sharing. Although some of the participants of the co-design workshop described there expressed the need for multi-user interaction, many of their ideas and concepts for collocated sharing did not manifest support for multiple users at all. The tools that participants conceptualised were usually intended for a combination of a narrator and a recipient, without *reciprocal exchange*. Reciprocal exchange refers to a bidirectional action or exchange between two or more people, where each of them exhibits similar behaviour (Nettle & Dunbar, 1997), in our case behaviour related to photo sharing. The exchange can be simultaneous, or in a back-and-forth manner. Reciprocal exchange, or reciprocal interaction, are terms that can be found in, e.g. social psychology, developmental psychology and anthropology and are based on the notion that in relationships between individuals each one is influencing and is influenced by the other at the same time.

The technologies that the participants from Chapter 4 use in their daily life reflect the individualistic nature of current commercial offerings, with advertisements for personal devices, customisable systems, tailored to personal preferences. These developments seem to ignore that most people spend the majority of their day within a social environment: e.g., at work, at the gym, queueing in the supermarket, commuting to work, or picking up the children from school are all activities that include multiple collocated social interactions. Moreover, also at home, most people engage socially (in 2016, only 17,2% of the Dutch population lived alone[2]), and make use of technology in the process. Furthermore, the focus on technologies for individual use does not facilitate embedding photo use in current social interactions, which was one of the requirements that we described in Chapter 4.

In the past few decades, interactive systems for domestic use have become increasingly popular, to provide services for everyday use, e.g. in entertainment, communications and, more recently, home automation. Commercial examples include media players to stream music, videos or photos from mobile devices to the television (e.g., Apple's *Apple TV*[3], Google's *Chromecast*[4]), wireless speaker systems (e.g., Sonos[5], Bang & Olufsen's *Beosound 1*[6]), smart thermostats (*Nest*[7]), and connected lighting systems (e.g., Philips' *Hue*[8], Elgato *Avea*[9]). Complex and interconnected interactive systems such as these are expected to appear even more in future homes. Because of

[2] Centraal Bureau voor de Statistiek (January 29, 2016) *Prognose huishoudens op 1 januari; kerncijfers 2016-2060.* Den Haag/Heerlen. Retrieved June 25, 2017 from http://statline.cbs.nl
[3] www.apple.com/appletv/, retrieved June 24, 2015
[4] www.google.com/intl/nl_nl/chrome/devices/chromecast/, retrieved June 24, 2015
[5] www.sonos.com/, retrieved June 24, 2015
[6] www.bang-olufsen.com/en/collection/wireless-speaker-systems/, retrieved May 22, 2017
[7] nest.com/, retrieved September 22, 2015
[8] www2.meethue.com/en-us/the-range/hue-tap/, retrieved June 24, 2015
[9] www.elgato.com/en/smart/avea, retrieved August 4, 2015

their interactivity, these systems offer great opportunities regarding flexibility, adaptability and personalisation. We notice, however, that they often seem to be designed for individual use and even if a system is used by a single person, interaction with it often influences multiple people at once. In these devices, multi-user interaction is hardly supported. For example, interactions of the different users are not visible to the others, and the intention of the interaction is not clear, which means that others cannot be held accountable if they are not considerate of these intentions. Of course, people will speak up to share this type of information, but there is not enough visibility of information to provide awareness and accountability. To support reciprocal interaction better, interactive systems that are intended to be used by multiple people should provide an interface that supports people in considering each other when making interaction decisions. A promising approach towards mutual consideration in interaction is to implement the three constructs of the *social translucence framework:* visibility, awareness and accountability (Erickson & Kellogg, 2000; McDonald, Gokhman, & Zachry, 2012).

To explore the process of designing for reciprocal interactions, this chapter describes four concepts that have implemented reciprocal interaction in the design. We will look at their implementations, by describing the support for the shared use of the system. Moreover, in the discussion we will reflect on the concepts both from a system interaction perspective and from a social interaction perspective, describing aspects of the design which afford reciprocal shared reminiscing and storytelling.

5.2. RELATED WORK

This section presents work related to multi-user interaction design. While the focus of this thesis remains on photo curation and sharing tools, we slightly broaden this section to include domestic interactive systems that are outside the realm of PhotoWare (Frohlich et al., 2002), to better illustrate existing multi-user solutions.

The interaction of contemporary interactive systems for domestic use is often based on applications that run on personal portable devices, such as smartphones, which make them less suited for multi-user interaction. The reasons for interaction designers to use smartphones are understandable: they offer advantages in, for example, computing power, mobility, and availability. However, smartphone interfaces make interaction highly personal (e.g. Lucero et al., 2015). Since smartphones and their connection to the larger domestic system are not necessarily tied to a specific location, the person who is interacting can be in a different location than the users that are affected by these interactions. Furthermore, since often not everyone in the household is equally connected or involved in the interaction, system accessibility might be problematic (e.g., when children or visitors need control). In everyday use, issues might occur when implicit interactions lead to, for example, lights turning off automatically when the primary

user is leaving the house even though other users might still be present, or music that is playing throughout the house from a phone is paused when that user receives a phone call.

5.2.1. Coordinating Interaction Between Users

One often-named approach to using technology to resolve multi-user issues in interactive systems involves conflict-management (Resendes, Carreira, & Santos, 2014). Conflict management systems store information of use in user profiles and use this information to coordinate interaction possibilities for each user for pre-programmed contextual scenarios. When a conflicting preference is observed between different users (e.g., in deciding which channel to watch on TV), such systems can implicitly mediate between preferences and present an average alternative or request explicit user input (Hasan, Ngoc, Lee, & Lee, 2009). Another approach towards multi-user interaction makes use of hierarchies in control: a user that is higher in the hierarchy has more permissions than a person who is lower in the hierarchy. These hierarchies are either determined by user profiles or by temporal or spatial priority (Petrushevski, 2012; Shin, Dey, & Woo, 2010). Hierarchical profiles result in coordination policies that prevent conflicts by limiting the interaction for some users compared to others (Morris, Ryall, Shen, Forlines, & Vernier, 2004, for example presented different interaction possibilities to parents and children).

While these approaches are interesting from a system interaction perspective, they might not fit the complexity of the social interaction in the home environment. Ethnographic research suggests that the home environment and family life is highly dynamic and that routines are continuously adjusted (Davidoff, Lee, Yiu, Zimmerman, & Dey, 2006). This means that the scenarios of use, the user profiles, the preferences, and the hierarchies, on which all coordination strategies are based, become incredibly complex and are unlikely ever to be complete. Also, permissions in real-life situations are not that static, and many unforeseen exceptions are expected to arise: when a parent supervises a child, for example, the child might be perfectly allowed to perform certain interactions. Creating a system that can interpret and predict the context and successfully coordinate interactions for all users without user intervention in all situations is virtually impossible (Bellotti & Edwards, 2001) as well as undesirable.

Since an erroneous interpretation of the context is likely to lead to misunderstandings, coordinating behaviour in multi-user situations by a system might not be the best solution. Estimating socially accepted behaviour for different contexts might be very difficult for a computer program, but humans possess highly developed social skills to interpret social cues, opinions, behaviour and intentions of other people. In daily life, people prevent and resolve arising conflicts through agreements, conversation, negotiation, and intervention all the time. For example, during remote instant messaging conversations, people will usually allow another person to finish typing a question before they respond. Another example is when teenagers get home too late, they will walk on their toes and find their way in the dark, to not wake their parents. These familiar situations illustrate that people are very capable of coordinating actions themselves in potentially

conflicting situations. We, therefore, propose to leave the coordination of interaction up to the users and to use system-mediation to support people in considering each other when deciding on an interaction.

In the process of collocated photo sharing, some form of reciprocal interaction is necessary to be able to react to one another in a way that is similar to a "normal" conversation (one that is not mediated by technology or photos). To be able to use photo sharing tools to support reciprocal interaction, the tools must support people to understand each other's intentions and interactions, so they can adapt their own behaviour accordingly. With the addition of photo sharing tools, coordination of social interaction partly becomes an interaction design challenge, which can be addressed by the *social translucence* framework.

5.2.2. Social Translucence

The process of coordinating actions to take each other into consideration in everyday life can be explained by the *social translucence* framework by Erickson & Kellogg (2000). This framework consists of three constructs: visibility, awareness, and accountability. *Visibility* refers to available information in a surrounding that allows people to judge what appropriate behaviour is. The provided information makes it possible for people to build up *awareness* of each other's actions, the intentions behind them, and the effect that interactions can have on others. In the first example described above, the instant messaging application has to indicate that the person on the other end is still typing, otherwise it will be impossible to take that information into account. In the second example, when the lights are turned off, and everyone has gone to bed, the person entering is aware that making noise might wake them up. Because of an understanding of action and reaction by all users, people can be held *accountable* for their actions. If the person entering is making noise even though s/he is aware that this noise will disturb others, the other people can ask for clarifications or might get angry. However, when the others went to bed early unexpectedly and the person entering could not deduce this information from the context (because of a lack of visibility and awareness), s/he can also not be held accountable if accidentally waking them. The social translucence framework describes that to support the users in coordinating actions amongst each other and consider each other, the system (or interface) should provide sufficient visibility, awareness and accountability information. Important to note is that what information is visualised should be carefully considered because of the "vital tension between visibility and privacy" (Erickson & Kellogg, 2000, p.63): hence the term social translucence, instead of transparency.

The social translucence framework derived from the field of Computer Supported Collaborative Work (CSCW). Naturally so, the complete absence of visibility in distributed interaction in the digital world makes designed support indispensable. However, the nature of the digital realm has evolved since the introduction of the framework in the year 2000. With the type of interactive systems for domestic use that we discuss here, the physical and digital have merged

into a complex hybrid. Therefore, we argue that a much broader adaptation of the framework would be in place, including not only distributed and work-related interaction but also interaction at home. We selected social translucence as a framework to evaluate and implement reciprocal interaction because it has proven to be useful in the context of remote interactive system design, and we were interested in applying the lessons learned from that context to rethink systems for collocated interactions.

To understand how to design for reciprocal interaction, we took a closer look at four concepts that address collocated photo sharing. To investigate what considerations should be made in the interface and how such a perspective can be supported in the design process we took a design approach. In two iterations, described in the next sections, we explored the interactions that need to be supported for collocated photo sharing tools. Similar to the concepts in Chapter 4, the concepts described in the following sections all address multiple activities from the PhotoUse model (see Chapter 3), which we mapped for each concept in Figure 5.1.

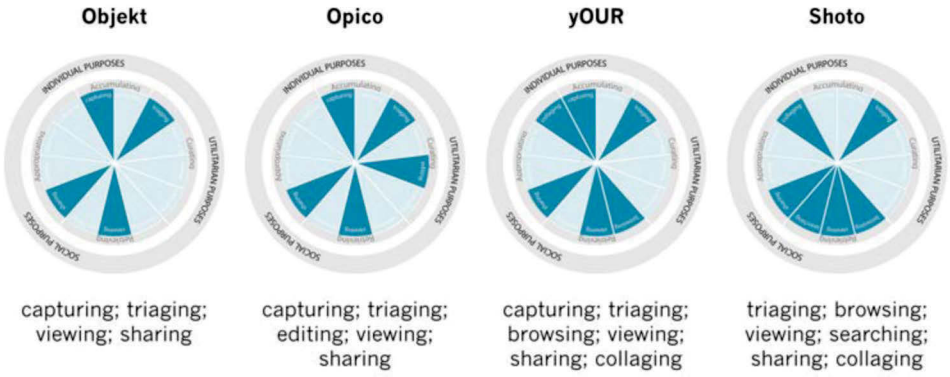

Figure 5.1: Overview of the PhotoUse activities that are addressed by each of the four concepts described in this chapter.

Because the designs have not been realised or evaluated, we analysed them using techniques similar to what is advocated by Carroll (1997) as *scenario-based design*, which can be used to describe the use of a future system at an early point in the development or design process. Detailed scenarios of the interactions between users and a system can be used to represent, analyse and plan how the system should behave, and how it would impact social practices. Scenario-based design can be particularly useful for interaction designers, because the roughness of the scenarios makes them both concrete and generalizable, which is at the right level of abstraction for generalizing and reusing design knowledge (Carroll, 1997).

5.3. ITERATION I: OBJEKT, OPICO AND YOUR

5.3.1. Process

The first iteration was a design project for Industrial Design students.[10] In this project, students were challenged to design new media technologies to capture and relive the experiences of a fun day out: designs that support people to (re)create, modify, view, share or express the moments they want to remember. In the project, the students were free to specify a context based on a target group, a social context or a specific type of leisure activity (e.g. a day out to an amusement park, a city trip or a wedding). In practice, the focus on a fun day out resulted in case studies that focused on social activities.

The aim of the projects was for the students to come up with innovative design concepts, not to develop them into fully functioning prototypes that could be used in more formal evaluations. However, since the approach was people-centred design, all case studies included informal interaction with potential users of the design, either in the early stages, when coming up with design requirements, or in the later stages, when evaluating design ideas or prototypes.

All students developed a concept either individually or in duos, resulting in 26 concepts in total. Out of the 26 concepts, we selected three to feature in this chapter because they are the most explicit examples of collocated photo sharing systems, even though the students did not make use of the social translucence framework in their projects. Other projects that we did not select for the chapter were either less social, not intended to use within a domestic environment, or dealt with a different media type, such as recorded sounds, or videos.

5.3.2. Design Case: Objekt[11, 12]

The majority of digital photo collections are stored in vast bulk on a hard drive hidden away and rarely accessed or relived (Petrelli & Whittaker, 2010). In contrast, our physical memorabilia are often on display in our homes, as cues for remembering, but also to display a personal identity, to serve as conversation starters or to make a house feel like home (Petrelli & Whittaker, 2010).

[10] The project *Pics or It Didn't Happen*, set up by my colleague Ine Mols and myself, ran from January to June 2015 within the Department of Industrial Design, Eindhoven University of Technology, the Netherlands, with 32 Interaction Design students, ranging from second-year Bachelor to first-year Master. BSc students spent about eight weeks full-time and MSc students twelve weeks full-time on the project, over the course of one semester.

[11] BSc team design project by Thomas Bouwman & Oscar van Beek, coached by myself. The concept *Objekt* was designed by the two students. My contribution to the design was in writing the design brief, facilitation of the project, and weekly coach meetings where I guided the students' process and discussed the concept direction. I did the critical analysis of the meaning of the concepts in relation to the social translucence framework afterwards.

[12] *This concept description appeared previously in:*
Broekhuijsen, M., Mols, I. and Hoven, E. van den (2016). A Holistic Design Perspective on Media Capturing and Reliving. In: *Proceedings of the 28th Australian Conference on Human-Computer Interaction (OzCHI'16)*, November 29 - December 2 2016, Launceston, Tasmania. ACM New York, NY, USA. pp. 180-184. DOI: http://dx.doi.org/10.1145/3010915.3010959

Context: Viewing photos in the home environment

After a holiday trip, people like to share their stories with others who visit them at home. Having relevant objects in the environment helps to spark the conversation around these trips. Individual reminiscing can also be supported by brief interactions with physical mementoes of recent or less recent trips. The challenge at the start of this project was therefore to enable the same kind of presence from digital mementoes.

Concept: Objekt

Objekt is a concept for contextualised media reliving. The design of *Objekt* was inspired by the discrepancy between the presence and visibility of physical and digital items in the home. The reliving of digital photos was redesigned with the aim to make the experience more accessible, social and tangible. Similar to the designs by van den Hoven & Eggen (2003) and Nunes et al. (2008), *Objekt* connects digital photos to objects or locations within the home. Using small, inexpensive RFID stickers, objects can be tagged to connect them to digital content. These augmented physical representations (a combination of a tangible object with associated digital media) becomes the new media type central to the design. *Objekt* allows for the creation of these hybrid media while on the go. The concept leverages the advantages of smartphones' capabilities through a specific application that enables users to make a direct coupling with an object, right before capturing. The result is a photo collection that is distributed throughout the house, allowing for contextualised reliving (Figure 5.2).

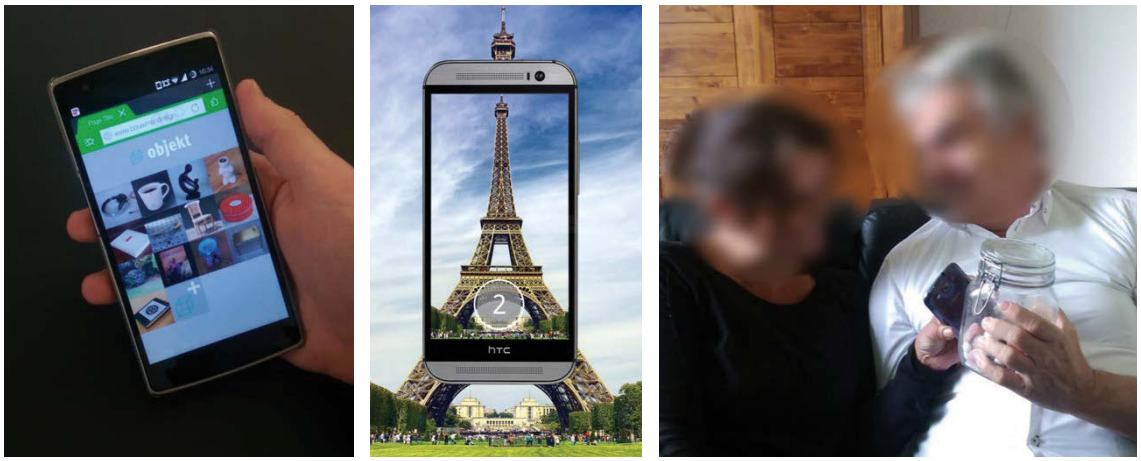

Figure 5.2: *Objekt*. f.l.t.r. Choosing object to link the next photo to; photo capturing; media reliving at home by using objects to retrieve the photos

Discussion

The simple scenario of connecting digital photos to objects sparks several interesting possibilities because the coupling can be done in multiple ways. Connections can be made based on the 'content' of the memory, for instance by connecting photos from a trip to unique souvenirs from that same trip, similar to the work done by, e.g. van den Hoven & Eggen (2005; 2007). However,

the connection could also be made based on anticipated context of use, stimulating the user to think about when and where s/he would like to view the picture and relive the memory, before taking the photo. This might lead to, e.g. connecting specific photos to a coffee pot, which would allow reliving these memories when someone visits for coffee.

Objekt was designed with the goal to make digital media easier to access for satisfying reliving experiences. After conceptualising how digital media could be relived through connections with the physical, a corresponding media type and capturing practices were designed to enable this reliving. This concept also illustrates that an explicit connection between capturing and reliving can also be made by the users, by forcing them to think about the anticipated context of use.

Even though multiple users can add photos to objects in the home, *Objekt* is not necessary a system that implements multi-user support with the system's interface. However, interaction with the hybrid objects in the home is not limited to one person (e.g. the person with the device with photos) because everyone who is part of the social encounter can interact with these objects.

5.3.3. Design Case: Opico[13, 14]

As mentioned before in this thesis, the advances in technology mean that taking photos has become very easy, but reviewing the photos is rarely done. One of the challenges is to enable people to enjoy their photos in the home environment. The next concept, called *Opico*, illustrates the use of media technology to support storytelling in the home environment. Through the use of abstract visual representations, *Opico* explores whether indirect representations can support more vivid remembering by challenging the mind to bring back a memory.

Context: A city trip

When returning from a city trip with loads of photos, it is always a burden to select the best ones. That is a shame, especially when people are proud of the things they have experienced and the stories that they want to tell their friends. The concept *Opico* aims at improving the storytelling-experience that can evolve around a memory that is cued by a single photo.

[13] BSc graduation project by Daan Weijers; coached by myself. The concept *Opico* was designed by the student. My contribution to the design was in writing the design brief, facilitation of the project, and weekly coach meetings where I guided the student's process and discussed the concept direction. I did the critical analysis of the meaning of the concepts in relation to the social translucence framework afterwards. For a preview of the concept visit http://fdslive.oup.com/www.oup.com/booksites/uk/booksites/content/9780198737865/video.html#22.5

[14] *The descriptions of Opico and yOUR appeared previously in:*
Hoven, E. van den, **Broekhuijsen, M.** & Mols, I. (2018). Design Applications for Social Remembering. In: Meade, M. L., Harris, C. B., Van Bergen, P.,Sutton, J. & Barnier, A. J. (Eds.) *Collaborative remembering: Theories, research, and applications.* Oxford: Oxford University Press. My role in this publication was co-organising the student project that resulted in the described design examples, acting as client and expert and as project coach for 8 of the 35 students. I wrote half of the design cases in the book chapter, and contributed equally to the discussion and design implications sections.

Concept: Opico

Opico (see Figure 5.3) is a media-platform that streamlines the selection process of pictures towards one final picture of a day out, which for the creator is the best representation of the story they want to tell. *Opico* consists of a smartphone application that enables the triaging process, while the user is on his way home from a trip. The goal of the triaging process is to end up with just a single photo that is iconic of the story they want to tell back home. The photo can then be edited with an intuitive interface, where a layer of abstraction is added to parts of the photo. Abstraction is done by means of a pixilation algorithm (see Figure 5.3). The added layer of abstraction by pixelating the image potentially enhances reconstructive remembering, because the clarity of a photo can also function as a filter for the memory, limiting the reconstruction process (van den Hoven, 2004). The result is (wirelessly) transferred to a digital photo frame that is placed at home. Just like other items on display in the home, the pixelated photo inside the frame draws attention from people who see it, inviting a conversation about the photo and the memories that are triggered by it.

Figure 5.3: The *Opico* app on a mobile phone (left), a photo blurred partially using the *Opico* app (middle) and a partially blurred photo on a physical photo frame in the owner's home (right).

Discussion

Opico focuses on a specific social setting in the home environment to stimulate remembering activities, alone or with visitors. The home environment offers a wide variety of possible scenarios of use, but *Opico* is designed for a specific setting: the design addresses the scenario where a friend enters the house and starts a conversation about the photo display in the living room. *Opico* addresses content curation, with both an individual and a shared purpose, anticipating the collocated content sharing that will occur at a later point in time. A part of the mediated remembering experience is therefore orchestrated by the person selecting, editing and positioning the photo in his or her home. The selection and editing app is not designed for any specific event, but for long-term use in general, because the effects of the blurring might be shown at a much later moment in time. The pixelated picture might cue more vivid and richer reconstruction of the memories because people are encouraged to think a little bit harder about what the photo represents and how they want to communicate that. Similar examples of abstract media have

shown a positive influence on the experience of remembering, e.g. through visually distorted photos in *Context Photography* by Ljungblad, Hakansson, Gaye, & Holmquist (2004), and audio recordings in *Sonic Souvenirs* by Dib, Petrelli, & Whittaker (2010). The *Opico* concept focuses on curation by modification of the presentation. Reviewing and deliberately editing the media might strengthen or change the connection to associated memories. Next to the individual remembering, social remembering is also supported, since placing the photo in a frame in one's home can serve as a conversation starter for visitors and the strengthened connection to the memories also supports the use of the photo for memory sharing. The interaction with media mainly takes place in the curation phase on a mobile phone or tablet. Interaction with the photo frame is more implicit, more concerned with viewing or showing the photo. The frame gives the digital content a certain material presence, stimulating memory cuing.

5.3.4. Design Case: yOUR[15]

The typical ways to view photos together are cumbersome, as we explained in more detail in Chapter 4. E.g. on smartphones, the screens are too small and the devices are too personal to hand over; on smart televisions photo viewing is limited to a slideshow, where one person is in charge and the others are viewing passively. The purpose of such sharing activities, especially when people talk about events that they co-experienced, is for everyone to take part in so-called *reminiscing talk* (Frohlich et al., 2002). The concept *yOUR* is an example of collocated shared reminiscing with viewing of shared content, with which we illustrate how design can support reciprocal interaction and reminiscing talk.

Context: A city trip with one parent and one child

The concept *yOUR* focuses on the context of a parent and child (18-25 years old) that have been on a city trip together. Many Dutch high school graduates take such a trip, aimed to strengthen the bond between the parent and the child right before they leave home. During the trip, they usually take many photos of each other. After returning home the challenge becomes to find a proper opportunity to view the photos together and talk about the trip and the shared experiences.

Concept: yOUR

yOUR (Figure 5.4) is made for two people to view photos together at home. It offers two physical navigation tools and a digital photo user interface to collaboratively view, search and discuss media on a television. *yOUR* lowers the threshold for viewing media together by making it easier to access the media using the tangible elements. The two physical tools are equipped with different wheels, used to scroll through days, moments or locations. The interaction enables a

[15] BSc design team project by Lianne de Jong & Nono Leermakers, coached by Fiona Jongejans. The concept yOUR was designed by the two students in consultation with their project coach. My contribution to the design was in writing the design brief and facilitation of the project. I did the critical analysis of the meaning of the concepts in relation to the social translucence framework afterwards. For a preview of the concept visit: http://fdslive.oup.com/www.oup.com/booksites/uk/booksites/content/9780198737865/video.html#22.3

non-linear way of navigating through the media, to trigger unexpected stories. While navigating, pictures of both users are shown in the two corners of one screen, which triggers users to compare their different perspectives on the same events. By agreeing on placing a photo to be displayed in the centre of the screen, the parent and the child can transition from talking about their own perspective (*your* story), to reminiscing talk (*OUR* story).

Discussion

yOUR enables collaborative viewing of photos, with the opportunity for equal contribution of both parent and child to the interaction and the conversation. This design specifically targets the parent and the child in the process of photo sharing, to enable an extension of the bonding experience.

yOUR illustrates a way to navigate through photos collaboratively, which in most current applications is done individually. Rather than photo sharing revolving around a single person's collection, *yOUR* contains the collections of two people who have been through a shared event. As part of an informal evaluation of an early version of *yOUR* with 2 participants, a mother (age 56) and a daughter (age 21) were asked to each share their ten most special pictures from a three-day city trip to Madrid they went on together, 4 years ago. Sharing was done via email, and they accompanied the photos by some text explaining the significance of the moments. Interestingly, many moments were selected by both mother and daughter but were not always captured in the same picture, indicating that both the mother and the daughter had their own perspectives and were drawn to different things during the same events. Both participants valued the experience of looking back and reading the explanations they wrote for each other. This exchange of perspectives inspired the design students to aim for a specific social interaction. The social interaction of *yOUR* includes collaborative viewing, sharing and remembering and particularly the support of reminiscing talk, because the photos are of events that both the parent and the child have taken part in, and are shown together on the same display. The interaction with the media combines the material handheld tools with the digital presentation.

Figure 5.4: *yOUR's* handheld tools for interacting with the photo collection (left) and the user interface displayed on the shared screen, used by a father and his daughter (right).

5.4. ITERATION II: SHOTO

5.4.1. Process

To investigate how to design multi-user interfaces for domestic interactive systems that leverage the human ability to take each other into consideration, we wanted to specifically implement social translucence in design in the second iteration.

The process started with a brainstorm session with fellow PhD students[16], where we discussed the social translucence framework, together came up with scenarios where social translucence could be implemented, and identified opportunities for new concepts. The design case that is presented in the next section was one of the resulting concepts, and is primarily aimed at exploring the steps in the design process that help in designing for multi-user interaction. The first idea that came from the brainstorm session was iteratively developed further by Karin Niemantsverdriet and me. By reflecting upon the design process, we aim in this chapter to indicate questions, tools, and considerations that can help interaction designers implement the social translucence framework.

5.4.2. Design Case: Shoto

Context: Digital photo sharing in a social setting

With the advent of digital photography, sharing summer holiday photos with friends has been taken over by digital interfaces: instead of passing around our printed copies of photos, we now pass around our phones and tablets. Current commercial devices typically do not offer a dedicated interface for collocated photo sharing. However, there are technologies available to view photos on a larger screen, on smart televisions or popular domestic media streaming devices such as *Apple TV* and Google *Chromecast*. The photo is shared full-screen (either on the device or on a connected screen) by opening it in the photo management application of the (mobile) device.

One of the scenarios of using systems like the ones described above is a presentation setting, with one dominant presenter and an audience of spectators. An alternative scenario (serving the people who are happy that the typical endless family gatherings for slideshows are getting rare) is a more dynamic photo sharing scenario: multiple people can connect to modern media streaming devices sequentially (when connected to the same network), allowing for users to continuously alternate between presenting and viewing and listening.

Context Analysis

In the shared scenario as described above, there are essentially four main roles: users could be talking about a photo (*narrator*), users could be searching for a photo and selecting it to share (*browser*), they could be sharing it, e.g. on the screen (*sharer*), or they could be viewing and

[16] A two-hour brainstorm session about multi-user interaction in design took place in May 2015 with six participants: four fellow PhD students and the organisers Karin Niemantsverdriet and me.

listening (*recipient*). While not all roles necessarily include interactions with the system itself (the recipient is usually not directly interacting), all these roles play a part in the multi-user setting and are influenced by interactions of others. Therefore, users need information about each other in order to decide on appropriate interactions.

In the current setup of media streaming devices, this multi-user interaction is hardly supported. Interactions of the different users have little visibility, which is amplified if the group size increases: when a photo is shared, it is not obvious who the owner of the photo is. Also, there is no visibility of the intention behind the shared photo. Since every photo is shared full screen, there is no visible difference between photos that are intended to serve as an addition to the current narrative, as a contrast, or to introduce a new story, leading to low awareness of the sharer's intentions. Even though people can talk to explain their intentions, if the previous photo disappears when a new photo is shared there is no way to retrieve an image or to recover from an interaction that is undesired by other users. In addition, there is little accountability on, for example, attention: when someone is interacting with a mobile phone, they could just as well be typing a text message as searching for a new photo to share. Therefore, we can conclude that current domestic media streaming devices currently do not present their users with sufficient information to coordinate behaviour seamlessly amongst each other. In other words, the interaction is not socially translucent: there is not enough visibility of information to provide awareness and accountability.

Design Process

Our main goal in this design case was to design an interface that made photo sharing with media streaming devices more socially translucent. We aimed at providing sufficient information in the interface to enable people to estimate appropriate behaviour. The roles that we presented before (narrator, browser, sharer, and recipient) required different types of information to do so. A narrator would need awareness of the attention of the audience (are they interested in the story or are they distracted?) and about whether other people would like to share photos too. A browser and a sharer would like to know when sharing (and thus interrupting the narrator) is appropriate. And the audience would like to be aware of the story: who is sharing a photo and how does the photo relate to the story and the previous photos.

In order to translate this information into the new interface, we took inspiration from the more old-fashioned way of photo sharing: passing around printouts. In media streaming devices, there is only one way to introduce a photo, namely full screen while removing the previous photo. With printouts, however, there are many more possibilities to share a photo. One could place the photo on top of the previous photo to take over the story or next to the previous photo to e.g. contrast the story. Also, in the act of placing the printout photo, intention can be expressed through the speed of movements, and the body posture of the person who is sharing. One could introduce the printout slowly, and hold it until the other person is finished talking, or slap it onto

the table in one resolute movement. Both actions have very different consequences for the course of the story and the role of the current narrator and the person interrupting. In the design of the interface we wanted to facilitate these different interaction opportunities by adding (1) different placements and (2) expression to the interaction.

Before a photo is shared, it needs to be selected from the personal collection. In photo sharing settings with printouts, this selection process is visible for the other people. Someone picks up their stack of photos, starts flipping through them, orders the pictures, or takes a desired photo from the stack. This photo might be placed immediately, but could also be placed in front of that person facedown to wait for the right moment. In this process, other people are aware that that person is looking for a photo to share in the near future. This means that it becomes possible to anticipate: if sharing of photos is not desired at that moment, they can address that person to stop selecting new photos. Important to note is that, while the activity of selecting is visible to others, the photos themselves are not. People can shield off the stack in the selection process and thus shield content of photos that are not being shared, either for privacy reasons, or not to distract from the current narrative. This awareness of the intention to share photos is another element we wanted to bring into the new interface of the media streaming devices.

We translated the relevant interactions from photo sharing with printouts to the interface of media streaming devices with the aim to make them more socially translucent. We used the physical layout and actions of users with printouts as a metaphor. The resulting concept is called *Shoto*.

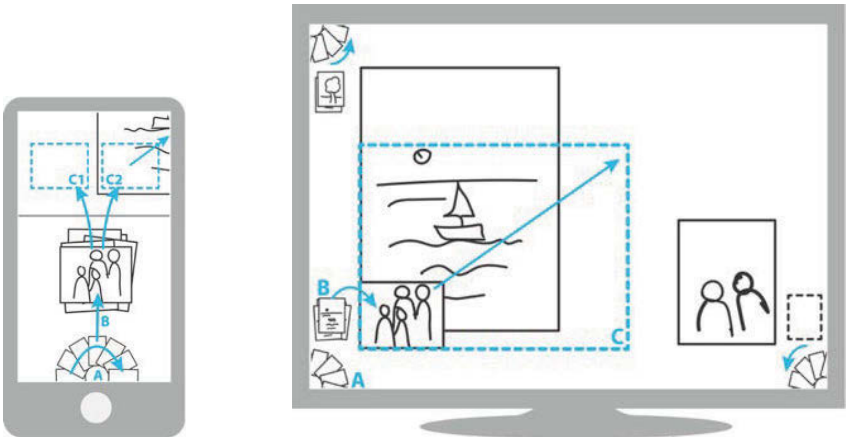

Figure 5.5: *Shoto* interface. On the left, the personal interface of Shoto allows users to select a photo from their collection with the scroll wheel (A), drop it onto the stack to save it for later sharing (B), and drag a photo onto the canvas to share the photo. They can choose to place the image beside (C1) or on top of the previous photo (C2). The image can be scaled up by dragging out the corners. On the right, the shared interface of Shoto presents the scroll wheel (with blurred thumbnails; A) and stack with saved images for sharing (B) of each connected user. The central canvas shows (C) the collection of shared images in the size and position determined by the sharer. All interaction happens through the smartphones' applications.

Concept: Shoto

Shoto is an application for social photo sharing. The concept shares its goal with *yOUR*, but the navigation and feedback are implemented on digital instead of tangible interfaces, and the target group and viewing context is less specific and leaves more room for other domestic sharing practices. The *Shoto* interface consists of two parts: a personal interface on each user's mobile phone where photos can be selected from the personal collection, and a collective interface for displaying on the shared screen (Figure 5.5). The personal mobile phone interface consists of three parts: the scroll wheel (A), a stack of selected photos to share (B), and the canvas for sharing and presenting (C). People can browse through their personal photo collection using the scroll wheel and drop images that are meant for sharing onto the stack. Photos from the stack can be shared on the screen by dragging them onto the canvas, either on top of the previous photo or beside, after which the shared photo on the canvas can be resized. This is the translation of the different placements (covering the photo to change a story line, or placing next to it for comparison) and expression (in speed and final size when resizing the photo). All interaction happens through the smartphone applications. In the shared interface on the television screen or projector, similar elements can be found: a scroll wheel (A) and stack (B) for every connected user, and the canvas where all shared photos are presented (C). In this shared interface, the thumbnail images of the scroll wheel are blurred to make sure that content of unshared photos is shielded off. However, the activity of searching for photos is visible to the other users in this way. Similarly, the stack tells the other users that this person is planning to share photos soon and gives information about the size of the photo that the other is about to share.

Contribution

While *Shoto* has not been realised, it presents a way of photo sharing that takes the multi-user situation into account. Some of its main advantages are that 1) users remain in control of the content that is shared; 2) there is diversity in ways of sharing for less intrusive additions; 3) since shared photos remain on the canvas interactions can always be undone. Apart from being more socially translucent, *Shoto* potentially offers a more participatory and engaging way to share photos for all users involved, because the added translucence aids reciprocal interaction.

5.5. DISCUSSION

We have presented two design iterations, with a total of four design cases (*Objekt*, *Opico*, *yOUR* and *Shoto*), which all support photo sharing practices. In this section, we will discuss these concepts, from the perspective of system interaction, and from a social interaction perspective. Moreover, we look at what lessons we can draw from these concepts that we can apply to designing curation tools to support reciprocal photo sharing.

5.5.1. Social Interaction Perspective

Even though not all these concepts support multi-user input, they all deliberately support reciprocal social interaction. When using *Objekt*, the social implication of preparing for the anticipated context of use (the reliving experience) requires from users to consider other people's preferences when coupling certain photos to certain objects. Similar to *Objekt*, *Opico* provides no multi-user control on the system interaction, and no shared content either, but as with *Objekt*, the need to consider other people is made explicit in the way the concept deals with supporting the anticipated context of use. *yOUR* offers both social- and system level support for reciprocal interaction, with the opportunity for simultaneously viewing content from both parent and child. Lastly, *Shoto* fully implements the construct of social translucence to afford reciprocal interaction.

Leave interpretation to users

We have tried to design the interface of *Shoto* in such a way that it does not prescribe behaviour. In line with the claim by Erickson (2003) to portray actions, not interpretations, the concept aims to leave the interpretation of what behaviour is appropriate to the users themselves. In *Shoto*, this is translated into how people can, for example, engage in unrelated activities on their mobile phone at any time: their other applications are not disabled or shielded off. Reflecting on the interface, we see this as a key feature since what is accepted varies: we could think of examples where answering a text message is perfectly acceptable while listening to a photo presentation. As mentioned in the related work section of this chapter, it would be virtually impossible for a system to interpret such subtle differences in the situation only from contextual information (like whether a text message is more important than the current story that is being told). Therefore, our implementation supports people to hold *each other* accountable for any undesired behaviour, without the need for systems to interpret what is appropriate by shielding off certain applications.

Support dynamic interaction needs

All these concepts support mediated storytelling. An aspect of reciprocal interaction is that it is dynamic and that the direction of the interaction is potentially being determined by any participant. We discovered in the design process of Shoto that to be able to support this kind of mediation, the tools need to be able to return to a previous state. The need to correct system's actions has been mentioned before (for example by Bellotti & Edwards, 2001) but it seems just as important to recover from other user's actions. Even with a more socially translucent interface, undesirable outcomes of an interaction are still possible: people can misinterpret the situation, interact without sufficient attention, or decide not to consider others in their interaction, to name some examples. For accountability to work, returning to a more desired (previous) state should be made possible when an action is undesirable or, in the case of mediated storytelling, the natural flow of the story pushes it in a particular direction that requires returning to a previous state. This means that in interactive multi-user systems, previous states of a system need to be retrievable. In *Shoto*, this is resolved by allowing the person who is about to share a photo to

cancel his action with a simple gesture. In *yOUR*, the physical interface allows users to revert actions as well.

Consider anticipated context-of-use

Concepts like *Objekt* and *Opico* rely on curated content: with *Objekt* one selects multiple photos for future reminiscing, while *Opico* is limited to a single photo that is displayed in the home, hopefully providing an appropriate cue for storytelling when the occasion arises. *Objekt* more explicitly gives the user the responsibility to consider how media will be relived. Because the user has to choose a context for the digital media, an anticipated context-of-use needs to be considered, while the abstract visual that is created in the *Opico* concept leaves room for interpretation afterwards.

However, it is debatable whether people can estimate what they will value in the future, and therefore it can be challenging to make a suitable selection. A fixed pre-curation process might leave too little room to revalue photographic material, while we know from the literature that new experiences and memories influence how we perceive and value existing references to events in our lives (Van House, Davis, Ames, Finn, & Viswanathan, 2005). Moreover, we could also argue that the abundance of photos that might seem "useless" at the time of capturing can lead to exciting (re)discovery of forgotten photos (e.g. Zhang, Kim, Brooks, Gino, & Norton, 2014).

5.5.2. System Interaction Perspective

To support reciprocal social interaction, all these concepts implement some form of multi-user awareness or support, ranging from no multi-user support (*Opico*) to fully reciprocal multi-user interactive systems (*Shoto*; *yOUR*). Opico is a single-user interactive system, but with a focus on social storytelling. In Objekt, the remote linking of photos to objects using the smartphone application might be used by multiple people in the same home, by giving each of them their own set of tags in combination with their smartphone application. They might also be able to share tags, each connecting their photo to the same object in the home. However, *Objekt* did not explicitly implement that. The design of *Shoto* and *yOUR* allow multiple users to share photos simultaneously.

What *yOUR* and *Shoto* also have in common is that they both involve a *shared screen* to display photos of both users simultaneously. They also both make use of *distributed individual controls*. With individual controls, each user has the opportunity to have control of the content that is shared on the fly, and in the case of *Shoto* also allows for a private environment for each user to browse through their content. The distributed controls are lacking in *Objekt* and *Opico*, and there is only one person in control of what is shared.

What all concepts have in common is that there is some level of *preparation*, which occurs before the photo sharing event. The preparation allows people to curate appropriate content for the *anticipated context of use*.

Provide interaction alternatives

In the design case of *Shoto*, we found that intricate interaction possibilities were required. Even if people have a high awareness of each other's needs, if there are no interaction alternatives it becomes impossible to act according to this information. For example, when someone can only choose to share a single photo full-screen or share no photo at all, this person can speak to the other people to understand the current situation, but that person has little support from the *system* to take others into account in the interaction. While accountability would still be possible, this situation will result in compromises, where, e.g. people take turns in the photo sharing activity. Moreover, the earlier mentioned roles of, in particular, sharer and recipient can change several times during photo sharing. Therefore, the system should be able to adapt the interface to facilitate these changing user roles. It seems that socially translucent interfaces should not only express information about other users but should also present sufficient interaction alternatives to mediate between the different user needs.

Balance visibility and privacy

In the design case of *Shoto* we focused on the visibility of information about an *interaction*, instead of information about the *content* in order to handle the issue of privacy, in line with Erickson & Kellogg (2000). The separation of a personal and a shared screen in *Shoto* already ensures some content privacy, but to keep personal content even more private, the scrolling wheel on the shared interface only presents blurred thumbnails of the photos. Only when a photo is placed on the stack with the intention of sharing it, it becomes visible to others. Similarly, the canvas only indirectly shows if users are engaging in other activities: when a user is interacting with their mobile phone, but there is no scrolling action visible, the other users can decide to ask for more information about the attention of that user. The canvas does not share this information about other activities that are performed with the mobile phone. In this way, plausible deniability (concealing behaviour with little white lies) remains possible, which we see as a crucial part of social behaviour. Furthermore, we made sure that all information is always visible to *all* users, so each user also knows what information is shared about themselves. This consideration is in line with Erickson (2003) who stated, within the context of social visualisation, that every user in the system should see the same thing, without customising the interface to add or leave out information for different users. We think that responsibility for guarding privacy in socially translucent multi-user interfaces lies with the designers, who should carefully evaluate the trade-off between the need for information and the privacy of users. Some of the choices and distinctions seem subtle, and for some social encounters not at all needed, while other social contexts require even more elaborate privacy considerations. *yOUR* implements some of the multi-user interaction principles but has less privacy because it features only a shared screen and no opportunity for personal pre-viewing of content.

5.6. REFLECTIONS ON THE DESIGN PROCESS

By reflecting on our design process of *Shoto*, we identified four steps in the design process where we see a specific need to consider questions related to multi-user interaction and social translucence (see Table 5.1). Below we describe each of the steps and the related questions in more detail.

Table 5.1: Four steps to incorporate into existing iterative design processes to design for multi-user interaction.

Process step	Example questions to be asked by the designer
1. Understand which users are part of the system, by describing the different user roles	*Who are the users of the system?* *How many different users (roles) can interact with the system?* *Are these roles using the system at the same time, or not?* *Can a user have multiple roles, or are they mutually exclusive?*
2. Determine the multi-user interaction need, by mapping the influence of every interaction on all the roles	*For every interaction, is there an influence on other users?* *If so, how are the other users influenced?*
3. Define the information different users require to consider each other in the interaction	*Which information is needed for every role to be aware of other users?* *Which information is needed for every role to be held accountable for their actions?* *What information is currently available (visible) for these users?*
4. Translate the required information that leads to enhanced social translucence into interaction aspects	*How can the necessary information be translated into interaction aspects?* *Which social interactions can inspire the translation of necessary information?* *Should the information be available centrally, locally, or both?* *Considering user privacy, is all information necessary in its current form?*

Step 1. Describe User Roles within the System

As discussed in the process of *Shoto*, people can have different roles in the interaction in different use cases. In *Shoto*, there are four roles in a typical moment in time: the *narrator*, the *browser* the *sharer* and the *recipient*. Usually, people switch between roles, and multiple people can have the same or different roles at the same time. Moreover, in social interaction that, e.g. includes storytelling, people change often between the role of narrator and recipient. Therefore, roles are not the same as what in design is often referred to as stakeholders or users: a user interacts with a system, whereas a role can be a person who is involved in the system without interacting (e.g., the role of the recipient in *Shoto*). It is important to have a complete overview of all roles that are part of the envisioned system. Thinking about the different roles that people can have in reciprocal interaction was in this case used as a design tool to facilitate the design process.

Step 2. Determine the Need for Multi-User Interaction

Once the roles are identified, it becomes possible to see whether roles influence each other. This determines whether there is a need for a multi-user focus in the design of the interactions. In Shoto, the multi-user situation is quite clear, since the different roles influence each other through simultaneous interaction: the canvas that the presenter is discussing changes when the sharer introduces a new photo. If there is no influence of an interaction on any of the roles, it might not be necessary to include visibility, awareness, or accountability for that interaction. Even in multi-

user situations, some interactions do not have a direct influence on others, which means that such interactions do not require information sharing to other users. Therefore, by identifying the situations in which roles can influence each other, one can determine which interaction possibilities need to be designed with social translucence in mind.

Step 3. Define Relevant Information

For every interaction that influences others, the information requirements need to be determined. The person that is interacting needs to be able to assess what appropriate behaviour is for him/her to be accountable. This assessment can only be done if s/he is aware of the intentions of others. In Shoto, the user placing a photo on the shared interface needs to know whether the time is right to put a new photo up. After the photo is changed, the others need to know *who* put the new photo up to address that person if the timing of the photo or the content was undesired. It is important to be specific about what information is required because as discussed before, providing too much information (such as showing all the photos that a person is scrolling through) could lead to privacy issues. As a tool to identify information requirements, Bellotti and Edwards' list on "human-salient details" for context-aware systems could be of use. These details consist of *presence*, *identity*, *arrival*, *departure*, *status*, *availability*, and *activity* (Bellotti & Edwards, 2001).

Step 4. Translate Information into Interaction Aspects

Lastly, the information requirements need to be translated into the interface or interaction. In this step, designer skills come into play. While the social translucence framework speaks of *visibility*, information does not necessarily need to be communicated visually but, depending on what suits the context and concept, could also be translated into, e.g. haptic or auditory information. In Shoto, we looked at interaction possibilities with printout photos to inspire the translation of information in the interface. We found that in the analogue interaction all the information requirements were covered (e.g. intention to share) and the analogy between the interaction possibilities with analogue photos helped us to make the overall interaction with digital photos understandable. In this case, looking at alternative interaction examples was useful for the translation process.

These steps can help us in the process of designing tools for reciprocal interaction. Tools to support shared remembering, such as *Shoto*, require the considerations discussed here. Especially on the system interaction level, these steps can aid the design process. However, following these steps does not automatically guarantee a successful multi-user interactive tool. The social interaction dynamics are determined by the practices that emerge around the technology, and so designing for reciprocal interaction is similar to designing for the user experience (for example, see Hassenzahl & Tractinsky, 2006; Hassenzahl et al., 2013) which cannot be captured easily in a set of design steps.

5.6.1. Limitations

We realise that the concepts described in this section have not been built or evaluated, which makes the previous sections hypothetical. However, by leveraging the techniques used in scenario-based design (Carroll, 1997) we can analyse hypothetical concepts and envision how they could support social practices. This allows us to iterate concepts without the need to prototype them.

The steps for the design process presented in the previous section were formulated after reflecting on our own design process, but we did not repeat the process using a new design case, nor did we evaluate these steps with other designers to assess their usefulness for the design practice. Moreover, the designs in iteration I were created by students, therefore we had limited insight into the process that was used by them to implement reciprocal interactive features.

5.7. CONCLUSIONS

In this chapter, we have elaborated on how to design for reciprocal interaction, both from a social interaction perspective and a system interaction perspective. This chapter illustrated how to design for reciprocal interaction in two iterations. We presented four different concepts, all with a focus on collocated photo sharing at home as the common goal. The analysis of the concepts provides what can be considered requirements that complement the requirements and considerations that we listed in Chapter 4.

Looking at the concepts from a social interaction perspective, we saw that 1) systems need to leave the interpretation of behaviour up to the users **[RQ.3]**; 2) systems for photo-mediated storytelling should be able to support dynamic interaction needs **[RQ.3]**, to allow people to rethink their behaviour or react to behaviour of others **[RQ.2]**. To support future collocated shared remembering, 3) some level of preparation allows people to curate appropriate content for the anticipated context of use **[RQ.2]**.

When looking at the concepts from a system interaction perspective, found that reciprocal photo sharing can be supported by 4) a combination of a shared screen to display photos, and by using distributed individual controls for navigation to allow in-the-moment control of content, needed for the level of privacy that is relevant for photo sharing **[RQ.3]**. On a lower interaction level, systems need to 5) provide enough interaction alternatives to enable users to consider each other, and lastly, when interfaces provide information about other users, 6) designers have to balance between visibility and privacy **[RQ.3]**.

After reflecting on the design process of *Shoto*, we formulated four design steps to aid the design process **[RQ.3]**:

- Step 1. Describe User Roles within the System
- Step 2. Determine the Need for Multi-User Interaction
- Step 3. Define Relevant Information
- Step 4. Translate Information into Interaction Aspects

Even though the designs from this chapter were not formally evaluated, the process steps can help us implement social translucence in design. We demonstrated with the design of *Shoto* that applying social translucence to collocated photo sharing can enable reciprocal memory sharing **[RQ.3]**, which contributes to our aim to design photo curation tools to support shared remembering.

In the next chapter, we will continue with the last design iteration of this thesis, where we translate the requirements from Chapters 4 and 5, as well as the process steps from this chapter into a curation concept to support collocated reciprocal photo sharing.

CHAPTER 6.
DESIGNING FOR CURATION-IN-ACTION

Chapter Summary

In the previous chapter, we explored how to design for reciprocal social interactions, and concluded with four steps that help designers implement the three constructs of *social translucence* (visibility, awareness and accountability) in the interaction. In this chapter, we will describe the last exploration of this thesis, where we translate previous findings and requirements in a curation concept. The first part of the chapter will introduce our approach to photo curation within a social context that we call *Curation-in-Action*, which integrates curation tasks into the social practices that motivate them. The second part of this chapter describes the conceptualisation, design and prototype development of *The Curation Arena,* which we created to explore Curation-in-Action. The last and largest part of this chapter describes the evaluation of *The Curation Arena*. In 40-minute sessions, eleven pairs (seven couples, three pairs of friends and one pair of colleagues) evaluated *The Curation Arena* using personal photos. Thematic analysis of the transcript data provided insights into Curation-in-Action in the way we implemented it in The Curation Arena, which allowed us to describe Curation-in-Action strategies, curation considerations and factors that influenced the experience of shared remembering. Finally, we formulated implications of our findings for the design of curation tools to support collocated shared remembering. We described that designers could 1) Centralise photo repositories; 2) Automate essential management; 3) Prioritise reciprocal sharing; 4) Support collaborative curation.[1]

[1] In this chapter, "we" refers to myself and my supervisors. Although the concept design work was done by me, the designs were discussed often with fellow PhD student Jésus Muñoz Alcantara who also helped me with building the prototype, and with my supervisors. I will therefore also refer to "we" in the sections about concept design.

6.1. INTRODUCTION

With our research, we aim to inform the design of photo curation tools to support the use of photos for collocated shared remembering better. So far in this thesis, we have seen that people engage in all kinds of media-related interactions, which we clustered in our PhotoUse model under *accumulating*, *curating*, *retrieving*, and *appropriating* activity types (Chapter 3). There we saw that people engage in many photo activities individually, even though the activities are motivated by a social purpose. The relation that we identified between the social purposes and curation activities motivated the exploration of the design opportunities for collocated photo sharing (Chapter 4), which resulted in a set of design requirements and a list of tensions for designing collocated photo sharing tools. In Chapter 5 we presented two design iterations where we explored the design of reciprocal interactive photo sharing, by implementing the elements of the *social translucence* framework (Erickson & Kellogg, 2000) in the design process. This chapter aims at bringing together what we have learned about designing curation tools to support collocated shared remembering practices in a final design iteration.

In the first section of this chapter, we will formulate our approach to curation within a social context, which we termed *Curation-in-Action*. The second part of this chapter describes the design of a concept that implements both Curation-in-Action and reciprocal PhotoUse, dubbed *The Curation Arena.* The third part describes the evaluation of *The Curation Arena*: in 40-minute sessions, eleven pairs evaluated the Curation Arena using personal photos. Thematic analysis of the session data identified the value of Curation-in-Action for the experience of collocated photo sharing. In the conclusion of the chapter, we will reflect on the concept and the evaluation study.

6.2. CURATION-IN-ACTION

In the introduction chapter of this thesis, we defined photo curation as *the creative activity that is intended to add value to an accumulation of photos by means of triaging, organising, editing and managing*. We argued in that chapter that the context of curation is usually separated from the context where the curated photos are used, because of the tools that are currently in use for photo curation. Our definition of curation does not dictate this separation, and to support that point of view we have described throughout this thesis that photo curation does not only happen when people are going through their collections prior to social interaction but also during collocated photo sharing: here people also make deliberate choices to include certain photos to show to certain audiences. The activity of photo curation might need to be moved closer towards the action of using that content for social purposes.

In previous chapters, we articulated several arguments in favour of making curation part of the ongoing (social) activity, similar to the notion of *sheer curation* (see Chapter 1), but focussed on photo curation: Chapter 3 mentions context-dependent PhotoUse, and that novel curation tools could make curation more attractive by combining curation with enjoyable activities that

motivate curation, either with a utilitarian, individual or social purposes (see Chapter 3). Chapter 4 discussed several requirements that support the need for curation during social interaction: on-the-fly content triaging, embedding photos better in narrative structure, and tailoring content to the audience.

Following these findings, we argue here that curation with a social purpose should not be separated from use, and that the context of photo curation should be merged with the context of PhotoUse. We therefore propose the concept of *Curation-in-Action*, with the following definition:

Curation-in-Action is photo curation done within the social event in which the curated photos will be used.

In this thesis, we consider Curation-in-Action only within the social context of collocated photo sharing. The collocated sharing context can involve, e.g. showing a photo to a friend on a mobile device, creating a photo album together, or simply pointing and talking about a photo that sits in a folder on the desktop computer. In line with our approach to curation, some of these events can lead to follow-up actions that result in alterations to the photo collections, but not necessarily: e.g., the event of selecting a subset of photos one by one on a tablet to tell a friend about a holiday trip, or using a photo for sharing on instant messaging or social media will, with the current technology, not impact the collection structure. The focus of Curation-in-Action is on the social context in which the curation takes place, and the curation result is used. The focus is not on the resulting changes in the collection, or possible future use of the collection. However, Curation-in-Action can result in permanent collection changes, e.g. when a person decides to permanently delete a photo while telling the story of a trip to a friend, or if a story that is told could be recorded to be reproduced later.

Specifying the definition of Curation-in-Action stimulates us to shift the focus of our design efforts: instead of designing photo curation tools that support curation for future purposes, we can now focus on curation tools that better support the social practices that motivate the curation. To investigate the value of Curation-in-Action, and to verify that bringing the curation context and the context of PhotoUse closer together indeed makes sense for photo sharing purposes, we designed and prototyped a concept which implemented Curation-in-Action and enabled us to study it. In the remainder of this chapter, we will describe the concept and its evaluation with eleven participant pairs.

6.3. THE CURATION ARENA

This section will describe the concept that we developed to study Curation-in-Action, along with the design rationale for the different choices, based on our previous studies, explorations and (co-)design efforts. We consider this the third design iteration, as a continuation of the first two iterations that were described in Chapter 5.

Because people often do not take the time to view their photos properly (e.g. Whittaker et al., 2010), we wanted to create the opportunity for them to view the photos in an environment that is more immersive than the small screen of a smartphone (Lucero et al., 2011; Van House, 2009), and which allowed us to examine their Curation-in-Action behaviour. Therefore, the context of the concept was set up as a special occasion; something people would not often do. The *Curation Arena* is an interactive system for Curation-in-Action, designed to support collocated photo sharing (see Figure 6.1 for an impression). At the core of the concept is an immersive room-sized 2D display that allows one to be surrounded by personal photos, and for people to walk around in the space to compare and examine their own and each other's photos up close. Because of the intention of our Curation-in-Action tool to invite a one-on-one dialogue between people within this confined space, we dubbed the concept the *Curation Arena*. The *Curation Arena*'s main components are a tablet interface for each user to privately browse their photos and a shared screen where the curated photos from the participants are displayed.

Figure 6.1: Left: mapping of the PhotoUse activities that are addressed by the *Curation Arena*. Right: The *Curation Arena*: two users experience immersive collocated photo sharing on a 360° wall projection.

6.3.1. Design Rationale

The basis for the Curation Arena concept was developed by combining earlier design explorations: mainly *Tailored Museum,* a concept for a personalised museum experience for friends or family (see Chapter 4), *yOUR,* a tangible interactive design for collocated photo sharing on a TV screen targeted at a parent and a child (see iteration I, Chapter 5) and *Shoto,* a redesign of Apple TV's photo sharing feature with added support for multi-user interaction (see iteration II, Chapter 5). The essence of our other design explorations also inspired choices for the *Curation Arena* concept.

The *Tailored Museum* concept from Chapter 4 was based on the fact that multiple people enter a building and have the opportunity to view photos from each other as well as their shared past. We thought of the *Tailored Museum* as an installation that, if realised, would be a valuable way to explore photo sharing in a unique setting. The basic concept of *Tailored Museum* was enriched in this iteration by focusing our design efforts on the notion of Curation-in-Action, which meant that curation had to become an integral part of the sharing activity. The curation had to afford dynamic selections to support dynamic purposes because during social interaction the requirements for what content is appropriate might change (Chapter 3 & Chapter 4). This aspect was implemented by adding a second screen as a distributed control (Chapter 5), as the selection possibilities and filtering on the second screen support the users in their need to better tailor content to the audience and the context (Lindley et al., 2009; Van House, 2009).

We designed the *Curation Arena* prototype to be used by two people because the purpose of the Curation Arena was to facilitate Curation-in-Action during collocated photo sharing of shared adventures. Sharing photos of a shared adventure was inspired by the concept *yOUR* (described in Chapter 5), where a parent and a child both take photos while on a trip and share the content after the trip, each with a tangible interface to navigate individual content. We wanted to evaluate the system with duos who engage in Curation-in-Action to support a shared remembering experience. To amplify the focus on a shared story and reciprocal sharing in the *Curation Arena*, the content from both participants was juxtaposed on the shared screen to form a collage with what they wanted to show each other.

To implement reciprocal photo sharing, we looked at the multi-user interaction principles we outlined in Chapter 5. In the design process, we described the different roles within the *Curation Arena.* Just as in the *Shoto* concept, these were a *browser, sharer, narrator,* and *recipient*. Our way of implementing multi-user interaction was to make no distinction or hierarchy between different users. The tablet interfaces were designed to be identical: the social interaction should determine if the user's current role is, e.g. the narrator or recipient. Moreover, the control and opportunity for Curation-in-Action to contribute to the shared screen also had to be determined by the conversation. Introducing Curation-in-Action technology to these practices should not force a certain balance upon a conversation. Therefore, the different user interfaces did not prescribe curation behaviour to the user (e.g. a specific number of photos that needed to be shared).

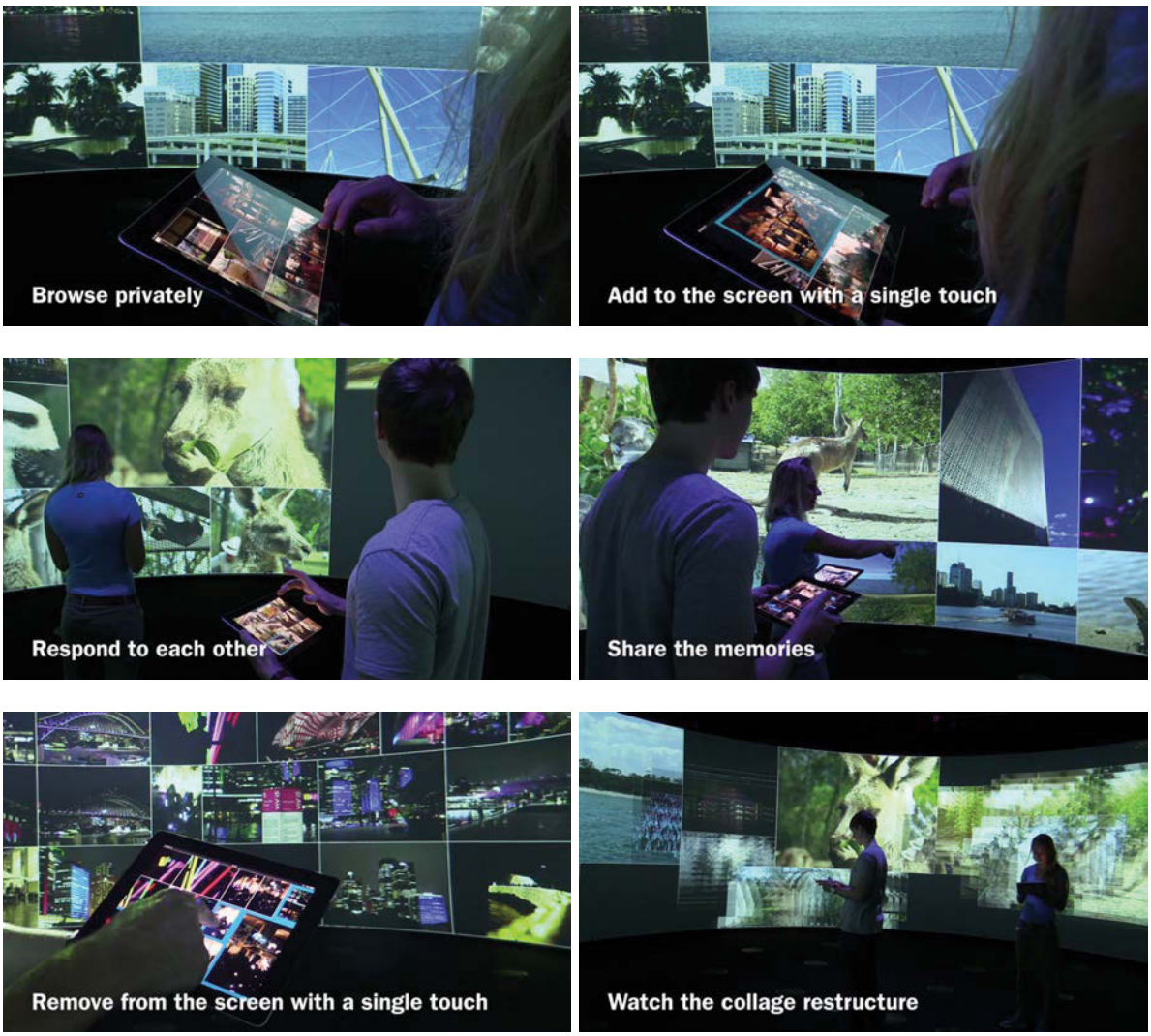

Figure 6.2: Storyboard explaining the interaction with the *Curation Arena*. Top left: both users have a their own tablet for private browsing; top right: by tapping on a photo, it will automatically appear next in line in the collage on the shared screen, for all to see, and the photo will be highlighted on the tablet to indicate that it was selected; middle left: because the photos from both users appear one by one in the order that they were selected, users can respond to each other's content with similar or contrasting photos; middle right: the photos can support the user to tell stories, reminisce and share their memories; bottom left: to make room for new photos, or if a user changes his/her mind, photos can be removed from the shared screen by tapping the highlighted photo again; bottom right: if photos are removed from the collage on the shared screen, the collage restructures to make sure there are no gaps in the collage.

6.3.2. Concept: Curation Arena

Tablet interface for private browsing

The tablet interface provides each user with an overview of their personal photos. The screen fits about nine photos, juxtaposed to form a collage, to support memory reconstruction based on the association between memory cues of related events. The photos are large enough to be recognisable so that people can select the best photo out of several similar shots. The photos are

arranged in a timeline in ascending chronological order, with the oldest photo on the left, and the most recent photo on the right of the timeline. To emphasise a sense of time and to distinguish the application from popular photo applications, users can scroll photos left-to-right, instead of top-to-bottom. When the user finds a photo that he or she wants to bring up to the shared screen, they have to tap it once to select it. The photo gets highlighted by a coloured outline, and will immediately appear next in line on the shared screen. To remove the photo again from the shared screen, either to make room for something else or because the photo turns out to be less relevant than expected, the user can deselect the photo by tapping it again (see storyboard in Figure 6.2). Users are given equal degrees of control over the displayed context, letting social dynamics and their role in the conversation determine the hierarchy.

The tablet interface supports private browsing to censor the bad photos, and to select the most relevant photos during the social encounter. The combination of both a private and a shared interface makes it possible for the users to engage in Curation-in-Action, to browse their collections privately and select only the most appropriate and relevant photos to show to others. We found in Chapter 3 that curation can be less daunting when people have a specific purpose in mind. In line with those findings, the *Curation Arena* brings the necessity to curate photos into the social context, therefore merging the context of curation with the intended context of using the photos for shared remembering.

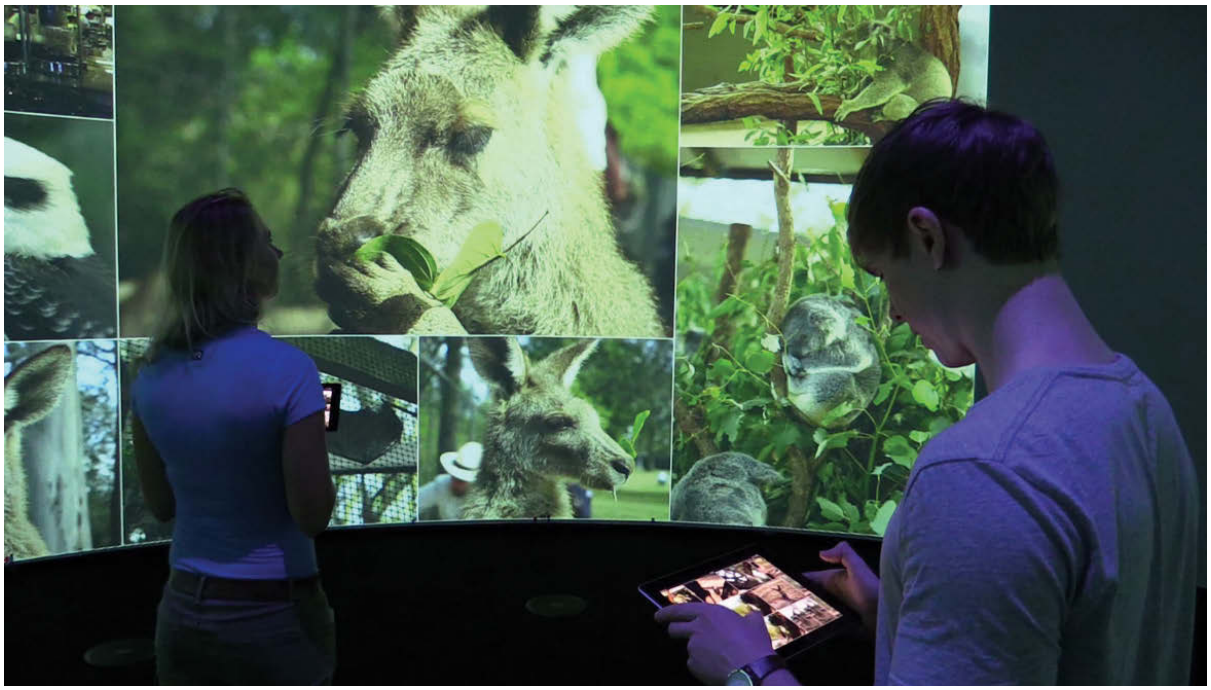

Figure 6.3: The tablet interface for private browsing in use

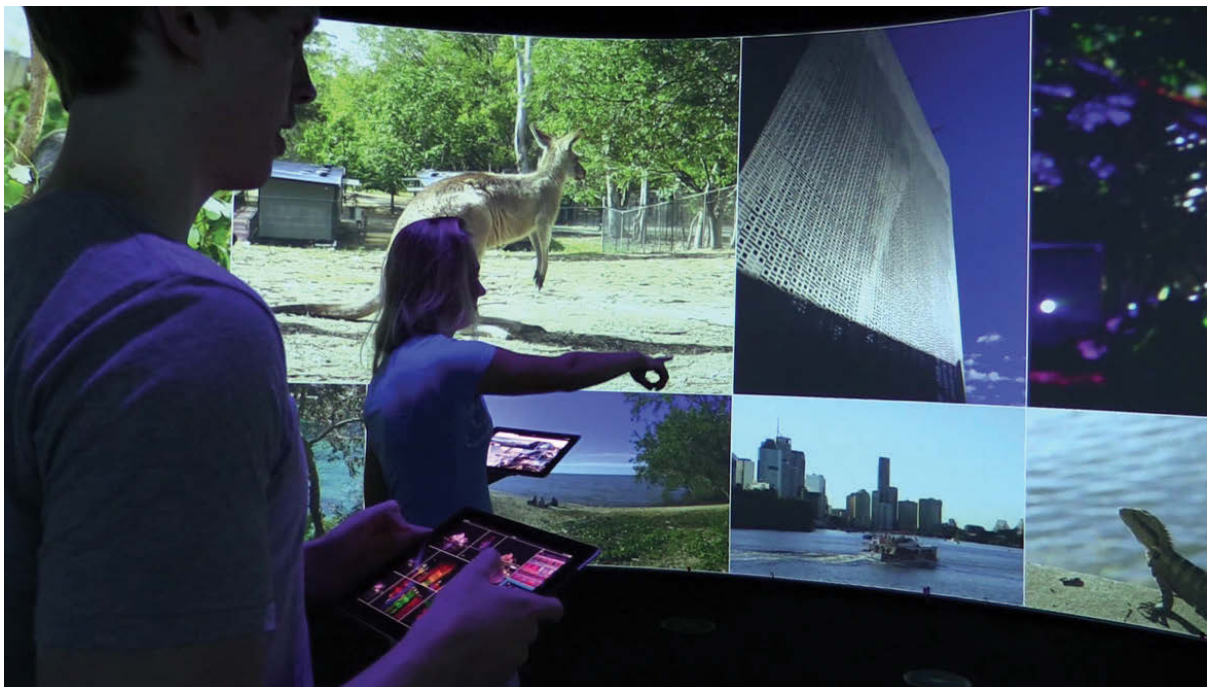

Figure 6.4: The shared interface for collocated viewing used by two people

Shared interface for collocated viewing

The shared interface starts as an empty black digital canvas that starts displaying the photos that are shared from the tablet interfaces. Similar to the tablet interfaces, the shared interface structures the photos from left to right, and juxtaposes them into a fitting collage, randomly enlarging about 10% of the photos to make the collage more dynamic to look at. Because of about 50 photos from both users are displayed at the same time, it offers a collage that can help them to compare and contrast different photos and stories.

6.3.3. Curation Arena contribution

There are several tools available that allow displaying content from a personal device to a shared screen, as we showed in detail in Chapter 2 and Chapter 5. As we outlined in Chapter 4 and 5, some form of Curation-in-Action is likely to occur when people are sharing photos but evidenced by the complaints about current tools (Chapter 4), people are not well supported. We, therefore, consider the central novelty of the Curation Arena that it is the first system that is designed around the concept of Curation-in-Action, with social encounters and their motivations as the point of departure to ensure that the tool is embedded in the social practices. Choices in the design are based on this principle. Most importantly, the activity of curation is brought into the context of photo sharing, making the activity of photo sharing merely a tool in the social encounter within the *Curation Arena*. Moreover, unlike existing domestic photo sharing solutions (see Chapter 2 for examples) the *Curation Arena* is designed as a multi-user system to stimulate reciprocal photo sharing with as little imposed rules as possible, to help focus the attention on the interpersonal interaction without constraining the natural social hierarchy. Finally, the *Curation Arena* enables

people to create something together, a joint effort based on content from all people. Although there are many tools available to enable the creation of a collage (e.g. embedded within *Google Photos*[2]), they are not aimed at creating something during social encounters, nor do they allow shared curation. The *Curation Arena* enables the creation of a shared story around a temporal, immersive collage with curated photos from both participants, which is the product of the social encounter.

6.3.4. Realisation[3]

The basis of the prototype made use of the facilities of the UTS *Data Arena*[4], which is a 10x10 meter, high-tech space with 360° wall projections which can be used for visualising complex data sets and interactive 2D and 3D (audio-)visual material. The choice for the UTS Data Arena early in the concept development shaped the concept towards a feasible, testable single-room environment where the basic principles of reciprocal photo sharing could be realised. The 360º degree projection facilities of the UTS Data Arena allowed the use of the whole room, instead of a set of smaller projections or screens, and that also took away the need for multiple rooms as was the case in the *Tailored Museum* concept mentioned before.

The *Curation Arena* prototype consists of four components that can be found in Figure 6.5: a photo server with basic sorting scripts that was implemented in Node.js running on a laptop; two tablets for private browsing, each running a full-screen web-based application in the Google *Chrome* browser; a 360˚ shared interface that leveraged the screen of the Data Arena. The tablets connected wireless to the local network of the Data Arena to access the photo server; the laptop had a wired connection to the Data Arena network. The communication between the tablets and the shared screen to send information on which photos need to be loaded onto the screen was established using Socket.io, a communication module within Node.js.

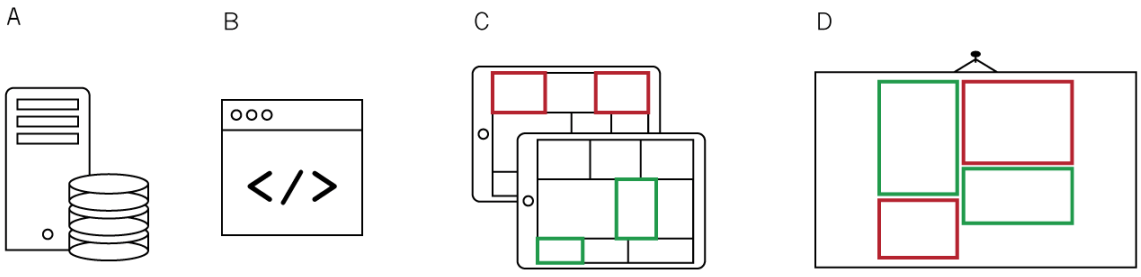

Figure 6.5: The Curation Arena system components, consisting of a photo server (A), automated basic organising scripts (B), tablet interfaces for private browsing (C), and a shared interface for collocated viewing (D).

[2] https://support.google.com/photos/answer/6128862, retrieved September 13, 2017
[3] I developed and built *The Curation Arena* prototype together with my colleague Jesús Muñoz Alcantara. We worked simultaneously on the realisation at TU/e, Eindhoven. He mainly took care of the back-end development, while I developed the front-end and interaction, supported by his expert knowledge. Darren Lee supported me remotely and locally with the connection of *The Curation Arena* prototype to the system of the UTS Data Arena at UTS, Sydney.
[4] www.uts.edu.au/partners-and-community/initiatives/data-arena/overview, retrieved August 18, 2017

A) Photo server

The *Curation Arena* system consisted of a web-based photo server that was implemented in Node.js running on an Apple *MacBook Pro*, Model Retina 13-inch Early 2013, OS X El Capitan 10.11. The laptop had a 2,6 GHz Intel Core i5 processor, 8 GB 1600 MHz DDR3 RAM and Intel HD Graphics 4000 1536 MB graphics. The laptop's performance was just enough for what we asked of the system, as long as no other tasks were running on the laptop. The laptop was a convenient way to temporarily store the participants' photos and make them available to the tablets and the shared screen via the web-based application. All photos were gathered in a local database and made available to the tablets and the shared screen via the photo server. The interaction on both the tablets and the screen was provided through a web-based application that was hosted on the photo server.

B) Automated management

A script within the server analysed the EXIF metadata of the photos to sort the photos in chronological order on the tablets, and to make sure that the rotation was correctly set, before making the photos available via the photo server. A second script generated thumbnails of the photos before they were made available in the photo server, to help reduce the loading time of the photos on the tablet interface.

C) Curation-in-Action interface

The tablets used for the *Curation Arena* prototype were Apple *iPad* 4th generation, running iOS 10.1. The iPad has a 9.7-inch (diagonal) LED-backlit Multi-Touch display, with a 2048x1536 resolution at 264 pixels per inch (ppi). With a 1.4 GHz dual-core processor, 1 GB LPDDR2 RAM and a Quad-core PowerVR SGX554MP4 graphics processor, the performance was barely sufficient for our web-based application. We first attempted to make use of the full-screen web-app functionality within the iOS software, but the performance and caching limitations of that specific feature prohibited us from using it. After a pilot test with the system, we concluded that it was more important for the user experience that the content was loaded than that the application ran in full-screen mode. Therefore, we ran a full-screen version of our web-based application within Google's *Chrome* browser application for iOS, even though it sometimes showed the browser interface (buttons and web address bar).

D) Shared screen

The shared interface of the prototype made use of the 360° screen of the UTS Data Arena, which is a combination of 6 overlapping 1920x1200 projectors that can output a display resolution of the 10080x1200 pixels. The content on the entire projection is controlled from a Linux-based desktop computer, and the shared interface itself was a webpage that ran in a *Chromium* browser. The Linux-based computer connected to the Node.js web server via the local network. The local URL or the images that users selected on the tablets were parsed to the shared interface, and a

full-resolution photo was then downloaded from the photo server and displayed on the screen. This setup made the tablet into a streaming device (similar to *Apple TV*), but rather a controlling device where the content is taken directly from the server (similar to, e.g. Google *Chromecast*).

6.4. LAB STUDY

The study aimed to provide a qualitative evaluation of the experience of Curation-in-Action during mediated shared remembering and storytelling, using the *Curation Arena* prototype. The setup of the study can be considered a laboratory study because the study took place in an artificial environment created for the purpose of research (Kjeldskov & Graham, 2003). Because not all the factors of the study could be controlled (i.e., what photos participants would bring and what topics they would discuss) the study cannot be considered a laboratory *experiment*, but it can also not be considered a field study because those take place in "the real world", using ethnographic approaches to study phenomena (Kjeldskov & Graham, 2003). One of the disadvantages of laboratory studies is the limited relation to the real world, but one of the major advantage of laboratory studies is the opportunity to focus on a specific phenomenon of interest (Kjeldskov & Graham, 2003). In our study, we focused on understanding the role of curation to support collocated shared remembering. The *Curation Arena* was intended to be a physical hypothesis (Koskinen et al., 2011), with which we wanted participants to experience the full potential of our approach to Curation-in-Action and reciprocal photo sharing, and slightly disrupt their perspective by offering something completely different from what they had ever experienced. The UTS Data Arena is an unusual environment, and entering the high-tech space is an overwhelming experience, especially the first time. Participants arrived in a brightly lit waiting room, where we also held the pre- and post-interviews. The corridor that leads from the interview area to the Data Arena was dimly lit, to build up towards the moment of entering the Arena itself, which was dark except for a spotlight on a side table with snacks and water for the participants to enjoy during the session. The theatrical ambience was intended to amplify the immersiveness of displaying the photos on such a large display. The focus of the experience had to be on enjoying mediated shared remembering, rather than evaluating yet another tool for photo sharing. Because we are ultimately interested in designing curation solutions for a domestic environment, the evaluation of the experience in the *Curation Arena* was also aimed at finding generalizable insights that could help design photo curation solutions to support photo sharing in the home.

6.4.1. Method

The study was set up as the evaluation of the *Curation Arena* to better understand the underlying concept of Curation-in-Action to support reciprocal photo sharing. To gather information from the participants we used two structured interviews with open-ended questions (see Appendix to Chapter 6 for details), one prior to the evaluation session focusing on the participants' common curation practices and preparation for the session, and one after the evaluation session focused

on curation, PhotoTalk and the use of the *Curation Arena* prototype. The pre-interview was audio recorded, as were the post-interview and the evaluation session within the *Curation Arena*. To support the audio recordings, two video cameras recorded the participants while they used the *Curation Arena* prototype. The prototype logged the communication between both tablets and the shared screen, to be able to check how many photos were shared from each tablet during the session. For the analysis of the data, we made use of the process of thematic analysis as described in the work of Braun & Clarke (2006); see §6.4.5 for details.

6.4.2. Pilot Study

Before the evaluation study, we did a pilot study intended to refine our interview questions and study procedure, including determining the appropriate preparation we could ask from participants, the time required for evaluating the *Curation Arena*, and also to test the robustness of our prototype. We did not analyse the data from the pilot, just the procedure.

The pilot was done at the Eindhoven University of Technology, in a so-called "Breakout Space" that resembles a living room, which is used for students and staff to relax or to study technologies for the home. We asked four of our direct colleagues to participate (two female), which meant that they had prior knowledge about our research, including the concepts of Curation-in-Action and the *Curation Arena*. For the purpose of refining the study procedure and the prototype that was not an issue. We partnered the participants based on their prior experiences (two of them had studied together, the other two were dance partners). To prepare for the session, we asked both of the participants from each pair to bring 300-500 photos from the past two years on a USB stick or as a folder on their laptop. This number was determined by the limited working memory of the tablets. The photos had to contain at least two holidays, trips, (business)travels, or other multiple-day events that they both attended and from which they both had photos in their collections. The photos that they brought did not have to be exclusive to these events, and they were welcome to bring photos from the past two years that were outside the events. It was vital to the experience that the photos were relevant and meaningful to them. Stock photos would not have the same relevance and it would not be possible to explore Curation-in-Action in the way that we intended the concept. Because as part of this study they would be using a tool to curate the photos on-demand, while they would be talking about the memories that surrounded them, we asked them not to curate the selection too much, but that they were of course allowed to censor what they brought to the session.

During the main study in the UTS Data Arena, two participants were left alone in the *Curation Arena* space to tell each other stories and show photos, but during the pilot, a researcher had to be present in the same room. Another difference in the setup was that the shared screen in the Pilot setup was not an immersive 2D screen, but merely a standard TV screen (see Figure 6.6). This was sufficient for the evaluation of Curation-in-Action and reciprocal sharing using the interfaces of the *Curation Arena* concept.

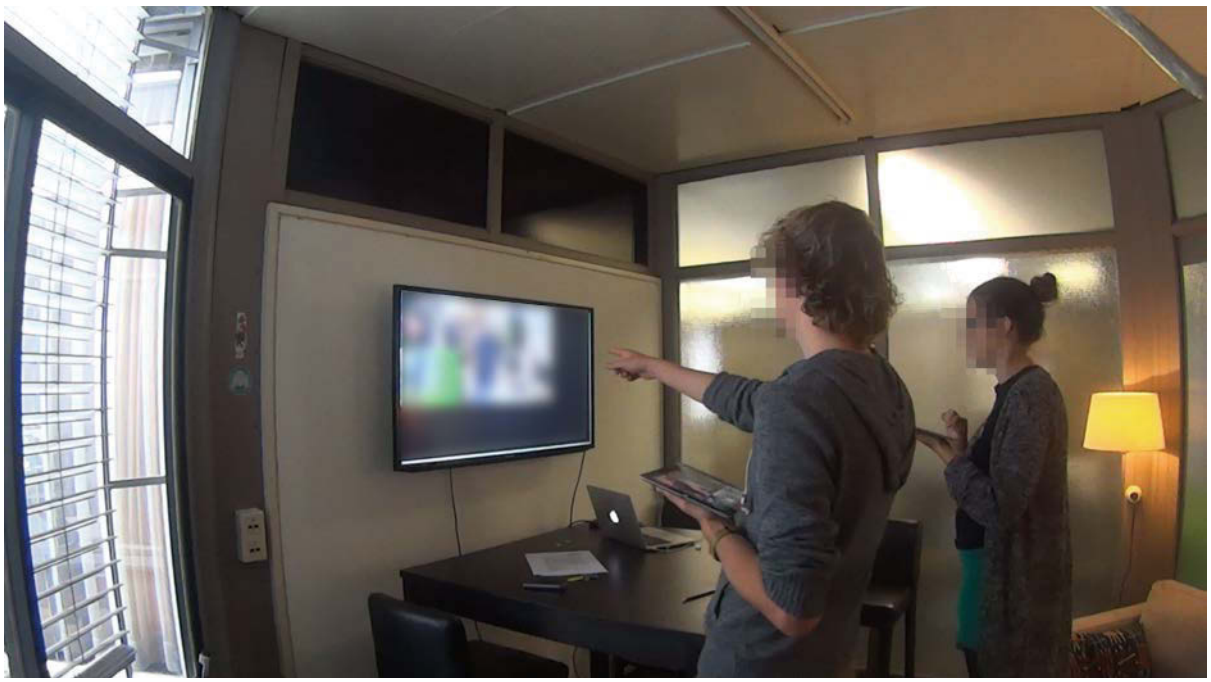

Figure 6.6: Screenshot from a recording during the Pilot study, which helped us to refine the study procedure. Instead of an immersive shared screen to display photos, we used a television screen.

Pilot Result

We were able to refine several elements of our study setup based on the pilot. The two pilot sessions lasted respectively 34 and 50 minutes, in which the participants showed each other photos until they exhausted the content on the tablet. After speaking with the participants, we decided that more content per tablet would help to keep the session engaging, as would limiting the session to 45 minutes because people might get tired from the activity after that.

We changed the number of photos that people needed to bring from 300-500 to 500-800. That number of photos would still be a reasonable representation of current personal collections, which according to our earlier research averages around 20,000 photos per person (based on the ten non-professional participants from Chapter 3).

We heard from pilot participants that it could be hard, even for good friends, to find enough photos of shared events, because the photos are scattered across several devices, which made us aware of the kind of preparation that we ask of participants. We broadened the timeframe from the last two years to the last five years, because we expected that it would make it easier for people to come up with sufficient photos.

On a technical note, the back-end software of the tablet interface needed to be adjusted because it was not loading all the thumbnails fast enough, and smaller thumbnails would enable the virtual memory to handle up to 800 photos. The lag impacted the user experience negatively because the participants had to wait for photos to load and to be able to continue with their story.

6.4.3. Participants

Participants for the actual study were recruited via closed user groups on *Facebook* that were relevant to the faculty in which this study took place, email lists for academic staff and students, and posters and flyers in the university buildings. Participants were asked to sign up with a friend with whom they had been on either a holiday or another multi-day event at least twice in the last six months. Each participant also had to own a digital camera or a smartphone, and had to be acquainted with digital photography, some form of online sharing services (ranging from email to dedicated services such as *Flickr*) and social platforms (e.g., *Whatsapp* and *Facebook*). They had to own a collection of at least 2.000 digital photos, to make sure that they were somewhat familiar with curation challenges.

Sample

The call for participants for this study attracted a specific group of participants. First, the nature of the study drew photo enthusiasts, and although that is the primary target group for photo curation tools, we would like to design tools that support all people who make use of digital photos. Second, the channels that were used for recruitment meant that more than half of the respondents were working in a university of technology or were graduate students, biasing the results towards highly-educated individuals with a background or interest in technology. Because of the low response rate on our advertisements and recruitment strategies, all respondents that signed up with a partner were allowed in the study. The sample for this study consisted of 22 participants, seven couples, three pairs of friends and one pair of colleagues. Because one female participant joined a second time for a session with a different friend, N = 21 (10 male, 11 female). Most of the pairs knew each other very well: the couples were married for at least three years and the friends from P10 had been flatmates for almost eight years. All but three of the pairs matched our sample profile, and for those three pairs, we made exceptions: The pairs from P7 and P11 knew each other for almost a year, which was shorter than we required initially, but because they had lots of shared experiences in the past year we allowed them in. The colleagues from P3 had no prior shared experiences, but they knew each other for the past 20 years through each other's work and the friends they had in common. We allowed them into the study because they were enthusiastic about using the system to explicitly get to know each other better through their personal and professional photos, and we were interested in this type of appropriation of the *Curation Arena.* The age of the participants ranged from 26 to 64 (M = 40.3, SD = 12.6). Native languages varied: English (9), Arabic (4), Dutch (2), Hebrew (2), Chinese (1), French (1), Hmong (1) and Farsi (1). The interviews and sessions were held in English, except for one session that was held in Dutch, the native language of both the participants and the researcher that executed the interviews. Two pairs were forced to talk about their photos in English during the session, although their native language was Arabic.

6.4.4. Procedure

Preparation

Having learned from the pilot, we asked both the participants of each pair to prepare a set of 500-800 photos that at least covered two of their shared events or holidays from the past five years. The limited number of photos would provide most of the participants with enough material to enjoy the sharing experience for the full 45 minutes. It also would allow them to experience it in such a way that they could reflect on the use of the system if it would contain their entire digital photo collections. The limitation that we put on 500-800 photos to bring to the session was also practical: we needed to process the photos in a reasonable time while we were doing the pre-interview. We expected each participant to select and bring their own selection. We instructed them that "*as part of this study, they would be using a tool to curate their photos while they would be talking about the memories that surround them*", and, therefore, we asked them to "*only lightly curate the selection*" they each brought with them.

Pre-interview

After welcoming the participants, we briefed them about the goal of the study to evaluate the experience of the *Curation Arena* prototype. We introduced them to the aim of the PhD research to provide solutions for photo curation, but we did not specifically brief them on the session's aim to also evaluate the Curation-in-Action that they would do during the session. After the briefing, we interviewed the participants about their general photo organisation, and specifically how they had prepared for this session, if they communicated about which events to choose for the session, and what criteria each of them had for including or excluding certain photos or events for this session.

During the introduction and pre-interview (lasting about 10 minutes), the photos of the participants were loaded into the *Curation Arena* server, without exposing the content of the photos to the researcher because we wanted to respect the privacy of the participants. Only the photos that participants chose during the session were displayed on the shared screen.

Prototype evaluation session

To investigate the use of the *Curation Arena*, the participant pairs were asked to try the prototype by showing a single photo, after which they were given 40-45 minutes to use the *Curation Arena* freely to share photos with each other. We determined the length of maximum 45 minutes after the pilot study. In total, we did not want to ask more than 1,5 hours from the participants and we also needed enough time to interview them before and after the session. These evaluation sessions were based on the use of personal photo collections of the participants. Because of the use of personal content, the researcher was not present while the participants showed each other their photos, to allow them to discuss the content openly. We did make recordings of the arena, which also exposed some of the personal content to the researchers during the analysis, but being

recorded seems less intrusive than being watched directly, and we anticipated that participants would feel more at ease if there was no experimenter watching the conversation in person. We ultimately wanted people to engage in what came as close to a natural social encounter as possible. The assignment that they got from the researcher was to "*use the system to show each other the photos and talk about the memories that come to mind, without being limited to the memories and stories that are directly linked to the photo on display",* because they were allowed to diverge a bit and have a chat about related thoughts and memories.

Post-interview

To understand the value and the effect on the user experience and the remembering experience of the proposed design interventions, we conducted a structured interview with open questions with the pairs together, right after the prototype evaluation session. The interview and debriefing afterwards took about 30 minutes.

At the end of the session, the participants were fully briefed about the aim to design for Curation-in-Action, and that we wanted to understand their choices for selection or to skip certain photos as part of the sharing. After the session, all personal photos from the participants were deleted from our system, because we did not need the photographic content for our analysis and wished to thus safeguard the privacy of personal data of the participants.

6.4.5. Analysis

In the analysis of the video material, we had only limited insight into the photos that were shared to the screen. Moreover, because of privacy concerns we could not identify the exact photo that people were talking about or see the selection process on the *iPad* (e.g. if a single photo was selected out of several duplicates, or how many of every event made it to the screen), nor could we be sure how they navigated through the timeline on the *iPad* unless their movements were visible in the video. Therefore, we had to derive the details of the actual curation process from the interviews and the recorded conversations, e.g. what participants said in relation to their actions, how they were asking each other for additional photos, and how they announced photos or pointed at photos. Thematic analysis was done in seven iterations by a single coder, with phases in accordance to the process described by Braun & Clarke (2006). We made use of thematic analysis as it aligns with our aim to study the actions and underlying motivations when using our photo curation tool.

In the first iteration, we transcribed the audio recordings of both pre- and post-interviews in full, and analysed the transcriptions using closed coding. The initial coding was based on the topics that we touched upon during the interviews (see Appendix Chapter 6 for interview procedures), which were based on the fact that we wanted to evaluate the *Curation Arena* concept. In the evaluation, we were looking for the aspects that we deliberately designed into the Curation Arena. The first set of codes consisted of the following: *General organisation* details, to get a basic

understanding of the typical photo activities of these participants and how they are organised; instances of *curation*, either in preparation or Curation-in-Action that occurred during the session, and instances where the current story guided specific photo selections; details of *mediated storytelling*, and *shared reminiscing*, where the photos guided the conversation; *system feedback* on the *Curation Arena* prototype, its usefulness and interaction details. To get a better understanding of the mediated shared remembering process using the *Curation Arena*, we viewed all the video material and made notes, screenshots and selective transcriptions of instances where participants engaged in *curation*, *mediated storytelling*, and *(shared) reminiscing*.

In the second iteration, after applying the codes to the interview transcripts and the video transcripts, we cut the snippets into the smallest possible data extracts that still included enough information for us to understand the context of the extract (sometimes the interview question was included in the snippet). The interviews provided 506 data extracts, divided over twelve preliminary categories that emerged inductively (see Appendix Chapter 6 for all the categories in different phases of the analysis). Some of the previously coded selections were in this phase moved to a new category, others were moved into more specific sub-categories.

In the third iteration, we gathered all the data extracts that we had labelled *viewing*, *capturing* or *general organisation* (in total 93 extracts from the interviews). These extracts were taken out of the analysis at this point and put aside for possible later examination.

In the fourth iteration, we still worked only with the interview data extracts, and we restructured them to get a sense of the themes. After this iteration, we had a three-level categorisation with six themes, nine categories, and 51 sub-categories. Data extracts related to the prototype feedback (75 extracts) and other irrelevant extracts were taken out of the analysis, which left us with 303 data extracts.

In the fifth iteration, we restructured the data into themes and categories that were more in line with the topics of the research aim to understand the role of photo curation to support collocated shared remembering.

In the sixth iteration, we collated the 565 data extracts from the video analysis onto the structure that we had. Of those additional data extracts, 478 fitted onto the existing themes and categories, which makes the final result based on 781 data extracts. The result can be found in the next section (Table 6.2).

In the seventh and last iteration, we refined the names of the themes and (sub)categories, we clustered subcategories to make them more distinct, and we identified exemplary quotes that could represent the themes and (sub)categories.

6.5. RESULTS

This section describes the results of the analysis of the interview data and the videos. In Table 6.1 the details of the sessions can be found. Participants spent on average 40 minutes in the *Curation Arena*, with a minimum of 27 minutes, and a maximum of 50 minutes. The variation was mainly due to participants arriving later than planned, or the prototype needing more time to process the photos.

Table 6.1: Number of total photos after pre-curation, and the number of photos that were shared to the screen per participant and per pair. The data for the participant pairs are split per participant (pt.A and pt.B) where relevant.

Pair #	Relation-ship	Pre-curation (before the session)	Photos on iPad		Shared onto the screen (photos shared, and % of total photos on tablet)		Session duration (minutes)
			pt.A	*pt.B*	*pt.A*	*pt.B*	
P01	Couple[5]	None[6]	417	825	47 (11,3%)	130 (15,8%)	28
P02	Couple	1 person	353	388	77 (21,8%)	74 (19,1%)	41
P03	Colleagues	Both	456	674	107 (23,5%)	108 (16,0%)	36
P04	Couple	1 person	364	336	69 (19,0%)	60 (17,9%)	50
P05	Couple	Both	708	560	61 (8,6%)	81 (14,5%)	45
P06	Couple	1 person	85	251	32 (37,6%)	41(16,3%)	41
P07[7]	Friends	Both	263	239	11 (4,2%)	23 (9,6%)	27
P08	Couple	Both	202	215	41 (20,3%)	66 (30,7%)	46
P09	Couple	Both	857	713	64 (7,5%)	54 (7,6%)	39
P10	Friends	Both	494	521[8]	128 (25,9%)	40 (7,7%)	44
P11[7]	Friends	Both	282	278	15 (5,3%)	30 (10,8%)	47
	Averages		**431 p.p.**		**61,8 photos**		**40 min.**

The logged data from the session revealed that seven out of the eleven pairs contributed a similar number of photos to the screen. In four sessions, one participant shared more than twice as many photos to the screen than the other; three of those pairs were friends. Six of the seven couples had an almost equal contribution of photos shared to the screen. The pair of colleagues also shared an equal number of photos.

Table 6.2 displays the themes and (sub)categories from the sixth iteration of the thematic analysis. The number of snippets that were added to each of the (sub)categories is listed on the right. The data points that were excluded from this analysis did not concern photo curation or the experience of photo sharing. The remainder of the results section represents the seventh and last iteration of the thematic analysis, with clarification and interpretation of the themes and categories we identified.

[5] This session was also joined by the 3 children of the couple, but they were not included in the interviews
[6] Even though there was no pre-curation, there was selection of events: just before the session participant A decided which folders would be interesting to look at, which the researcher then transferred to the tablets.
[7] Participant P07A and P11A are the same person, because she joined two sessions, with a different friend.
[8] Halfway one of the participants asked if more of his photos could be added to the system, which were initially left out to speed up the process.

Table 6.2: Categorisation that resulted from iterations 5 and 6 in the thematic analysis. Iteration 7 is the structure of the themes as can be found in the remainder of the results section.

Iteration 5	***Iteration 6 (refined categories from the themes from iteration 5)***		***#***
Themes	**Categories**	**Sub-categories**	
Contribution		(Equal) contribution to screen	11
General opinion	*Value of Curation Arena*	😊 (comments praising the experience)	43
		Reflection leading to future plans + Reflection on capturing behaviour	9
Strategy 1 – shared reminiscing	*Pre-curation process and selection*	Photos of shared experience	16
		Include trips & highlights/happy moments	3
		Looking for chronology, Specific time	2
		Motivation: Photos that person wants to know more about	1
	Reason to skip/show	To test others memory or check facts	53
		Private content they would otherwise not share	2
	What did they talk about:	Changes, (social) relationships, life	40
		Shared reminiscing	29
Strategy 2 – Getting to know each other	*Pre-curation: Common ground*	Photos that would interest the other + and/or to introduce yourself	22
		Censor / filter private material	2
	Reasons to skip/show	Relevance to the other person	12
	What did they talk about	Storytelling (to introduce / get to know each other)	19
		Asking questions to elaborate + invite others to talk about photos	8
Curation considerations – pragmatic	*No curation*	NO curation, only selection (pragmatic) per process	12
	Random selection	Random displaying photos	9
	Content reduction	Pre-curation process: Avoiding duplicates reducing number	3
Curation considerations – mnemonic / emotional	*Good story*	Because of the story event or memory	31
	Emotional associate	Positive negative associate with photo content	17
	Friends & Relationships	People	14
		With people on them	9
	Memorable events	Events + Happy times + accounts of anticipatory remembering experience	14
		Uniqueness of the event	1
Curation considerations - aesthetic	*Visual quality*	Aesthetic value/ no-value of content + Appreciation of content	33
		Aesthetic reasons	5
		Data arena tech as requirements for including photos	2
	Thematic fit	*Process during session*: Thematic	22
		Re-order (thematic) on screen	7
	Collaboration creation	Use the screen to recreate something	18
		(Visual) Dialogue	5
Factors - Behaviour	*Focus attention*	Focus attention feedback@ curator (e.g.-size)	23
	Timing content	Represent each event equally (proportionally) + Balanced set Timing relevant to the current narrative	36
	Narrating content	Story is determined by photos	26
		Importance of speaking	12
		Elaboration	10
	Reciprocal exchange	Dialogue style + reaction to a previous photo	39
Factors – Design/system	*Juxtaposing photos*	Collaging is cool!	14
	Conversation flow	Continuous sharing & storytelling	12
	Immersiveness	Experience + Immersive data arena + Curation arena as stage	33
	Second screen privacy	Multi user & second screen + Value of 2nd screen privacy	38
	Content familiarity	Have they looked as these before? (un)familiarity with photos	31
		Age of photos influences the experience	7
		Time in curation arena determined by # of photos	7
	Preparation time	Pre-curation time + Technical influence on ability of pre-curate	19
		Number of snippets	**781**

6.5.1. Value of The Curation Arena

The sessions in combination with the interviews before and after the sessions provided insights into the overall experience of the *Curation Arena*. In the videos, we observed that participants enjoyed the sessions, e.g. they smiled, laughed, told each other jokes, were very engaged in the Curation-in-Action and photo sharing activity. Because of their engagement, most of them reported that they lost track of time. Moreover, during the session, some of them expressed enthusiasm for the experience, and all reacted positively after the session.

> *"This is really cool, why do we not have a room like this in our house?" – P02B, during session*

> *"Thank you, that was a fun thing to do, thank you for this opportunity!" – P09A, after the post-interview*

Participants reported several reasons for their engagement, including the immersiveness of the *Curation Arena*, the fact that the photos evoked pleasant memories, and because the session enabled them to spend some time together and remember good times. The latter was also illustrated by participants taking selfies at the end of the session (P08, see Figure 6.7). Many participants also took photos during the session to capture what was on the screen, e.g. "for later remembrance" (P07B), or to capture the resulting collage.

The first thing that all but two pairs said after the sessions ended was that they would have liked to have more time in the *Curation Arena*. Most of the pairs also thought that the time went by really quick.

> *A: "Is it over?"*
> *B: "Come on, that is too early!" – P03, at the end of the session*

The session triggered some participants to, e.g. look more at these photos; go on a certain trip once more; revisit a friend; make a printed family album. One couple realised that they should make more photos than they currently do, to aid their memory:

> *"I think it also made us realise about all the things that we didn't take photos of, like all the different events that we could have and maybe should have [...] It is so much harder to remember it without... without something physical in front of you." – P06A, post-interview*

In summary, the *Curation Arena* provided an enjoyable experience, allowing the participants to share photos and talk about the memories attached to them. In the remainder of the result section, we will focus on the details of the sessions.

Figure 6.7: Photos and selfies are being taken at the end of the session to signify the moment (P08)

6.5.2. Strategies for Curation-in-Action

In our thematic analysis (Table 6.2), we identified two strategies that determined the practices around digital photos before and during the session in the *Curation Arena*. It appeared that the *social purpose* of the shared activity determined the strategy. The strategies relate to either *Shared Reminiscing* or *Storytelling,* and they are described in more detail below.

Strategy: Shared reminiscing

The first Curation-in-Action strategy was focused on supporting shared remembering of events, based on photos that were explicitly selected to cue those memories, with the goal to result in what was labelled by Frohlich et al. (2002) as *reminiscing talk*.

Specific to preparing for a shared reminiscing activity was that participants searched for photos of shared experiences. Those included highlights or family events, such as birthday parties. Two participants mentioned that in the pre-curation they were looking for photos from a specific time. The result of the pre-curation was that the selection of photos included a comprehensive set of photos of significant shared events from the past.

> *"I took things that we would have done together, so there' s a number of different trips that we undertook, a few different events we went to, just shared things, so I tried to exclude anything where it was just one of us that participated." – P02B, pre-interview*

> *"I looked for events that we did together, lasting one or more days, which are mainly holidays of course, but also, for example, public holidays, Christmas with the children. And, what more did I bring...? O, yes, children's activities, like the school dance, that kind of annual highlights" – P05A, pre-interview*

Although this was more prominent in the *Storytelling* strategy (see the next section), participants deliberately anticipated the sharing activity, by selecting, e.g. photos they were unsure about where, when or why it was captured, and intended to talk about that specific event:

> *"I also picked photos, because I did not know when we took them. Couple of ones I saw (...) and I wondered where it was, so I dragged them [onto the USB drive], so I can ask him (...) what the reason is behind these photos" – P08B, pre-interview*

The shared reminiscing strategy was dominant in eight of the eleven sessions, because these pairs focused mostly on sharing and talking about photos of shared events throughout the sessions. For example, the couple from P08 brought a mix of photos from different trips, celebrations, anniversaries and friends and family back in their home country. P08A considered it a game to show photos that could embarrass or surprise P08B. She also challenged him with questions about what he still remembered. During the session, they talked about the events surrounding the photos, and they focused their conversation specifically on the moment of the photo, hardly dwelling on a topic. A similar example was the young couple from P06, who started the session giggling because scrolling through the photos on their tablets already triggered good memories. They brought a lot of shared highlights (including photos of holidays, of their wedding, engagement and university graduations) and together they reflected during the session on these events and the people that were present. When the screen was full, they had a hard time selecting photos to remove from the screen, because they were too fond of the related memories to decide to remove the photos. At the end of the session, they hugged each other (Figure 6.8), emotional from "*Lots of good memories, in a fairly short time*" – as they explained to the researcher.

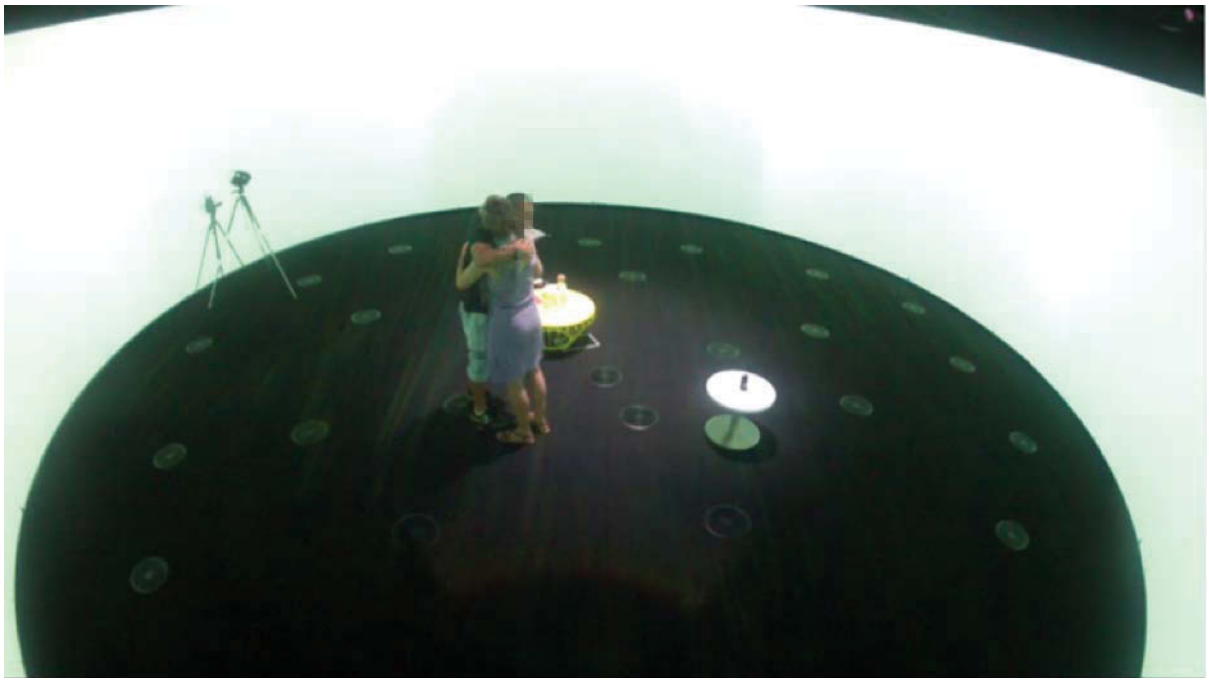

Figure 6.8: At the end of the session, this young couple realises how many happy things they have done during the short time they have been together (P06).

Figure 6.9: Two friends try to figure out when a particular celebration took place based on the evidence provided by the photos (P10)

The specific curation decisions that support this strategy all relate to selecting the content of shared events that somehow aid the process of remembering. One remarkable thing that we saw happening was that people challenged each other's memories or settled arguments, using the photos as a memory cue.

> *"Do you remember this picture? It was the first time I met [name]. It was the first time we ate hotpot." – P11B, during session*

> *A: "There we go, now you can tell who was there and who was not" (puts up a photo)*
> *B: "From the same event?"*
> *A: "Same event, I swear!"*
> *B: "Just to prove that you're wrong, look at the chair" (points at different photos, Figure 6.9)*
> *A: "Same event. This is the couch that goes this way, we took it out and opened the whole space. It is the same event. I think there is a group photo but I lost it. I have the group photo somewhere." – P10, during session*

In the second session, the P02A repeatedly challenged the recollection of the P02B by asking if he still remembered certain facts or event:

> *A: "And do you know where it is? What occasion it is?"*
> *B: "It was [name]'s graduation."*
> *A: "Hmmm mmm" (confirming)*
> *B: "But I still don't know who that is"*
> *A: "REALLY? SERIOUSLY? Sit down; you know who that person is! Whom could it be?"*
> *B: "...o, is it [name]?*
> *A: "Aha hmm" (melodic confirmation)*
> *B: "O my goodness" (somewhat embarrassed) – P02, during session*

Figure 6.10: Couple laughing out loud about an event (P08)

The conversation resulting from the photos of shared events were often characterised by what Frohlich et al. (2002) referred to as *reminiscing talk*, where people talk about the memories of shared events. Many of the shared memories resulted in positive emotions and laughter (see Figure 6.10).

> *"B: Well there was one taken in Norway where we were just bicycling along, and we came to this site of a stone circle (they both start chuckling). And there was a little thing about that stone circles were very rare in Norwegian culture, that was a Keltic thing, not a Scandinavian thing, and there were only three known in all of Norway. And then after we spent 5 more minutes then we found out it had been reassembled!"*
> *A: "The stone circle had been here since 1975" (hahaha)*
> *B: "They were just simple stones from the neighbourhood" – P02, post-interview*

Irrelevant photos were often removed from the shared screen, if selected at all, for example in session 4:

> *"I deleted a lot of what I put up (...) and especially the ones that I had taken when I was on my own when I was first in England. You know, that meant something to me that didn't mean much to him." – P04A, post-interview*

Another type of conversation that we observed was of a more reflective nature, where the photos were used to reflect on changes that occurred in participants' lives. They discussed changes in physical appearances (e.g. gaining weight; losing hair), changes in their everyday life (e.g. moving city or country, changing job), changing relationships (e.g. friends that they never see anymore, a deceased parent that they missed).

> *"O my goodness, look at that, look how tiny you were!" (directed at one of the children) – P01A, during session*

The photos were not only used to compare the photographed situation with the present, but several photos were also used to compare these details between different points in the past.

> *A: "Our life has changed quite a bit in the past five years."*
> *B: "Well, right before that. We moved to a new house; we got two new jobs; a house on the other side of the country."*
> *A: "New child."*
> *B: "New child, and the garden – we took care of the house and took care of the garden. Those are the changes that you see here, which are also things that you go through together. But also, things in the family that have changed" – P05, post-interview*

We observed a more general instance of this when participants reflected during the session on their overall life, as evidenced by the five-years' worth of curated photos that were displayed around them. One of the friends from session 10 explains afterwards why these photos and the changes they represent are valuable:

> *"It provides an overview over the years. Things have changed, but we are still friends. People come and go, things happen. But you also appreciate that. You know, there are not a lot of people that you can trust for a long time." – P10A, post-interview*

Strategy: Storytelling

The second Curation-in-Action strategy was focused on supporting stories about people, places and events that the other did not know or did not participate in. The stories were based on photos that were triaged to illustrate and augment the anticipated activity of *storytelling* (Frohlich et al., 2002).

Participants partly selected photos that were somehow related to the other person, or that might interest the other person to prepare for storytelling. Examples of these included photos of a trip that one person had done, but that s/he wanted to recommend to the other, photos of food that the other person had to try, or art exhibitions that might interest the other.

> *"I was first looking specifically for images of places that he and I had both been to, although maybe not at the same time; people that we know in common, although again we might not be at the same place on the same time. Sometimes pictures of tools, or objects we use that are in common, imagery that might relate to both of our practices, plus (...) I thought ok, he is going to have really great images, so I have to have really great images too!" – P03A, pre-interview*

Another part of the pre-curation following this strategy was intended to introduce oneself with photos related to elements of one's life, e.g. the family, home country, cultural customs and celebrations, or work examples.

> *"Some of the pictures I really wanted to show her to better introduce myself to her. So, she understands me better. Because at least we are going to be here in [country] for a very long time, so I just wanted to share these pictures with her and tell her who I am." – P11A, pre-interview*

More than in the pre-curation for the shared reminiscing strategy, participants mentioned that they filtered the photos that they did not want to share with the other person, because photos were too private, or they were not valuable for the story they wanted to share.

> *"I have some private photos, so I deleted them and selected the relevant pictures from my iPhone" – P07A, pre-interview*

This Curation-in-Action strategy was most discernible in three of the eleven sessions because for them the main purpose of the activity was to get to know each other better through mediated storytelling. This especially occurred when the participant pair were friends and colleagues, perhaps because they had less shared events and more unique, personal experiences that they could share with the other person. Specific aspects of this strategy made preparing, Curation-in-Action, and Phototalk different from the shared reminiscing strategy, because the photos were not related to shared events, but to events that somehow related to the other person, or that could be used to say something about oneself. For example, the friends from session 7 had been going out on a few trips, dinners, dances and karaoke parties, and the photos they brought with them were all from the last year they knew each other, so they had a limited amount of content to share. Most of the storytelling was done by P07B, who selected photos from her house, her housemates, her office and talked about what she curated. They also showed photos from shared trips, and every new photo they shared on the screen provided input for them to talk about, e.g. the photo, what people were in the photo, and the quality of the photo itself. P07A often requested specific content from her friend to elaborate on the current story. Another example: the participants from session 3 used the *Curation Arena* session as an opportunity to talk about their work as artists. They used plenty of visual material, very little holiday photos but instead lots of photos from objects and other things that interested them. They tried to put works with visual similarity next to each other. They also had prepared their curated set better than most other pairs. Therefore, they knew well what they had on their tablets and also why: because they wanted to show each other specific works and parts of their lives. P03B was the most talkative during the session, pointing out to P03A what he wanted to say about photos. He started most new photos with "this was..." and then came a small story. During the session, they were taking photos of the result they "created" on the wall. Because they had no shared memories, the session was somewhat different from the other participant duos in this study.

From what some participants expressed during the session it became clear that they had been looking forward to sharing stories about their past, such as specific stories of their family history or cultural customs from their home country because it allowed them to understand each other's background and cultural roots better. These participants selected the photos that they thought would support the kind of conversation that they had in mind, or they anticipated that specific photos would appeal to the other.

B: "Tell me about this black and white image."
A: "See, I knew that you would like that!" – P03, during session

To support storytelling, these participants selected photos during the session that would relate to either themselves, to the other person in some way, or to the story that they were sharing.

"There were some images that I just [put up] because I knew he would know something or someone in the image" – P03A, post-interview

"I preferred to select some photos particularly about myself or some places I have been to (...) which were exciting experiences, so I wanted to share my experience with [P11B]." – P11A, post-interview

In line with the kind of photos that participants selected, and what they anticipated, *Phototalk* centred around storytelling, ranging from stories about, e.g. a family member in traditional dress, a favourite actor or details about a place they went to.

"I went to [place], many years ago. You know, the first day of spring is our new year, and we gather all these elements (pointing at the photo), and we call it Nowruz in Persian". – P11B, during session

"I was trying to remember how the radiograph was called and how to explain the nature of this museum to [P03B] so that he would want to come and see it" – P03A, post-interview

There was reciprocity in the conversations and the photo sharing, not just because both participants had their own stories to tell and took turns doing that based on the photos, but also because each of them had been looking forward to hearing more about the other person's past life, and actively asked questions to hear more details. (This reciprocity can also be explained because it is a social and polite form of communicating.)

B: "This is [place], this was at the same place as [place]" (points at a different photo).
A: "O what is this?" (walks over and points at something, Figure 6.11)
B: "You see, it was exactly like this" (puts up a new photo, a detail of the other). – P11, during session

Figure 6.11: P11A asks a question about a photo of P11B, and as reaction, P11B puts up another photo of the same event

To summarise this section, the different Curation-in-Action strategies affected what photos participants prepared for the session, what they expected to be talking about, and what kind of photos they selected during the session to support *Phototalk*. The differences per strategy are listed in Table 6.3.

Table 6.3: Difference between strategies for mediated shared remembering, related to the purpose of the social gathering. The strategies differ in the kind of preparation, photo selection and conversation. They are not mutually exclusive and can be used together.

	Strategy: shared reminiscing	**Strategy: storytelling**
1. Pre-curation	Focused on photos of shared events	Focused on photos that might interest the other person or to introduce themselves, censoring inappropriate photos
2. Anticipated remembering experience	Shared reminiscing	Storytelling, finding common ground, getting to know each other
3. Curation-in-Action	Selecting photos of shared events, challenges each other's memory recollection, identifying changes based on photographic 'evidence'	Selecting what is relevant to the other person or to demonstrate an important part of one's own life
4. Phototalk	Reminiscing talk, reflecting on changes in everyday life, relationships	Storytelling, getting to know each other, asking each other questions

It is worth noting that the strategies are not mutually exclusive. In Figure 6.12, we illustrated this using two axes between which users can move freely during the conversation: social encounters can have as a purpose to share a story of yesterday's event with a friend (storytelling as the goal, A in Figure 6.12), and at the same time the encounter can be used to view the photos of a holiday trip and share the memories of the events during the trip (shared reminiscing as the goal, B in Figure 6.12). Within a session and from talking to the participants we saw that the two strategies can be used together, especially when people have had some shared experiences but still do not know each other well.

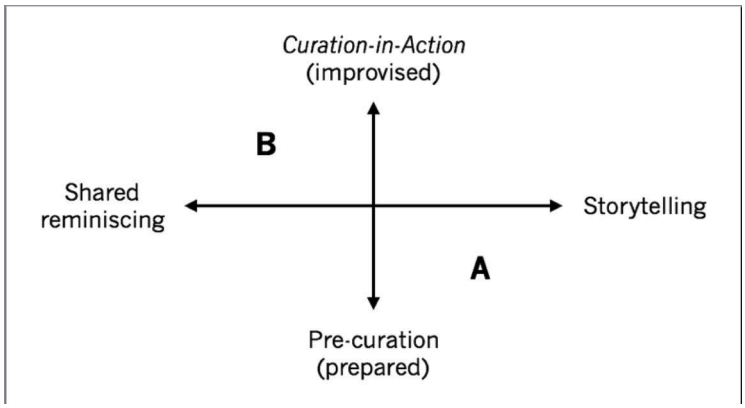

Figure 6.12: The y-axis represents the curation of photos to mediate the conversation; the x-axis represents the kind of Phototalk that dominates the conversation at any point in time. Examples are indicated by A and B in the figure: A: share a story of yesterday's event with a friend; B: view the photos of a holiday trip and share the memories of the events.

6.5.3. Mnemonic Curation Considerations

We observed and heard from the participants that photos were often selected because of the value related to the memory that was attached to them. We refer to this as mnemonic curation considerations. In some sessions, the participants were even more focused on mnemonic value. For example, the couple in session 5 had mostly family photos with them. While showing the photos, they constantly made sure that the other person looked at the newest photos. They mainly talked about the events that took place right at the time of the photos, (e.g. how the children had been feeling), or they talked about certain events that took place just after or before the photo was taken.

We clustered the quotes related to the mnemonic considerations under emotional association, memorability of the event, quality of the story, and featuring people.

Emotional association

Some photos were mainly chosen because of a strong emotional association with the content or the person displayed. Participants explained that they were mostly engaged with positive selection during the Curation-in-Action, which meant that they focused on finding photos that they liked, rather than skipping what they did not like. As P06B put it:

> *"I did not look for a specific topic. I looked for something that would grip my eye (...). I was looking for something that would raise some kind of strong emotion within me. I am just going to give you another example of my granddad. There is something that made me, like... I miss him so much now. It could have been a different photo of him, but it does not matter what I see in the photo, it matters more what I feel when I look at it. And the fact that he's in it." – P06B, post-interview*

Memorability of the event

Another consideration was how memorable an event was, either because they were special (such as the honeymoon, the holiday overseas, the first dinner at a specific place) but also because they were unique, as explained by P01B:

> *"The snow pictures. We don't get to the snow very often, no Australian does. That obviously stood out. That was not on my iPad that was on [P01A]'s. But I was actually happy to see that, you know. If I had the iPad, I would have selected that too. Just an obvious thing that popped up as being something interesting" – P01B*

Quality of the story

Some photos simply had to be selected because there was such a good story to tell around them, for example of someone dancing really funny, or of a memorable hike. In the following example, the photo also turned out to be really impressive and was kept on the screen for that reason, but was initially selected because of the story:

> *"There was one photo that I deliberately kept up after I put it up, I kept it up the whole time I never took it off. And it was the day where we climbed a very picturesque fjord in [place], and as we were climbing up it was very foggy and we were going all the way up and so were so*

many other people and we kept saying the sun will burn this and we got to the top of the fjord, and there was no visibility at all (Hahaha!). But we took a photo, and you know I was probably close to not taking any photo at all because there was no visibility. But there is this photo of a few people on the top of the fjord with all this mist around them and nothing else and I am so glad we have that. In a big format, it was the most impressive photo we had." – P02B, post-interview

Featuring people

Some photos were favoured over others, simply because they featured specific people (friends or relatives). Several participants mentioned in one way or another that photos with people in them were "always kind of interesting" as P04A put it. P06A describes:

"I was more focused on people than I was on things and even if we did put up a landscape or a thing we took it off to make room for photos of people" – P06A, post-interview

6.5.4. Aesthetic Curation Considerations

Other participants also had what we identified as aesthetic curation considerations. Some of the participants selected photos because they were primarily interested in the way it would look on the screen of the data arena, rather than overthinking the story behind it, especially the participants who reported to be photo enthusiasts. For example, the couple from session 4 started exploring how the system worked, and as soon as they understood how it worked, they were until the end intrigued by curating in such a way that they ended up with a beautiful mosaic on the shared screen. They each had half of the pre-curated photos on their tablets, so they needed to negotiate what could go first and what belonged together. Especially P04A had specific ideas about which photos could go together (such as trips), and which photos had to wait and even be deleted from the shared screen because it did not fit the current theme. Not because they were talking about it, but because they were crafting the visual story rather than the spoken narrative. Towards the end, they became more engaged with making the mosaic fit and filled the complete 360° screen.

We clustered the comments and observations relating to aesthetic consideration into *photographic quality, visual similarity* and *contribution to collage.*

Photographic quality

The first consideration is where the aesthetic quality prevails over the mnemonic value of content. As illustrated by the following conversation from session 9, where there is no mentioning of the memory related to the event, just the quality of the photos:

A: "Ok, so I have got lots of Hanayashiki, did you take any of Hanayashiki?"
B: "The amusement park? Yes, this one. That is almost snapped before yours (pointing at the two images that are very similar)."
A: "What about this one?" (puts up another photo)
B: "Hahaha o yeah. You did not get this one!" (points at a specific aspect of the scene that he had been able to capture, see Figure 6.13)
A: "Are you sure? Oh, the driver, here we go (selects another photo). I got a driving one." – P09, during session

Figure 6.13: P09B points proudly at something he was able to capture in the photograph

A few participants knew what the UTS Data Arena was capable of and for them, it became a requirement in the preparation phase because they wanted to see some of their photos on the big screen. Other participants did not know the data arena but were interested in the photographic quality, which is reflected in their behaviour in the pre-selection and the curation during the session.

> *"I really also like to show the best shot. We are quite fussy at the presentation because we enjoy photography, we like photography, and photography as an art form, so I guess we are quite perfectionistic about what we show other people." – P09A, pre-interview*

> *"[I put them on the screen] just to see what they looked like, large, because you are looking at photographs and they are big, and then you also realise, just me the technical sort of side, that some of them you can't really blow them up big (...) and when I blew them up, I deleted them almost straight away. And also, the ones that I deleted a lot were the ones where the light wasn't right and I hadn't fiddled with them beforehand, hadn't edited them at all." – P04A, post-interview*

Visual consistency

Several comments from participants during and after the session related to the consistency of the photo to the current theme on the shared screen. Some participants even asked others to take photos down that were out of place.

> *B: "Here we should put some tools in here, so we can have a bit of a tool wall."*
> *A: "O nice one, let me see if I have any tools" – P03, during session*

> *"I started doing a thematic curation. I am very interested in infrastructure, and things about the city, urban things, so then I just started curating that way a bit, thematically" – S09A, post-interview (see Figure 6.14)*

Figure 6.14: P09A (on the chair) started to create a thematic overview of a certain topic that inspires her.

Contribution to collage

Especially towards the end, most participants were interested in putting some effort into what they had been creating together on the big screen and started judging photos based on their contribution to the emerging collage. Some also engaged in what P03A referred to as a "visual dialogue", where one person reacted to a photo with a photo that was visually similar, to balance and compare what was on the screen.

> *B: "We were concentrated on trying to get ones that were vertical so that they would fit in."*
> *A: "And then at some point, we were thinking: why is there a gap? If we had gone for a vertical one before we put that other one up, there would not have been that gap!" – P04, post-interview*

6.5.5. Pragmatic Curation Considerations

Pragmatic considerations are usually not as deliberate as the mnemonic and the aesthetic considerations, but they do play a role in Curation-in-Action, and especially in the pre-curation. We clustered the pragmatic considerations under *no curation*, *content reduction*, and *random selection*.

No curation

Some participants did not curate their photos before the session. Even if there was some specific selection, individual photos were not considered and people judged quickly on the computer if a whole folder would be relevant or not. Especially in the pre-curation phase, other pragmatic constraints played a role, for example, available time to curate, and effort to get individual files from remote hard drives. E.g. the couple in session 1 did not have time to pre-curate the content,

so they brought their entire collection with them, stored in a bag of flash drives. Right before the session, P01A and the researcher made a quick selection to accommodate the limited number of photos for the tablets, which the researcher then split and put one part on tablet A and one on tablet B.

> *"It is an accumulation of everything because when I downloaded it, I just put it all on one disk until it filled out, and then I moved onto the next one. As I said, there is no order, no sorting out. We will get to that once we'll retire. It is all random, it is all chaos, our system. That's the sum of our life really: chaos" (laughs) – P01A, pre-interview*

Content reduction

Content reduction considerations focus on reducing the number of photos they included for this session, per event, as well as the total number of photos. However, rather than looking at the specific photos and selecting the best one, the content reduction considerations are less detailed. In the examples, the number of photos was reduced by taking out similar and duplicate shots, but just working off the large icons in the file manager software, without enlarging the photo and comparing them.

> *"There were few events where there was an excessive number of photos taken, sometimes where friends had given us their shots of the same events, and so I did not do them on photographic merit, but sometimes I would take blocks of 15 photos and take them out of this compilation." – P02B, pre-interview*

Random selection

Only a few participants also showed pragmatic curation during the sharing session, but because only a small part of the content was shared from the *iPad* to the screen (maximum of 30%, see Table 6.1), people were most likely not too pragmatic and did focus on getting deliberate content on the screen. Therefore, the pragmatic considerations during the sessions were limited to how the participants looked for specific content: in some cases, the participants just went from left to right, where others frequently moved on the timeline to find specific content to match the story. Some participants started rushing a bit towards the end and paid less specific attention to what photos they selected, mostly because they wanted to go through the whole set before the end of the session, showing the other whatever events were still left. Here the priority is clearly on sharing, and not on synthesising a curated artefact.

> *"It is really for enjoyment, so I do not mind whichever photo came up and in which order. And in which design, whether it is small or large" – P01A, post-interview*

> *"What I am doing now is merely scrolling through, and just looking for whatever I like to show" – P05B, during session*

> *A: "In the beginning, [we selected] occasions."*
> *B: "years maybe. And then we started putting up everything..."*
> *A: "The last ten minutes maybe."*
> *B: "At the end, we choose randomly" – P08, post-interview*

To summarise, in this section we have discussed what people consider before selecting a photo during mediated shared remembering. The considerations are specific to people's interests within the current situation, and they determine the choice to include or exclude certain content.

6.5.6. Behavioural Factors Influencing Mediation

This section describes four factors that we identified that relate to the behaviour of participants that influenced how they used the curated photos to mediate and guide the narrative.

Figure 6.15: P08B demands attention from P08A, saying "Look here, look here!"

Focus attention

For photos to support the narrative, everyone who was part of the conversation needed to look at the photos: participants often made sure that the focus of the other's attention was on the newly added photo. They made sure to point out new material, tapping the other on the shoulder (see Figure 6.15), or simply telling the other, e.g. to "look at this one". Another way to focus the attention that was suggested by several participants was to enlarge a photo on the shared screen, but that was not possible in the current prototype.

> *B: "Look at these beach photos, this last one. Look [P05A]."*
> *A: "Yes, I am already looking at it" – P05, during session*

Thematic relevance

Another factor that influenced the mediation of the story was the relevance of new content and either a good fit with the current theme or a deliberate diversion from the current topic. Some participants put up more photos of the same event to add detail to a particular story; others threw in a new photo to deliberately change the topic.

> *"There were lots of pictures related to one topic [on my iPad], so I just shared one picture that I thought was the most interesting, but when I started to talk about that, I thought there are other pictures that I can choose to share onto the screen to explain it better." – P11B*

In some instances, specific photos were out of place for the current story, and therefore had to wait for the appropriate moment:

> *A: "Remember you (directed at P04B) moved from Greece into Rome..."*
> *B: "And I was premature!*
> *A: "...and I had all the ones from Greece, and you'd moved onto Rome, and I was saying to you "if you do that we're going to have them all mixed-up". So, you deleted some of them, we went back and had a look at those Greece ones, and then we took those [Rome photos] further." – P04, post-interview*

Most of the participants gave the feedback afterwards that they would be interested to interact with the content once it is on the shared screen, e.g. to change the size of a photo, and more importantly to be able to restructure the photos to either make a nicer collage, or to group photos in a certain way. Participant P08A suggested having several clustering options to better support the kind of conversation that is in progress.

> *"My [suggestion] is that if we put all the photo on the wall, we can [then] move those photos anywhere we want (...). Maybe there is more, that one [should] become bigger. And we can move the pictures into another place, and we can group all [the photos] with a similar topic." – P07A, post-interview*

> *"I would do* stories*, and then talk about that, and then change to a* theme*, and talk about it." – P08A, post-interview*

Narrating content

During the post-interviews, we asked all the participants about the value of talking about the photos. Although some said that certain photos needed additional explanation, almost all of them stated that telling the stories was a big part of what made it enjoyable.

> *"I think it is a very important part of memory consolidation, you know. Without the other person to bounce things off, you'll have far fewer details to the memory." – P02B, post-interview*

On the other hand, the conversation in the *Curation Arena* was almost exclusively determined by the photos, even though we explicitly had invited the participants to talk about whatever came to mind without the need to stick to topics directly related to the photos. Only in some instances, we saw some elaboration around the photo, e.g. the friends from session 7 talked more about the photos, and as a result, shared fewer photos on the screen than other duos could in the same time:

> *A: "We just looked at the photos and described the things [in the photos]. And then we continued to talk about those topics, maybe extend them."*
> *B: "It was in the pauses in between that we were looking for photos." – P07, post-interview*

Reciprocal exchange

The last behavioural factor that influenced the mediation was how people reacted to each other with new photos. The system provided some constraints, but most of the social "rules" were open and had to be determined by the people in the room. Similar to what happens naturally when people engage in reciprocal storytelling (see also Chapter 5), some participants agreed on a dialogue-style process at the start of the session (P05B: "Shall we take turns?" P05A: "Yes, that's fine"), while other pairs took turns when showing content without agreeing to a priori (P08B during the session: "Is it my turn?" P08A: "Yeah it is your turn"). The *Curation Arena* afforded reciprocal exchange through the equal interaction possibilities, and we saw many instances where one person responded to the content that was on the screen by adding their own, very similar content to the screen, also illustrated by the fact that many of the pairs shared an equal number of photos to the screen (see Table 6.1). P03A commented on this:

> *"There was a moment where he showed a picture of his wife, at a particular location in South India. And I thought, ah I know that I have a picture of myself in exactly that spot five years ago, and I hadn't exactly the same, but I had from the same day in the next time over." – P03A, post-interview*

What complicated this was, e.g. that content was hard to locate, but also that participants were also distracted by the other content on their tablets, which potentially caused a conversation to arc in a new direction. As P05B explains:

> *"At some point, a theme emerges, and you try to look for that, to also add something to it. That does not always work out, and at a certain point you come across something else that you like as well, which can be something totally different, and then the conversation actually changes automatically to that topic. Sometimes it just comes in between, and then the conversation continues with the previous theme. But sometimes it is something you both like, and then you go for that. (...) At a certain point, we talked about the theme of birthdays, because we both happened to have photos of birthdays in front of us." – P05B, post-interview*

The last instance within this topic was when one person was asking for specific content from the other person (e.g. P01: "Put more photos up from the snow!"; P07A, while pointing at a previous photo: "Show me more photos of us in the pub or the karaoke").

6.5.7. Design Factors Influencing Mediation

This last part of the results describes the factors of the design that influenced the mediated experience of within the *Curation Arena*. By design we mean here both the designed *Curation Arena* concept but also the study setup.

Preparation time

Because of our study setup, participants got the time to prepare for the sharing session. The time spent in the preparation seemed to be a factor that influenced not only the experience of pre-curation itself, but the anticipation also influenced the experience during the session.

> *"While I selected things she (P08B) was on the other side so I was just saying "ooooh", and she said, "I want to see that!". But I was just giving some more [hints], like a puzzle." – P08A, pre-interview*

However, the technology that was used had an even bigger influence on the experience during the preparation. Some participants needed to go through various hard drives or remote servers to gather their photos, which took them so much time that they did not get to enjoy the preparation properly. When asked if the pre-curation was enjoyable, P09A said the following:

> *"No, because I was just being pragmatic. I did not even go through the shots, and I was just moving big chunks of data across, and… I mean it was nice to kind of look very briefly at it and go "O I remember", you know, so there was that little kind of memory prompt that was quite pleasurable. But I didn't get a chance to go through any really [in a] kind of detailed way. I was all ready to enjoy it because I had not downloaded the photos from this camera. And I was ready to spend some time and look through, but then other things happened, and I just did not have the time to spend on it, so it would have been enjoyable if I had more time. But in the end, I just dumped a chunk of photos, and that was it." – P09A, pre-interview*

Content familiarity

Another factor that influenced the session was how familiar participants were with their content. Participants that were more familiar with their photos were able to find relevant content more quickly, but participants that were too familiar with their photos were also not very much interested in looking at them or talking about them. Less familiarity also led to serendipitous encounters with content, which also led to pleasant surprises.

> *"Mine was a little bit sad because I got the iPad that actually had all the pictures that keep coming up on my computer. So, they were extremely familiar to me. [P02B] had the iPad that had all the different - that I hadn't seen for a while. So, I was just sitting there waiting for him to put another one up." – P02A (see Figure 6.16)*

Figure 6.16: P02A (right, the tablet placed on the table) is too familiar with her photos, so the first part of the session she is mostly looking at what P02B (left) is putting up.

Figure 6.17: Participants from session 3 looking several times for photos to delete to make room for new content.

Flow continuity

Another factor that influenced the process and experience was the seamlessness with which the photos could be added to and removed from the shared screen while talking about it. From the comments after the sessions, it became clear that people like to be able to continuously share new content on the screen, without being interrupted in order to remove material. Sharing to the screen was done with an easy interaction because in the implementation of the *Curation Arena* we implemented an interface where photos toggled with a single tap between showing on the shared screen or removing them. This meant, however, that if photos needed to be removed to make room for new content, people had to find them again in their photo stream, and tap them to remove them from the screen. Even though the photos that appeared on the screen were highlighted with a blue border on the tablet, it took people some time to find them, which interrupted the process of continuous sharing:

> *"Sometimes the line of thought was cut off because we needed to get rid of some photos to make room for something - so the photo that we wanted to get up there; we needed to stop for a moment and it kind of disrupted the flow of the conversation because we needed to get rid of a photo to get the other one in there." – P06A*

Juxtaposed content

The design decision to show a collage on the shared screen, which grows with every photo that is added was well received by the participants. The influence of the juxtaposed wall was, e.g. that the conversation took a different turn because of certain combinations, or that people actively tried to add or remove photos to have certain content next to each other. However, most of all, it

intrigued people how the collage added to a new narrative. When asked about the favourite aspect of the whole session, P09A responded:

> *"I think looking at it with the things together, like just being able to put our photos together and look at them simultaneously, or next to each other, or... I quite enjoyed that" – P09A, post-interview*

> *"We were fascinated by the ways the images locked usually interesting together, and to me, that was quite important to carry on that way to have a constant response to, like, this image. And that was lovely to see that some random juxtaposition like that could be so interesting." – P03B, post-interview*

> *"The collaging was quite interesting, that actually kept me interested. You have a big one in there, and then you have a small gap and then you, you know, you have a small image going in there. It was actually quite smart, the way the images were sort of interlinked." – P01B, post-interview*

Immersive experience

Another factor that seemed to influence the experience was the fact that the *Curation Arena* made use of a 360º projection. When asked afterwards what they valued the most from this session, many participants valued either the immersiveness or the size of the photos on the shared screen. This made sure that the focus was only on the photos, and the more photos were added to the shared screen, the more immersive the experience became.

> *"For me, it was the size; you do not get this arena anywhere." – P07B, post-interview*

> *"For me, it was the immersiveness, not necessarily the size. (...) It was that we were surrounded by it. We could have spent a lot more time in that situation; we completely lost track of time. The way we were being transported, that's what it was." – P06A, post-interview*

A few participants did not immediately see the added value of a screen all around them, also because they had to turn (in) their seats. However, after they filled the screen and they started looking or walking around, their opinions changed.

The immersiveness and the uniqueness of the experience also made the Data Arena space a particular venue, and different from everyday solutions. Therefore, when asked, many participants found it difficult to think of this way of photo sharing as something they would often do. They talked about going to such a place every few months, years or decades with new photos, or that they could invite friends after a holiday and all share their photos with snacks and drinks in the room.

> *"Like groups of people (...) it is going to be very awesome if the four of us bring all our photos and we came here, [and] no one knows what [the others] brought. It is going be a very awesome experience." – P10B, post-interview*

Figure 6.18: There were several occasions where participants looked at each other's iPad. Here P04A looks and points at P04B's content.

Screen sharing patterns

The implementation of both a private and a shared screen in the *Curation Arena* influenced how participants behaved, but not exactly as we expected. Most participants kept their *iPad* mostly to themselves (which we expected to happen), but especially the couples also looked at the content on each other's *iPad* since all content came from a shared collection (Figure 6.18). Some even interacted with the tablet of the other or showed each other a photo by holding up the iPad. What stood out was that participant P08A was not allowed to look at his wife's *iPad*, because she wanted to surprise him with exceptional photos. However, she was allowed to look at his *iPad* during the session (or at least she did).

Overall, the fact that there was the option to keep content to oneself, and at the same time contribute together to a shared collage was an essential aspect of the experience to many of the participants, and also what made it different from previous sharing experiences they had.

> *B: "We had simultaneous control over what we put up there. Shared viewing of that selection, that was nice, because that is not something we could do on our laptops".*
> *A: "No, or not having to take someone through all your stuff, but being able just to put it up there. (...) and, also, being able to see their stuff, yeah that was nice."*
> *B: "Yeah, and just the ease of having all the photos in front of you to scan through with a touchscreen. That is quite handy." – P09, post-interview*

> *"What I liked about it is that you both have an interface because it can be annoying when we look at photos together that there is one person behind the controls, and then you constantly have to ask the other to speed up or slow down. (...) I think here we really did it together (...) because we were clearly showing photos to each other, saying "look here", and "you will like this one". So, you are also selecting a photo* for *the other person." – P05A, post-interview*

A few participants were somewhat annoyed by the fact that they could not interact directly with the shared screen since they now had to look a lot at the small *iPad* screen, while there was a huge screen in front of them, which also made them sometimes miss out on new content from the other person:

> *"I was frustrated that I had to stare at the small screen when I was surrounded by a big screen, that was the only frustration I had with the experience because I could say "O what did she put up?" – P03B, post-interview*

6.6. DISCUSSION

The study described in this chapter was intended to explore Curation-in-Action within a social context, through an evaluation of our *Curation Arena* concept. We deliberately designed the *Curation Arena* to demonstrate our view on Curation-in-Action, using reciprocal photo sharing (see Chapter 5 for more information) to support social purposes of PhotoUse (see Chapter 3) with a focus on Curation-in-Action to support shared remembering. We presented the evaluation of the Curation Arena with eleven participant-pairs, which led to four main findings: 1) the evaluation revealed that participants enjoyed the social and immersive approach to photo sharing implemented in the *Curation Arena*; 2) we identified two Curation-in-Action strategies that people use when they prepared for and engaged in collocated photo sharing (storytelling, and shared reminiscing); 3) we identified several curation considerations that people have when they decide which photo is the most appropriate; 4) we described behavioural factors and design factors that play a role in the process of mediated remembering.

Because the results touch upon various topics, we will in this discussion focus on the results pertaining to Curation-in-Action. We will start with the limitations of the evaluation study, followed by insights concerning Curation-in-Action, and what aspects and factors are important when designing for curation.

6.6.1. Limitations

The call for participants for this study attracted a specific group of participants, mainly photo enthusiasts, although we would like to design tools that support all people who make use of digital photos. Moreover, more than half of the respondents were working in a university of technology or were graduate students, biasing the result towards highly-educated individuals with a background or interest in technology, which most likely affected the ease at which they were able to use the technology presented to them. To minimise the influence of these biases and make the results also applicable to a broader audience, we focused less on the evaluation of particular features of the prototype and more on the lessons that we could learn about Curation-in-Action and reciprocal PhotoUse.

We are aware that the unique and immersive experience, provided by the UTS Data Arena's facilities, was entirely different from participants' regular photo sharing practices. The

360º screen and four-meter-high projections, amplified by the space's dimly-lit entrance and our study procedure made sure that for the duration of the session, the focus of the participants was on each other and the photos that they shared. Participants might have reacted in a certain way because the technology-heavy concept was so much different from what they were used to, and so their behaviour may be different from the ones that will unfold during actual everyday home use.

The privacy of using two tablets alongside the shared screen was bypassed by almost all the seven romantic couples because they had a shared collection and did not need to keep any of it private. Moreover, we asked the participants before the session to each make a selection, but many of the couples did not do the curation individually but instead curated the set together, or one of them did the curation. However, the fact that both participants had the opportunity to contribute and control what was on the shared screen made the multi-user interaction still one of the most valued aspects of the experience.

We asked all the participants afterwards if they were aware that they were in a test environment. Almost all of them responded that they did not pay too much attention to the cameras, and that they were enough drawn towards the content of their photos to not think about it at all. Even the participants that were reasonably aware of the test situation said that it did not inhibit their reaction and conversation.

> *"No not at all, you feel like, I don't know, maybe something in the room, maybe something in the size of the photos, maybe the actual task... made it if somehow to disconnect you from the fact that you are being watched inside a cube. I just feel like I am drowning in these photos especially with the size and everything you know. Yeah. It is very immersive" – P06B*

Two participants mentioned during the session that they censored certain photos because they were not appropriate for this session, and also some conversations (e.g. about work or personal matters) were avoided or cut short because they felt uncomfortable talking about it during the session. The two duos that were required to talk about their photos in English, although their native language was Arabic, sometimes cracked a joke in their native tongue, and at least one of them said afterwards that he was less fluent because of this constraint, and therefore also more aware of the test environment. During the session, we also saw some participants interact with the camera, e.g. making sure that their actions were within its viewing angle, which indicates awareness of the system. Most notably was the reaction of one of the children (age 8) at the end of the first session:

> *"Bye camera, we looked at all one-thousand-three-hundred photos. I hope you have successful data. Bye!" (waves at camera) – P01-child, during session*

Despite the awareness of the cameras and this being a test environment, we did not observe self-presentation or apprehensive behaviour and, also based on their reactions, participants appeared to act similar to how they would act in any social activity.

6.6.2. Reciprocal PhotoUse

The two strategies that we defined follow directly what Frohlich et al. (2002) observed as being the two distinctive types of *Phototalk*: reminiscing talk and storytelling. In this chapter, we link them to PhotoUse practices that are related to the purpose of respectively shared reminiscing or storytelling. When it comes to Curation-in-Action to support social encounters, one of the main components that made it work was the reciprocity in the interaction, in combination with displaying content from both participants. In research, we have seen some examples of photo sharing applications that implement reciprocal sharing with shared creation (e.g. *Pipet* by Meerbeek et al., 2010, see also Chapter 2), but there is to our knowledge no commercial offering that implements the same features. In this study, each person was as much in control as the other, making photo sharing very similar to sharing a story in daily life. Couples shared an equal number of photos in the majority of the sessions compared to the friends, perhaps because the couples included more shared experiences in their selections, while the friends had more stories of events that they did apart from each other. The colleagues from P03 also shared an equal number of photos, but that was also because their session took the form of a dialogue and they were better prepared than most of the other participants.

We observed several participants actively focusing the attention of the other person to the new content that was shared to the screen. In Chapter 5, we discussed how implementation of the constructs of the social translucence framework from Erickson & Kellogg (2000) could help interaction design to support reciprocal interaction better. In this case, the tablet interface of the *Curation Arena* could have provided the person that was browsing with the information that new content was added to the shared screen by the other person, which could trigger him or her to redirect attention to the shared screen.

6.6.3. Collaborative Curation

Reciprocal sharing also allowed participants to curate a collage collaboratively on the shared screen. Initially, we were unsure if participants would like to keep the result of their shared curation activity but the behaviour of the participants, the way they created the overview and the many photos that were taken of the shared screen implies that it would be valuable to use the shared selection for follow-up PhotoUse purposes. This was currently not supported in the *Curation Arena*. Moreover, Curation-in-Action could in this way result in a permanent curated selection, e.g. by exporting it to custom folders in each of the users' libraries, based on, e.g. events, themes or favourites, automatically created as the result of the session. Exporting the on-screen selection to a print service can help speed up and smooth the process of making physical albums, which many people still pursue. Lastly, exporting can also be an easy way to share a folder with curated content directly to social media or instant messaging, a feature that for single photos is already well integrated into almost all mobile and desktop applications.

Although we did not implement interaction with the shared screen of the Data Arena, there were several ways in which it was possible to influence how the photos appeared on the screen (e.g. adding and sequentially removing them made them appear next to each other), affording collaborative curation. Because we did not realise prior to this study that interacting with the shared screen would in fact constitute Curation-in-Action, we felt it was only a minor omission to leave the shared interaction out of the prototype. However, we got many comments afterwards that participants would have liked to be able to interact with the content once it was on the shared screen, and be able to restructure, cluster, and move topics that are related next to each other.

The limitation in the number of photos that could be displayed on the shared screen bothered some participants because removing content took them out of the sharing flow. The fact that it annoyed participants was mainly due to our technical implementation of removing on the iPad UI, which meant that it was difficult and therefore many participants did not enjoy removing that much. Removing photos from the shared screen in itself was not an issue, and many participants enjoyed removing some to create a beautiful end-result on the screen with only the best photos from both their collections.

6.7. IMPLICATIONS FOR DESIGN

In this section, we will look at the implications of our findings for the design of curation tools to support collocated shared remembering.

Based on a comment from P02A, we wonder if curation is, in fact, the core obstacle that prevents most people from sharing photos with each other, or instead, that people only need to take the time to view their content together. The participants from our study enjoyed looking at their photos and sharing the related stories. Despite all the systems that designers can come up with – even curation solutions that fully integrate into existing social practices, as we advocate here – people still need to take the time to look at their photos, either alone or together. To quote P02A:

> *"Well, how much different would it be for you [directed at P02B] to sit there and look at them at on a tablet? Because, to me, if I had all the pictures of my life I would be probably just as interested, almost as interested in seeing them." P02A*

The quote from P02A indicates that she is merely interested in looking at her photos, perhaps not realising that all she needs to do for that, is to get the laptop out on a rainy Saturday morning. However, we are confident that better curation tools can lower the threshold for people to enjoy their collections, especially when they are together. Insights into the strategies for Curation-in-Action that we described in the results (shared reminiscing; storytelling) helped us understand how curation in these sessions took place to support shared remembering. Moreover, the curation considerations (mnemonic, aesthetic, pragmatic) gave insights into the decisions that might need

to be supported by curation tools. Finally, the behavioural and design factors that we identified from additional requirements for supportive curation tools.

Curation-in-Action tools such as the *Curation Arena* can support collocated shared remembering practices, as we have demonstrated in this study. Several system elements can contribute to that success, which we will elaborate on in the next sections.

6.7.1. Centralise Photo Repositories

One of the elements that seem essential for the success of Curation-in-Action tools is a system architecture that allows all personal content to be (automatically) combined in a single, accessible repository. In our study, participants had a hard time gathering a specific set of photos, one of the reasons being the distribution of the items in their collections. The distribution included old hard drives that were kept in a different house (sometimes even in a different country), photos that were only stored on a friend's drive which could not be reached in time, or photos that were stored on a computer at work. Participants from this study presented three issues: 1) the ever-expanding collections force people to add new types of storage to their existing solutions, including newer hard drives and online storage. Limited storage on mobile devices and memory cards in cameras also forces people to sometimes transfer files to a temporary location such as a computer at work or a laptop, which scatters the collections even further; 2) gathering and migrating large collections to larger or online storage solutions take a lot of time and effort, and even if people make a start with it they do not always finish the project; 3) online storage solutions, either via a paid service (e.g. *Dropbox*) or via a personal cloud at home (Network Attached Storage) rely on fast internet connection with enough bandwidth, especially when large numbers of photos need to be downloaded. Unfortunately, the upload speed of local networks as well as the download speed is in most parts of the world insufficient.

The issue of distributed collections, including difficult to reach remote storage locations, could be solved with single repositories where the whole collection can be collected, either a solution at home (like the implementation in the *Curation Arena*), or online storage servers ("the cloud"), as offered commercially by most major companies like Google (Google *Photos*) Apple (*iCloud Photo Library*), Microsoft (*OneDrive*), Yahoo (*Flickr*).

6.7.2. Automate Basic Management

At the start of the study described in this chapter, we thought that Curation-in-Action might potentially be the only thing that one needs to appropriately use their photos for collocated sharing, without the need for any pre-curation. However, the results of this study have indicated that it is not enough to support Curation-in-Action. To be able to react appropriately to the current conversation, it is also necessary that one can quickly find the right photo, and to be able to adapt to what is going on. The participants that were more familiar with their content, either because they were better organised in general or because they had done more thorough pre-curation,

seem to benefit more from Curation-in-Action as implemented in the *Curation Arena*. To support pre-curation, and ultimately Curation-in-Action, there is a need for tools to reduce duplicates and to cluster content based on events, themes, people and chronology. Luckily, we have seen in the past few years an increase in commercial offerings that are capable of advanced image processing (see Chapter 2 for examples), even with machine learning that form the base of the automated algorithms. Basic sorting can be done using metadata the already exists in most digital content. Companies such as Google and Apple even extract more information from the photos, such as location (GPS) and face recognition, used to create folders of events, trips and people automatically.

6.7.3. Prioritise Reciprocal Sharing

In this study we found that reciprocal sharing and equal control is vital to keep photo sharing exciting and keep all parties fully engaged in the sharing activity. The choice for implementing both a public and a private display worked well for the *Curation Arena* because it offered the privacy to select appropriate material during sharing (the essence of Curation-in-Action), but it also allowed participants to engage in reciprocal exchange.

Several aspects of the *Curation Arena* exist in some form commercially: often-used smartphone photo applications (e.g. see Zürn et al., 2017 for an overview) resemble elements of the tablet interface of the *Curation Arena:* a visual pleasurable overview of the photos in chronological order (either ascending or descending), with the addition of different zoom levels (decades, years, seasons, months, weeks, days) to allow fast scrolling through the content. Moreover, the shared display of the *Curation Arena* can also be replaced by existing solutions, such as a smart TV or a device that connects to a TV (e.g. Google *Chromecast*, *Apple TV*), that can display content from the mobile devices.

Despite the fact that these platforms offer appropriate hardware, they all lack the two features of the *Curation Arena* that make it valuable to support collocated shared remembering: the mobile device and the shared screen need to support a multi-device user interface for collaborative photo sharing, allowing multiple users to engage jointly in reciprocal sharing. This includes multi-user interaction in the tablet interfaces, as well as support for sharing multiple photos from all users at the same time to the shared screen as a collage, preferably one with which users can interact.

6.7.4. Support Collaborative Curation

Before this study, we did not realise that the shared display can also be a canvas for people to create something together using their photos. To better support that specific element of collocated shared remembering, designers might consider implementing specific support for collaborative curation of content once it is on a shared screen. We saw that collaborative curation of shared content was an essential element of reciprocal exchange. While being able to both interact at the

same time with the shared content to create a new curated set is one of the strengths of the *Curation Arena*, the concept lacked the opportunity to interact with the photos once they were shared.

6.8. CONCLUSIONS

In this chapter, we started with presenting our definition of Curation-in-Action, a specification of our definition of curation, following the findings in this thesis related to the need for curation within a social context, where we argued that curation with a social purpose should not be separated from use, and that the context of photo curation should be merged with the context of PhotoUse **[RQ.2]**. We described the concept and prototype of the *Curation Arena,* a physical hypothesis which allowed us to study Curation-in-Action. the *Curation Arena* supported the social purpose of PhotoUse (chapter 3), by implementing curation within the activity of sharing (chapter 4, this chapter) and reciprocal photo sharing (chapter 5) **[RQ.3]**.

The second part of the chapter described the setup and the results of the evaluation of the *Curation Arena* with 11 pairs of participants, from which we have found that the *Curation Arena* provided the participants with a social and immersive approach to photo sharing, which was both an enjoyable and a unique experience **[RQ.2]**. Based on the data we identified two strategies for Curation-in-Action related to the underlying social purposes of the photo sharing activity, focussed on either *shared reminiscing* and on *storytelling* **[RQ.2]**. In parallel to the Curation-in-Action strategies that are determined by the purpose of the shared experience, we found that there are several curation considerations, divided in *mnemonic considerations, aesthetic considerations* and *pragmatic considerations,* which determine at the level of individual photos which one is selected and which one is not **[RQ.2]**. We found *behavioural factors*, relating to how people make use of their photos during social encounters, and *design factors* relating to the *Curation Arena* prototype, and how those influenced the experience during the sessions. These factors affect the overall shared experience during the social interaction **[RQ.3]**.

Finally, we described that designers of curation tools to support collocated shared remembering could 1) Centralise photo repositories that allow all personal photos to be combined in a single, accessible repository; 2) Automate basic management to reduce duplicates and to cluster content based on events, themes, people and chronology; 3) Prioritise reciprocal sharing to allow equal control, which is valuable to keep people engaged; 4) Support collaborative curation, allowing people to shape and keep the story of their shared memories, using the result of the shared curation effort **[RQ.3]**.

In the next and final chapter, we summarise and discuss the work from this thesis, structured around the research questions from Chapter 1.

CHAPTER 7.
DISCUSSION & CONCLUSION

Chapter Summary

In this final chapter, we will provide an overview of the insights from this thesis. Chapter 2 provided an overview of available tools for photo practices. Chapter 3 reported an interview study about current photo practices, which resulted in our model of PhotoUse. Chapter 4 provided requirements and design directions for tools to support collocated photo sharing. Chapter 5 presented the first two iterations that helped us understand how to design for reciprocal interaction. Chapter 6 introduced the concept of *Curation-in-Action*, and *The Curation Arena* design, with which we explored Curation-in-Action to support collocated shared remembering. In this chapter, we will first discuss what we have learned about photo curation and share our insights into the relation between curation and remembering. We will then address the design challenge of photo use, structured around the research questions that we formulated in Chapter 1, related to what people do with their photos, what people want to do with their photos to support collocated shared remembering and what kind of tools could support these desired practices. The last section of the chapter describes future research directions.[1]

[1] In this chapter, "we" refers to myself and my supervisors.

7.1. INTRODUCTION

As we mentioned in Chapter 1, the process of *design research* as described by, among others, Fallman (2003) and Zimmerman et al. (2007) results in two types of knowledge (Zimmerman et al., 2007, revisit also Figure 1.2). This thesis so far has balanced between knowledge gained from our explorations that was directly applicable to designing novel concepts, referred to as *intermediate design knowledge* (Höök & Löwgren, 2012) (especially Chapters 4, 5 and parts of 6) and insights that could be generalised for research into Human-Computer Interaction (HCI) and related fields, e.g. memory studies, behavioural science and anthropology (especially Chapters 2, 3 and parts of 6). This discussion chapter is no exception and preserves this dualism, and aims at serving our intended audience of interaction designers and HCI practitioners, working in the field of multi-user interaction, digital media or personal information management, and interaction design researchers and HCI researchers interested in design for remembering, reciprocal exchange, everyday life, or design for the user experience.

This thesis aims to offer a better understanding of current and desired practices concerning the use of photos to support collocated shared remembering. The challenge for interaction designers, we argued in Chapter 1, was to develop photo curation solutions to enable the use of photos to support collocated shared remembering. We formulated three design challenges applicable to photo curation practices, of photo storage, photo management and photo use. In this thesis, we focused primarily on photo use to support collocated shared remembering, and how curation tools could support those practices. In this chapter, we will discuss the knowledge we gained from the studies in this thesis. We will start with our insights around the main themes of this thesis (photo curation; remembering), followed by the remaining insights, structured around the research questions from Chapter 1. Throughout this discussion, we will use brackets **[CH.1]** to cross-reference the chapters that provided the insight.

7.2. PHOTO CURATION

7.2.1. What is Photo Curation?

We defined digital photo curation in Chapter 1 *as the creative activity that is intended to add value to an accumulation of photos by means of purposive triaging, organising, editing and managing.* We explained that our definition was the result of our accumulated understanding of what curation is. In this section, we will elaborate on the insights from this thesis that helped develop our definition.

The creativity of the activity of photo curation came in part from our observation that people tend to tailor specific photo selections to different (social) contexts **[CH.3]** and that it appeared that the individual and social requirements for what makes photographic content relevant for a specific person are very subtle and dependent on the social configuration **[CH.4]**.

From the analysis of the *Curation Arena*, which was designed to support *Curation-in-Action*, we understand better how curation works within a social context and how participants experienced it. Based on the data we identified two curation strategies that participants used to prepare themselves for and during social gatherings. The strategies relate to the underlying social purposes of the photo-sharing activity. We made the distinction between a strategy focused on shared reminiscing and a strategy focused on storytelling **[CH.6]**. Here it also became clear that it is essential that both pre-curation and Curation-in-Action are supported **[CH.6]** because some level of preparation allows people to curate appropriate content for anticipated use **[CH.5][CH.6]**, which means more successful photo curation to support collocated shared remembering.

The shared reminiscing strategy focused on supporting shared remembering of events, based on photos that were explicitly selected to cue those memories, with the goal to result in what was labelled by Frohlich et al. (2002) as *reminiscing talk*. To prepare for a shared reminiscing activity, participants looked for photos of shared experiences, which resulted in the selection of photos including a comprehensive set of photos of memorable shared events from the past. The storytelling strategy focused on curating photos in such a way that they allowed the participants to tell stories about people, places and events that the other person did not know or in which they did not participate. This resulted in what has been labelled by Frohlich et al. (2002) as *storytelling*. To prepare for storytelling, participants partly selected photos that were somehow related or of interest to the other person, e.g. photos of a trip s/he wanted to recommend to the other, photos of food that the other person had to try, or art exhibitions that might interest the other.

While the curation strategies determined the overall purpose of the shared experience, the direction of the conversation and therefore the nature of the social encounter, as mediated by the curation activity, was determined by different kind of curation considerations related to photos: mnemonic considerations, aesthetic considerations and pragmatic considerations. The considerations were specific to people's interests within the current situation, and they determined the choice to include or exclude particular content **[CH.6]**. Mnemonic curation considerations concern photos that are selected because of the value related to the memory that is attached to them; Aesthetic curation consideration concern photo selection that is based primarily on the way the photo looks, rather than the link to the story behind it (often observed by participants who reported to be photo enthusiasts); Pragmatic curation considerations refer primarily to the choices made in the pre-curation of content for sharing, and concern photo selection based on things like time required to download or transfer specific items, the total number of photos that is required, or ease of retrieval.

In the evaluation of the *Curation Arena*, several design factors surfaced that influenced the experience during the sessions. The factors described were independent of the afore-mentioned curation strategies and curation consideration, but they affected the overall possibilities and opportunities, therefore interfering or supporting the overall shared experience during the social

interaction. The design factors related to the preparation time that people take, which influences the content familiarity. During shared remembering, it appeared to be important that people could keep adding content for the other person to see, and that this content was displayed next to content from that other person, thus creating new stories together. Our decision to implement a shared screen and a private device for Curation-in-Action in the *Curation Arena* was not always used as rigid as we anticipated, and when participants looked at each other's devices, they made curation also into a shared activity **[CH.6]**.

Next to the design factors, we also found several behavioural factors, relating to how people make use of their photos during social encounters. One of the factors was the focus of attention, which refers to the fact that people needed to look at photos that were curated to support the narrative of the story that was told by one of them. Another factor that influenced the mediation of the story was the relevance of new content and either a good fit with the current theme or a deliberate diversion from the current topic. Another factor was the importance of narrating content, as almost all of the participants from the *Curation Arena* evaluation stated that telling the stories was a big part of what made it enjoyable. The last behavioural factor that influenced the mediation was how people reacted to each other with new photos, in what we referred to as *the reciprocal exchange* of content during a conversation.

The PhotoUse model, the strategies, considerations and factors all helped us shape the definition of curation, because it provided the insight into the activities that are part of curation (triaging, organising, editing and managing) **[CH.3]**, the kind of value that is created through curation (e.g. photos function as well-chosen memory cues), the creativity that is put into curation activities (e.g. select photos to direct the narrative), and the purposive nature of curation (e.g. for deliberate shared remembering).

7.2.2. Curation is Changing

The world of digital media, and with it the notion of a file has changed, and photo storage, management and use are affected accordingly (for example, see Harper et al., 2013). Moreover, online platforms such as *Facebook* and *Google Photos* that allow users to store, view, share and publish photos, blur existing ideas of ownership and privacy (Harper et al., 2013). In return for their privacy, people can access their collections at all times and use the features that support them in their dynamic use practices. Even though the number of different services that are connected to mobile devices can be overwhelming **[CH.4]**, the connectivity and availability of digital collections can provide exciting new experiences around personal collections.

We, therefore, argued that the current perspective of photos being objects in hierarchically managed collections might need to change, and instead consider photo collections as flexible streams of information which are transformed dynamically to match the fluid and emergent needs of users, their context and activities. New metaphors can also accommodate hybrid forms of photos, such as audio-photos (Frohlich, 2004), 3 second animated photos (*live photos*), video

clips, photo sequences, and many other forms of emerging photo formats that can be included in digital collections. The metaphor of printed photos, which is often used for designing for digital photo practices, might not suffice to cover all the qualities of digital content but still can be used to consider the intimate qualities of the analogue sharing practices themselves, such as looking at a family album together **[CH.4]**. The shift from printed film photography to digital photos changed curation practices, which was one of our motivations to create a new visualisation of PhotoUse practices **[CH.3]**. We suggested that the PhotoUse model can be used to illustrate the dynamic and flexible set of photo activities that people engage in, inspiring the design of novel technologies to support people in their social, individual and utilitarian purposes of photo activities **[CH.3]**.

7.3. CURATION & REMEMBERING

Because we approached photos as memory cues throughout this thesis, we have gained a better understanding of the relation between media curation and the constructionist perspective on remembering. This relation is on an experiential level because we did not study the role of photos in the complicated process of memory reconstruction or the role of specific photographic content in relation to a type of memories that is cued by it. In the introduction of this thesis, we stated that if we approach photos as objects of memory (a term used by Van House, 2009), we would not need to look at the other features of photos, such as aesthetic or artistic value, even though these could also play a role in the value of a photo to cue our autobiographical memory.

7.3.1. Mediated Remembering

In Chapter 1, we introduced that photos can be used as memory cues (van den Hoven & Eggen, 2014) that can trigger the reconstruction of memories related to our own lives, or autobiographical memory (Conway & Pleydell-Pearce, 2000). Van Dijck (2008) explored how these photos are not only objects of memory but also important for self-presentation and identity display during shared remembering. During shared remembering, the photos are not the only cues for our memories but what people tell each other can also trigger the reconstruction of memories (*cross-cueing* see Harris et al., 2014). In the analysis of the *Curation Arena* **[CH.6]**, we described two curation strategies (*shared reminiscing* and *storytelling*) that can help understand how people use the photos in the process of shared remembering. We identified variations for the two strategies that applied to 1) the preparation of relevant photographic material; 2) the anticipated experience of the shared remembering activity; 3) the use of the photos during shared remembering (*Curation-in-Action*); 4) the conversation that emerged around the photos (*PhotoTalk*, Frohlich et al., 2002). These strategies shed light on the role that photos can play in shared mediated remembering activities.

7.3.2. Memory Curation

One of the participants from the study described in Chapter 3 explained the process of making a photo album as a way to "frame the memory", which was an enjoyable process that should not be automated. She also deliberately chose to leave photos out, allowing herself to not be reminded of certain aspects while emphasising others. Curation can in this way help to frame and construct what will be remembered, and forgotten. This is in line with findings from the work of, e.g. Stevens et al. (2003) that shows that the activity of curating and annotating can also increase the value of the objects. We can thus approach photo curation as a way to frame the memories of our experiences, using the natural tendency of autobiographical memory to forget things that are less relevant. There are several forgetting strategies described in cognitive psychology (e.g. Harris, Sutton, & Barnier, 2010), such as retrieval-induced forgetting where participants who got the task to recall a list of items from memory, forget items from a list they memorised earlier. Strategies like these can inspire new approaches to photo curation, where, e.g. viewing photos of favourite events can support people in forgetting less favourable parts of particular events.

One of the early thoughts behind our research was that people might need support to forget memories of certain events, by deleting photos that triggered those events. We did not study this, partly because almost all participants from our studies told us that they did not have any photos of events that they would rather forget, simply because the sad events – funerals, arguments, fights – are either never captured, or the photos are a reminder of bad times, but because it is also part of life, the photos (and the memories) are still relevant to hold on to. Because we were interested in design to support everyday remembering, we were also hesitant to look for participants with a trauma for whom photo curation could be used as a therapy to forget specific memories. However, if capturing becomes more automated, e.g. using wearable cameras, perhaps there will be a need to design new tools to support forgetting through photo curation specifically.

7.4. PHOTO TOOLS & PRACTICES

Most of this thesis centred around gathering insights for the design of novel photo curation tools to support shared remembering. Fuelled by the research questions, we have gained insights into current photo curation tools and practices, desired photo practices and opportunities for tools to support those practices. In this section, we summarise our insights, structured around the three research questions.

7.4.1. RQ.1 What kind of tools and practices exist around personal photos?

We provided an overview of the commercial tools and concepts from academia that are related to digital photography **[CH.2]**. In our design overview, we saw an abundance of commercial tools for capturing media and remote sharing compared to a relative scarcity of curation tools. We

attributed this to the worldwide adoption of social media platforms which seemed to have geared commercial interest towards remote sharing solutions using mobile devices, rather than collocated sharing in the home using dedicated tools. We found find many research projects taking on the challenge of making use of all those photos that were taken for communicative or remembering purposes, using tools that offer richer interaction possibilities beyond touchscreen interfaces **[CH.2]**.

Pace of technology

One of the problematic aspects of designing media technology is the fact that the pace of development is high. It feels as if interaction design is currently at a stage where the pace of technology developments pushes designers towards dealing with issues of scale, rather than improving emergent interaction qualities of new designs. As a result, users do not get the chance to familiarise themselves with the systems and appropriate them in such a way that they integrate into their desired practices. In Chapter 3, the participants mention their current practices, including the use of, e.g. *Picasa* web albums, *iPhoto* and *Aperture*. These software solutions do not exist anymore, only a few years later. Great reads from two decades ago feel outdated because they mention file sizes, software solutions and workflows that are not comparable with modern ways of working.

Similarly, helpful services like Dropbox' *Carousel*, *Snapseed* desktop editing software, *Tidy* curation app and *Aperture* disappeared within a few years. Also, unfortunately, the alternatives are usually not providing the same or a better experience - even though they are always marketed as being "new and improved!". But it remains unclear what is supposed to happen with a collection once the service that curated it stops being supported. Web content suffers from an even faster turnover, as many of the services we mentioned earlier have no official information websites anymore, and can only be visited by the excellent preservation website of the Wayback Machine[2], an internet archive that enables everyone to access past versions of online content.

The implications of the fast pace of technology is that a) research into new technology is quickly outdated; b) solutions that come from academic research are behind on industrial developments; c) companies are obsessed with designing and producing temporary solutions, without considering the possibility that people are interested in solutions that are future proof.

Practices evolve around tools

Concerning photo curation, we echo previous research into photo use (e.g. Frohlich et al., 2002; Kirk et al., 2006; K. Rodden & Wood, 2003; Whittaker et al., 2010), that the majority of our participants as well as most of the people we have informally spoken during this research project

[2] http://web.archive.org, retrieved August 26, 2018

confessed that their collections were poorly organised and that they were *not* motivated to curate their ever-expanding collections **[CH.3][CH.4][CH.6]**.

Concerning photo storage, we encountered several examples of participants who lost part of their collections due to, e.g. hard drive failures, storing on obsolete technologies, accidental formatting of drives or losing phones with local storage **[CH.3][CH.6]**. Backups are often poorly maintained or not well secured, even though many people have the means to properly back up their collections. Maintaining a future proof multi-device photo archive is challenging, especially since the fast pace of the consumer electronics industry continues to hamper both the software, hardware and web-services that these archives are built on.

We saw that people rely more and more on technological advances for the essential management of their collections **[CH.3][CH.6]**. Where some participants used to rename each photo file individually, now they mostly use the filenames that were automatically generated by the capturing devices. Modern capturing and storage technologies include many management features, such as automatic location information, date and time of capturing, orientation (portrait, landscape) and face detection, which is all added to the photo's metadata **[CH.2]**. Some (online) applications even go one step further and automatically generate folders, albums and highlights **[CH.2]**. Even though some participants commented that the automated highlights and albums are not always accurate representations of their experiences, they valued the attempt and made use of the features **[CH.4]**. The results of these developments are promising to support the use of photos.

Practices are complex and connected

Based on contextual interview data we found that there are many different activities around photos that people engage in, which often take place simultaneously, or are part of the same overarching activity **[CH.3]**. Practices are changing with the rise of new mobile technologies and Internet-enabled devices. The temporal sequence of photo activities, as displayed in traditional models of photo practices (for example, Kirk et al., 2006), appear to be more varied at times, without a clear start or finish **[CH.3]**. We, therefore, introduced a model of *PhotoUse* practices, which provides both an overview of current photo activities that we found, as well as a visualisation of our holistic perspective on photo practices. The model is shifting the focus away from a secondary, preparatory activity that happens earlier than the enjoyment of the photo, to a primary task that is closer in time or even interleaved with the *use* of photographic content in the context of social remembering. The activities from earlier models are still part of current processes, but not necessarily as a temporally bound process, also because the technologies afford new practices (Figure 7.1).

Figure 7.1: PhotoUse model, as presented in Chapter 3. Left: a typical practice that includes several activities; Centre: all the activities from the participants and how they link to each other; Right: PhotoUse model.

Practices are purposive

A vital part of the PhotoUse model is the focus on the purposes that motivate photo usage, rather than just the operation of the technology involved. This perspective arose out of interviews with participants that focused on the needs, experiential goals and purposes motivating photo usage **[CH.3]**. To support the use of photos during collocated shared remembering better, innovative curation tools could emphasise the purpose by bringing the activity of curation and its purpose (such as shared reminiscing) closer together **[CH.3]**, a notion that we conceptualised as *Curation-in-Action* **[CH.6]**.

Conclusion of RQ.1

In conclusion, we saw that people engage in many different kind of photo activities that are often overlapping and linking to each other, but in an order and following procedures that are often dictated by the technologies involved. The pace of technology makes it harder for people to make the best use of the available tools, because there is almost no time to get familiar with one tool before it is superseded by another. Photo curation, as an activity, is not done as much as people feel they should, and we argued that this is caused in part by a lack of purpose for the curation activity and the lack of tools that support purposive curation.

7.4.2. RQ.2 What do people want to do with their photos to support collocated shared remembering?

Our participants were motivated and geared towards using their photos for social purpose **[CH.3]**, yet often lacked the motivation to curate for those purposes. The lack of motivation for curation, we argued, is caused mostly by the fact that, because curation in itself serves no apparent purpose, even though it is vital for successful future photo use. We found that curation practices can be more gratifying if people have a clear purpose in mind (such as triaging photos for a printed album) **[CH.3]**.

Another observation from our research was that people like to tailor specific photo selections to different (social) contexts **[CH.3]**, filter and tailor content based on social configurations **[CH.4]**, or react to the behaviour of others during collocated sharing **[CH.5]**. However, they lack support from the currently available photo tools for this kind of context-dependent selection. Following this consistent finding related to the need for curation during a social context, we have argued that curation with a social purpose should not be separated from use, and that the context of photo curation should be merged with the context of PhotoUse **[CH.6]**, which we referred to as *Curation-in-Action*, a specification of our definition of curation, intended to draw attention to the need to facilitate curation during photo use.

In the process of this research, we thought about curation solutions to seamlessly embed into existing social practices. However, we see that many people are interested in (interacting with) technological gadgets, albeit sometimes because society leaves them no choice but to embrace technology. This means that tools can be present in the environment, but they should still be embedded into existing practices, or give rise to *preferred* practices that should emerge from the individual goals of people. The key to achieving that is to design new tools in such a way that they can be *appropriated* by new users to fit their specific social practices, or allow them to develop new and preferred practices around the tools, without losing sight of what matters – in the case of social practices: some form of social engagement.

Conclusion RQ.2

In conclusion, we found that often people want to use their photos for a social purpose. When using the photos for collocated shared remembering, which was the focus of this research question, it is vital that the use of photographic material supports conversation. From our findings, we can conclude that the dynamic flow of memory sharing calls for dynamic photo selections that can be curated during the conversation to support the social configuration. The use of technologies to this end does not need to disappear into the environment, but they can be part of new and evolving social practices.

7.4.3. RQ.3 What kind of curation tools can support the use of photos during collocated shared remembering?

In order to design photo curation tools to support shared remembering we have formulated several requirements, tensions and guidelines throughout this thesis. We invited designers to think about portability of devices that are required to display a lot of content, and suggested the possibility to address this digital overview challenge with a) portable projectors; b) the use of public displays for temporary displaying content; b) Augmented-, Virtual- or Mixed Reality technology **[CH.4]**. Another tension concerned the focus on either a dedicated tool or a multifunctional device, where we suggested three possible design directions: a) dedicated tools that provide no distraction from other tasks; b) tools that extend existing devices, similar to smartwatches that are connected to smartphones; c) applications that are capable of dedicating

a device temporarily, thus blocking distractions without the need to carry multiple devices with you **[CH.4]**. Our last tension that we invite designers to think about is between system automation and manual tailoring. We hypothesised a solution to combine the social capabilities of people for triaging and editing content, with technologies supporting them by automatically organising and managing the photos **[CH.4]**. For this to work, especially for collocated multi-user environments, systems should be able to support dynamic interaction needs **[CH.5]**.

More specifically, reciprocal photo sharing can be supported by a combination of a shared screen to display photos, and by using distributed individual controls for navigation to allow in-the-moment control of content, needed for the level of privacy that is relevant for photo sharing **[CH.5]**. On a lower interaction level, multi-user systems need to provide enough interaction alternatives to enable users to consider each other **[CH.5]**, and when interfaces provide information about other users, designers will have to balance between the visibility of information or content and privacy of users **[CH.5]**.

The Curation Arena: a physical hypothesis

The *Curation Arena* supported the social purpose of PhotoUse, by implementing curation within the activity of sharing and reciprocal photo sharing **[CH.6]**. Applying the framework of social translucence to collocated photo sharing can enable reciprocal memory sharing **[CH.5]**, and we formulated four design steps to help implement social translucence in design **[CH.5]**, which we applied when designing the *Curation Arena.*

When presented with our concept for collocated photo use, in the form of the *Curation Arena*, we saw that participants enjoyed sharing their photos and stories with each other **[CH.6]**, supporting our argument for developing tools to support social PhotoUse.

Based on the *Curation Arena* evaluation, we formulated implications of our findings for the design of curation tools to support collocated shared remembering. We suggested that designers could 1) Centralise photo repositories that allow all personal photos to be combined in a single, accessible repository; 2) Automated essential management to reduce duplicates and to cluster content based on events, themes, people and chronology; 3) Prioritise reciprocal sharing to allow equal control, which is valuable to keep people engaged; 4) Support collaborative curation, allowing people to shape and keep the story of their shared memories, using the result of the shared curation effort **[CH.6]**.

Conclusion RQ.3

In conclusion, to support collocated shared remembering, designers could implement the concept of social translucence in curation tools to facilitate reciprocal interactive photo sharing. Furthermore, designers could implement what we termed *Curation-in-Action*, to facilitate curation during shared remembering activities.

7.4.4. Where is Design Heading?

Distractions of technology

Most new technologies advertise that they provide a certain level of support for everyday tasks and that they make aspects of life more comfortable, such as writing an article, cleaning our homes, shopping for groceries, travelling, and remote communication with friends. However, some technology is perhaps causing more distraction than benefits for the people using them, and other technologies are widely used, but the long-term effect on society is not yet evident. For example, according to an online survey done in 2014 by Tecmark among 2000 UK residents, people check their smartphones 1500 times a week on average, spend 3 hours 16 minutes on their phones per day to carry out 221 tasks.[3]

Embedding in social practices

Design practitioners and researchers should always operate with the promise of making things better for tomorrow's world, even for challenges as seemingly trivial as organising digital photos. The complex and connected nature of new technologies makes it difficult to predict their impact upon their launch. Even though the impact of a design is usually difficult to predict, designers have a responsibility with every piece of technology that they introduce to the people. Designers also need to consider the impact of a novel tool on the social practices that emerge around it.

We argued for embedding novel tools in existing social practices, and to do that it seems relevant to design tools in such a way that their owners can appropriate them. To facilitate multiple practices, one can think of what we called temporary appropriation **[CH.4]**. As an example, a specific gesture could turn a multifunctional smartphone into a dedicated photo viewer without distractions from other applications. This kind of temporary appropriations seems promising to fully embed tools into our everyday (social) practices, without always providing the distraction from irrelevant information. That might, in fact, be a definition of any successful design.

Future Proof design

The pace of technology means that the future of our technology for media preservation is changing: technology is not designed to last. To give an example: Apple's *iPhone 4S* is made of high-quality materials and can be seen as a valuable object (even without the 700$ price tag). However, pushing software, and stimulating the consumer to get the next one, results in still valuable devices being made obsolete because the newer software is too unresponsive on devices that barely meet the specifications for the software to function correctly. Another example that faces the same problem is a smartwatch: as soon as the connected phone needs an upgrade, or the operating system becomes too heavy, the watch is rendered unusable. Compared to a real classic timepiece of, e.g. the brand *Patek Philippe* that advertised a watch with the slogan *"You*

[3] www.tecmark.co.uk/smartphone-usage-data-uk-2014, retrieved December 5, 2017

never actually own a Patek Philippe, you merely look after it for the next generation"[4], these technologies are a disturbing development.

During this research, we came to realise that designers need to change their course to facilitate a sustainable future for digital autobiographical media, and that design could and should facilitate the endurance of our technology, in *future-proof* design. We again use the term *appropriation*, but for the technology to be future proof it also has to be possible to *repurpose* (or *re-appropriate*) designs that can no longer be used for their original purpose but as an artefact still have the quality and endurance to last for a second, third and fourth life.

Curation in 2050

Given the development of automated photo processing and analysis software in recent years, we can be confident that automated systems will do a lot of the tasks that we are currently required to do manually within the next 30 years. The accuracy of artificial intelligence will also develop steadily, along with the processing power of all our portable technologies. Devices the size of smartwatches will be able to do what only powerful machine-learning computers can do today. Because of these technological advances, systems will be able to better respond to natural language, interpret complex social contexts and adapt accordingly. This might give rise to what we refer to here as a *contextual responsive design*. Contextual responsive systems will be able to adapt the interface and the content to the social and physical context. This would include an understanding of who is present, what topics are discussed, how people are feeling, behaving and doing. In 30 years, cognitive science will also have progressed with understanding human memory, and so the knowledge about the relevance of particular (photographic) content to cue specific memories can be embedded into a contextual responsive system. Based on these interpretations, the system can produce content that fits the current context, narrative and memory. Despite the possible future automation opportunities of photo curation, we echo the argument of Rogers (2006) that, even if this future is a reality one day, it might not be desirable to leave all decisions up to artificial intelligence. Based on the research that we have presented in this thesis, we project that there will always remain the need for personal choice and intervention, whether it is required by the technology or not.

7.5. LIMITATIONS & FUTURE RESEARCH

7.5.1. Limitations

This thesis presented our research into photo curation, which was studied using a design research approach, with mixed methods for data gathering and analysis. We have motivated our choice for looking at photo curation as a design challenge, but we acknowledge that this also limited our

[4] blogs-images.forbes.com/robertanaas/files/2016/12/Photographer-Peter-Lindbergh-Boat-C.jpg, retrieved December 5, 2017

view to mainly interpret the collected data for its relevance for the design process. Our goal to understand the requirements, desired interactions and design processes needed to create an interactive photo curation system guided our interpretation. While useful for the purpose of designing, our focus might have led us to overlook valuable insights that we could have contributed to other fields besides Human-Computer Interaction and interaction design.

In the choice to mainly use semi-structured interview techniques and generative co-design techniques we also allowed ourselves to gather more data about specific topics, while leaving other topics underexplored. This effect is emphasised by the choice to analyse most of our study results using thematic analysis as described by Braun & Clarke (2006), which allowed us to find underlying themes and motivations of observed behaviour. Although it is a systematic method, it is a subjective method that should be used for discovering themes bottom-up but can be misused to discover support for themes that were discovered *prior to* the analysis, instead of *during* the analysis. Especially towards the end of the research project, our knowledge about curation and collocated sharing practices might have guided the analysis, and if researchers not related to this topic would have replicated our elaborate analysis, they might have reached slightly different conclusions. However, build-up of knowledge in the course of a project and its influence on the researcher's capacity to analyse data objectively can be considered a common challenge, not just for us in this project, or for the process of thematic analysis. Therefore, follow-up prototype evaluations based on our design requirements or application of our design process recommendations can provide more certainty for the conclusions drawn from our research in previous sections. We warmly invite design researchers to take our insights further.

Moreover, the next sections describe other research directions that we touched upon but did not get the chance to explore within this thesis.

7.5.2. Curation of Shared Photo Collection

In this thesis, we have studied the use of personal photo collections. More and more (online) storage tools also offer multi-user interaction with collections and shared ownership. We also saw in the evaluation of the *Curation Arena* that the line between individual and shared collections is fading when couples live together for a long time, and even when friends share a hard drive or a camera. Similarly, on social media platforms such as *Facebook*, the photos that are about a person appear next to the photos that the person uploaded, making them automatically part of that person's collection because s/he is in the photo. The changing role of ownership might call for revisiting the activities of our PhotoUse model, and explore the way curation practices can be used not only for sharing memories but for the preservation of shared collections of memory cues.

7.5.3. Support Individual Remembering

In this thesis, we explored shared remembering, but individual reminiscing presents also a set of relevant and interesting challenges (e.g. Gennip, van den Hoven, & Markopoulos, 2015) that have not been explored in the present thesis. We decided to continue to study shared remembering, based on our interest in design for social interaction, the social function of autobiographical remembering (e.g. Bluck et al., 2005) and the prominent social purposes of PhotoUse practices that we found in our first study. It could be interesting to explore the concept of Curation-in-Action, applied to curation tools that specifically address individual reminiscing.

7.5.4. Explore the Whole Media Process

We have looked only at curation tools to support the use of existing photo collections. In Chapter 2, we showed a few examples of designs that limit the influx of digital photos by restricting the user during photo capturing. If photo capturing is also considered a part of the whole *media process* that involves photos, curation solutions could also be targeting the capturing phase of the process, to ensure that the media that is captured will be both necessary and appropriate for the intended photo-mediated remembering.

Based on the design review **[CH.2]** and our concepts, we see that designers either (re)design capturing, leaving questions unanswered on how to curate and retrieve the resulting media or redesign the experience of media use, neglecting how the required media is captured, collected or curated. To be able to address this discrepancy between capturing and mediated remembering, one could look with a more holistic perspective on the media process, that invites designers of media experiences to consider all aspects of the media process.

The notion of this holistic perspective on media capturing and use came from a side project related to this thesis.[5] Even though we acknowledge that it is important to consider the whole media process (including additional media such as video, sounds, text, etc.), in our concept design we usually dealt with existing collections, and we therefore designed isolated parts of the experience, focusing only on curation. There lies an opportunity to innovate photo capturing along with photo curation, and study the effect on photo-supported remembering.

7.5.5. Nostalgic Mementoes for Digital-Only Generation

Because of our study setups, the range of participants was often limited to people aged 18-68. Most of them had experience with film photography and remembered the shift to digital photography and the changes it brought with it. For the younger generations, film photography is but a distant memory. Digital photos and how newer generations use them can become separated

[5] **Broekhuijsen, M.**, Mols, I. and Hoven, E. van den (2016). A Holistic Design Perspective on Media Capturing and Reliving. In: *Proceedings of the 28th Australian Conference on Human-Computer Interaction (OzCHI'16)*, November 29 - December 2 2016, Launceston, Tasmania. ACM New York, NY, USA. pp. 180-184. DOI: http://dx.doi.org/10.1145/3010915.3010959

entirely from the traditional use of printed photos. As Van House (2011) argued, photos can become more important as objects of communication than of memory.

We addressed the use of mobile devices for photo sharing **[CH.2]**, but not for curation. However, we addressed mobile photo curation activities performed on smartphones in a separate study, aiming to identify design opportunities for applications that will help users curate their photo collections[6]. The semi-structured interviews with eleven young adults showed that participants had (access to) 900 to >14,000 photos on their smartphones but that curation was avoided as much as possible unless it was necessary because, e.g. the device was running out of storage space. Moreover, these participants used various applications for triaging and (file) managing, but hardly any applications for editing and organising. Although they also used automated backups of the photo from their phones, the number of photos could become problematic for future use. One of the design opportunities from this study was for better organisation applications, with support for deleting photos. Another suggestion involved better support for individual reminiscing, which was currently inhibited by the size of photo collections on smartphones and the lack of overview.

This study addressed the curation challenges for smartphone users, but it did not cover participants from the generation that know only of digital media, while their attitudes towards curation and preservation of photos for future use might be different from participants who used to make family albums with photo printouts. One of the research questions that we can think of is what will be the nature of future digital keepsakes and mementoes for the next generations and how will they be curated?

7.5.6. Identity Formation Through Photo Curation

In our work, we focused on social bonding through sharing memories, as part of the social function of autobiographical memory (e.g. Bluck et al., 2005). However, the performative nature of storytelling, including self-expression, especially in collocated social interactions such as the home, as studied by Durrant et al. (2009), but also in remote interactions via social media, as mentioned by, e.g. Van House et al. (2005) was out of the scope of this thesis. We briefly touched upon this topic in a study that resulted in *Memora*, a concept designed in a participatory approach, aiming to enable teenage girls to interact with digital photos using interactive jewellery.[7] One of the findings from an early exploration with teenage participants was that many photos were not shared with others, but still play a significant role in teenagers' lives. A working prototype was realised and evaluated with teenage girls, to explore how hybrid interactive jewellery can invite

[6] Zürn, X., Damen, K., Leiden, F. van, **Broekhuijsen, M.** and Markopoulos, P. (2017). Photo Curation Practices on Smartphones. In: *Proceedings of ACE 2017: 14th International Conference on Advances in Computer Entertainment Technology*, December 14 - 16, 2017, London, UK. Springer, Cham. pp. 406-414 DOI: https://doi.org/10.1007/978-3-319-76270-8_28

[7] Hermans, L., **Broekhuijsen, M.** and Markopoulos, P. (2017). Memora: a Design for Teenagers to Connect Virtual and Physical Possessions. In: *Proceedings of ECCE 2017: European Conference on Cognitive Ergonomics*, September 20 - 22, 2017, Umeå, Sweden. ACM, New York, NY, USA. pp. 121-128 DOI: https://doi.org/10.1145/3121283.3121312

new ways to cherish, value, and access those particular personal digital photos. The evaluation of *Memora* demonstrated that interactive jewellery does function as a memento which allows expressing one's identity to the outside world through the jewellery, as well as keeping an intimate relationship with personal memories which complements current uses of photos for self-presentation on social media. Through the whole study of *Memora*, sharing photos has always surfaced as an important part of expressing oneself. In contrast, the findings from the evaluation showed that *Memora* does give the opportunity to use valued photos for only personal purposes and that there is a need to do so.

The personalised interactive jewellery enabled expression of identity, but to explore further if and how interactive technologies such as *Memora* also help identity formation, further research might aim for longitudinal deployment of prototypes like these in real life. Future research into identity formation could also link to address well-being. People enjoy the fact that they are building up a life story, and photos can be empowering for what McAdams (2011) referred to as *narrative identity*, the story of one's own life. An interactive application could motivate people to engage in photo curation, to stimulate them to think about their (narrative) identity, contributing to their wellbeing in the process.

7.6. CLOSING REMARKS

The research topic of photo curation is accessible, which meant that every person we came across in the past years was able to relate to this research, independent from their background, educational level, interest in technology or familiarity with research. It also made the research relevant, because most people asked when we would be serving them with a solution to their curation issues. The exploratory nature of our design research process did not result in a single final design. Even though the *Curation Arena* is based on earlier explorations, it was an exploratory design, and we used it to learn more about the design space and the curation practices. In short, it does not provide a comprehensive solution to the photo curation challenge that we started with, and so we have to look for other opportunities to share our thoughts on what such a solution could be. This could be done in several ways, for example: a) *develop a product*, a curation tool that is based on our insights; b) *inform interaction designers* by publishing the requirements and insights that are relevant to their practice in an (online) magazine, and inspire them to improve curation solutions based on our research; c) *inform people* via (online) popular media (e.g. newspaper, Facebook, YouTube, technology blogs) on how to make the best use of existing software and hardware solutions to curate their personal collections. The benefactors of our research endeavours should ultimately be everyday users, like all the people we spoke with, and as design researchers, we should try our best to make sure that our research insights also find their way into commercial design practice.

In this thesis, we presented a new perspective on photo curation that brings the curation to the moment of shared viewing. This new perspective can spark new creative solutions because it defies the current way of dealing with photos. We can look at existing designs and reinvent them using Curation-in-Action principles. Our new approach also raises new research questions, regarding interacting with each other, with our systems and with our memories.

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APPENDIX CHAPTER 3 – INVITATION & CONSENT

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INVITATION LETTER

UNDERSTANDING PHOTO RETRIEVAL
(Part of the project* Materialising Memories*, program approval HREC 2012000570)

Dear …….

My name is Mendel Broekhuijsen and I am a PhD candidate at the Eindhoven University of Technology, under supervision of Dr. Elise van den Hoven.

I am conducting research into digital photo retrieval and would welcome your assistance. The research will involve showing some of your favourite photographs and talking about your photo retrieval activities. The study should take no more than 1 hour of your time. I have asked you to participate because you are well acquainted with digital photography, because you own a digital camera and/or a smartphone, and because you own a large collection of digital photos.

This research has been funded by NWO (*Nederlandse Organisatie voor Wetenschappelijk Onderzoek / Dutch Organisation for Scientific Research*).

If you are interested in participating, I would be glad if you would contact me by sending me an email.

You are under no obligation to participate in this research.

Yours sincerely,

Mendel Broekhuijsen MSc.
PhD Candidate User Centered Engineering
Department Industrial Design
Eindhoven University of Technology
HG 2.44
+316 1874 9143
m.j.broekhuijsen@tue.nl

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.

The researcher's primary affiliation is with the Eindhoven University of Technology, so you can contact: the Project Officer of the Industrial Design department at the Eindhoven University of Technology (ir. Karen Luijten-Hoffman, phone: +31 40 247 4772, e-mail: k.luijten.hoffman@tue.nl). Please quote the names of the project and researcher.

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Technische Universiteit Eindhoven University of Technology

UNIVERSITY OF TECHNOLOGY SYDNEY

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UITNODIGING DEELNAME ONDERZOEK

"BEKIJKEN VAN DIGITALE FOTO'S"

Geachte meneer/mevrouw,

Mijn naam is Mendel Broekhuijsen en ik ben promovendus bij Industrieel Ontwerpen aan de Technische Universiteit Eindhoven, onder begeleiding van Dr. Elise van den Hoven. Het onderzoek is een samenwerkingsproject met de Technische Universiteit in Sydney, Australië.

Ik doe onderzoek naar het bekijken van digitale foto's, en uw hulp is zeer welkom. Als u bereid bent deel te nemen aan het onderzoek zal ik u een aantal vragen stellen over het bekijken van foto's, en zal ik u vragen een paar foto's uit uw eigen collectie te laten zien. Het interview zal maximaal 1 uur duren, en zal plaatsvinden bij u thuis, op een moment dat u uitkomt. Dat kan overdag, 's avonds en in het weekend. U ontvangt deze brief omdat u binnen de doelgroep van mijn onderzoek valt.

Mijn promotie onderzoek wordt volledig gesponsord door het NWO (*Nederlandse Organisatie voor Wetenschappelijk Onderzoek*).

Als u geïnteresseerd bent om deel te nemen aan mijn onderzoek, dan hoor ik graag van u per mail, telefonisch of per brief. Vervolgens zal ik contact met u opnemen voor een afspraak.

Uiteraard bent u op geen enkele manier verplicht om deel te nemen aan het onderzoek.

Met vriendelijke groet,

Mendel Broekhuijsen

Copernicusstraat 100-A
2561 XC Den Haag
+316 1874 9143
m.j.broekhuijsen@tue.nl

PhD Candidate User Centered Engineering
Department Industrial Design
University of Technology Eindhoven & Sydney

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.

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CONSENT FORM

UNDERSTANDING PHOTO RETRIEVAL
(Part of the project* Materialising Memories*, program approval HREC 2012000570)

I _____ (participant's name) agree to participate in the research project Understanding Photo Retrieval, part of the project *Materialising Memories (HREC 2012000570)* being conducted by Mendel Broekhuijsen, HG 2.44, +316 1874 9143, of the Eindhoven University of Technology, for his PhD degree. Funding for this research has been provided by NWO *(Nederlandse Organisatie voor Wetenschappelijk Onderzoek / Dutch Organisation for Scientific Research)*.

I understand that the purpose of this study is to understand photo retrieval activities. I understand that I have been asked to participate in this research because I am well acquainted with digital photography, because I own a digital camera and/or a smartphone, and because I own a large collection of digital photos. I also understand that my participation in this research will involve showing personal photographs, and that I will be invited to talk about those photos.

I understand that my participation in this interview will last for approximately 1 hour, in which I will be asked to show a few of my photographs and to talk about my photo retrieval activities in detail. During that time, it is possible that I am asked to answer questions that are about personal events, however it will always be my choice what I want to share with the researcher.

I am aware that I can contact Mendel Broekhuijsen (m.j.broekhuijsen@tue.nl), or his supervisor Dr. Elise van den Hoven (e.v.d.hoven@tue.nl) 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. Moreover, during the interview I can refuse to answer any question about topics or events that I do not want to talk about, and I am also free to hide all photographs that I do not want to show to the researcher. I will not be penalised in any way for declining to take part in any stage of the research.

I understand that all the data that is collected during this study will only be available to the researcher and his supervisor. I agree that Mendel Broekhuijsen has answered all my questions fully and clearly. I agree that the research data gathered from this project may be published 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.

The researcher's primary affiliation is with the Eindhoven University of Technology, so you can contact: the Project Officer of the Industrial Design department at the Eindhoven University of Technology (ir. Karen Luijten-Hoffman, phone: +31 40 247 4772, e-mail: k.luijten.hoffman@tue.nl). Please quote the names of the project and researcher.

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APPENDIX CHAPTER 3 – INTERVIEW PROTOCOL

UNDERSTANDING PHOTO RETRIEVAL - INTERVIEW_EN

1. Introduction: Explanation about the interview, and the goal to investigate Photo Retrieval.

2. Participant is asked to sign the consent sheet upon agreement

3. I will show the participant examples of retrieval activities in certain contexts, and I will ask them if they have engaged in those, and how often on a scale of 1 (never) to 5 (very frequent).

4. I will ask them why they engage in photo retrieval, and try to find out what their motivations and goals are.

5. I will ask the participants if there are other retrieval activities that we have not discussed but are important for them. The participant will be asked to explain those as well, and indicate the frequency of occurrence.

6. I will ask the participant to show me a photograph from their collection.

7. I will ask them if this is their usual retrieval practice.

8. If not: please demonstrate your usual practice if possible.

9. Co-reflection: Does the retrieval practice lead to the participant's ultimate goals and matches with the motivations for photo retrieval? Why (not)? If not, what does it lack? Can it be improved? (Open discussion, in which I will be looking at the expressed values, not the technological desires that people might express).

10. If the participant needs encouraging in this reflection phase I will show the participants existing (research) retrieval activity tools and I will ask them if they would appreciate using them, and for what reasons.

11. I will thank the participants for their time, and I will invite them to keep up to date on the project's progress, and I will ask them if they would like to be contacted in case any follow up study welcomes their participation.

APPENDIX CHAPTER 4 – INVITATION & CONSENT

TU/e Technische Universiteit Eindhoven University of Technology

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INVITATION LETTER

CO-DESIGN EXPLORATION: MEANINGFUL USE OF PERSONAL PHOTOS
(Part of the project* Materialising Memories*, program approval HREC 2012000570)

Dear ……..

My name is Mendel Broekhuijsen and I am a joint PhD candidate at the Eindhoven University of Technology & University of Technology Sydney, under supervision of dr. Elise van den Hoven and prof. Panos Markopoulos.

I am conducting research into **social photo use**, and would welcome your assistance. Your participation means that you will be asked to join a creative **co-design session** with myself and 3 to 5 other participants. In this session we will discuss new ways to **share digital photographs within a group of friends or within your family**. As part of the session you will be asked to share your thoughts about the concepts that are proposed by me or the others, and to share your experiences with showing your photos in social settings. In the session we will create scenarios that describe your experiences. With the other participants we will identify opportunities for **new technologies** that can support social photo use, and we will make scenarios to clarify the use of these new technologies. The session should take **approximately 2 hour,** and will be held at a location that is convenient for all participants.

I am asking you to participate because according to my information you are part of a group of friends with whom you regularly share personal photos. You are also selected because you own a digital camera and/or a smartphone, and you are well acquainted with digital photography, online sharing services and social platforms, and because you own a collection of digital photos.

This research has been funded by NWO (*Nederlandse Organisatie voor Wetenschappelijk Onderzoek / Dutch Organisation for Scientific Research*).

You are under no obligation to participate in this research. But if you are interested in participating, I would be very happy if you would contact me by sending me an email or giving me a call.

Thank you in advance for considering to participate.

Yours sincerely,

Mendel Broekhuijsen MSc.
PhD Candidate User Centered Engineering
University of Technology Eindhoven & Sydney
+316 1874 9143
m.j.broekhuijsen@tue.nl

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.

The researcher's primary affiliation is with the Eindhoven University of Technology, so you can contact: the Project Officer of the Industrial Design department at the Eindhoven University of Technology (ir. Karen Luijten-Hoffman, phone: +31 40 247 4772, e-mail: k.luijten.hoffman@tue.nl). Please quote the names of the project and researcher.

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CONSENT FORM

CO-DESIGN EXPLORATION: MEANINGFUL USE OF PERSONAL PHOTOS
(Part of the project **Materialising Memories***, program approval HREC 2012000570)*

I _____ (participant's name) agree to participate in the research project "Co-design exploration: meaningful use of personal photos", part of the project *Materialising Memories (HREC 2012000570)* being conducted by Mendel Broekhuijsen, +316 1874 9143, Room HG 2.44, of the Eindhoven University of Technology / University of Technology Sydney, for his PhD degree. Funding for this research has been provided by NWO *(Nederlandse Organisatie voor Wetenschappelijk Onderzoek / Dutch Organisation for Scientific Research).*

I understand that the purpose of this study is to explore design solutions for social photo use with friends or families. I understand that I have been asked to participate in this research because I am part of a group of friends with whom I am regularly sharing digital photos. I am also selected because I own a digital camera and/or a smartphone, and I am well acquainted with digital photography, online sharing services and social platforms, and because I own a collection of digital photos.

I understand that my participation in this research will involve attending a creative co-design session with 3 to 5 other participants. I understand that my participation in this session will last for approximately 2 hours, in which I will be asked to share my thoughts on concepts that are proposed by the researcher, myself or the other participants, and to share my own experiences with sharing photos with friends and family. During the session I will be invited to elaborate on these photo use activities, and together with the other participants I will come up with concepts and new technologies that can support sharing digital photos. I understand that I will be involved in sketching the concepts and scenarios, together with the researcher and the other participants. I understand that my input will be valuable during the whole session. During the session, it is possible that I will be asked either by the researcher or by the other participants to share experiences or knowledge that is drawn from personal events, but I understand that I can always refuse to answer any question to elaborate on topics or events that I do not want to talk about.

I am aware that I can contact Mendel Broekhuijsen (m.j.broekhuijsen@tue.nl), or his supervisor Dr. Elise van den Hoven (e.v.d.hoven@tue.nl) 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. Moreover, I will not be penalised in any way for declining to take part or contribute in any stage of the research.

I understand that all the data that is collected during this study will only be available to the researcher and his supervisors. I agree that Mendel Broekhuijsen has answered all my questions fully and clearly. I agree that the research data gathered from this project may be published 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.

The researcher's primary affiliation is with the Eindhoven University of Technology, so you can contact: the Project Officer of the Industrial Design department at the Eindhoven University of Technology (ir. Karen Luijten-Hoffman, phone: +31 40 247 4772, e-mail: k.luijten.hoffman@tue.nl). Please quote the names of the project and researcher.

APPENDIX CHAPTER 6 – INVITATION & CONSENT

Do you take a lot of photos, and do you often share photos with your friends?
Have you recently been on a trip with your partner or friend but did not get a chance to view your photos together?

My name is Mendel Broekhuijsen, and as part of my PhD research I am conducting a study about on-demand curation of personal digital photos, to improve the experience of collocated sharing. I am looking for pairs of participants who have recently been on holiday or a short trip together, who both have photos of these events, and who want to view the photos of their shared experiences on the 360° screen of the UTS Data Arena!

If you want to experience the Data Arena first hand, this is your chance. The study will be held in November, and there are several time slots available throughout the month to ensure that the study will take place at a day and time that is convenient for you and the person you bring along.

Please visit www.futurenostalgia.nl to read the official invitation letter with more in-depth information regarding the study. This study has been approved under UTS HREC REF NO. ETH16-0777. If you want to take part in my study and are excited about viewing your photos in the UTS Data Arena, please ask your partner, a friend or a colleague to join you and contact me via mendel.broekhuijsen@student.uts.edu.au. Feel free to hand this information to others who you think might be interested in participating too.

Thank you in advance for considering to participate!

Warm regards,
Mendel Broekhuijsen

_____

Joint PhD candidate
Eindhoven University of Technology - Department of Industrial Design
University of Technology Sydney - FEIT School of Software

UTS: CB 11.06.460
mendel.broekhuijsen@student.uts.edu.au
www.materialisingmemories.com
www.futurenostalgia.nl

INFORMATION SHEET

The experience of on-demand photo curation for photo sharing
(Part of the project Materialising Memories, program approval HREC 2015000629)

Dear ……..

My name is Mendel Broekhuijsen and I am a joint PhD candidate at the Eindhoven University of Technology & University of Technology Sydney, under supervision of prof. dr. Elise van den Hoven and prof. dr. Panos Markopoulos.

I would like to formally invite you to participate in a study to evaluate new designs that support sharing photos, with UTS HREC approval reference number ETH16-0777. This study is part of the Materialising Memories research programme and funding for this research has been provided by NWO (*Nederlandse Organisatie voor Wetenschappelijk Onderzoek / Dutch Organisation for Scientific Research*).

I am conducting research into **digital photo curation**, and would welcome your assistance. Your participation means that you will be asked to join, together **with a friend or partner**, in the evaluation of **new tools that help you to select and share digital photos during a conversation**. You will be asked to **evaluate one or more prototypes** that are designed to support on-demand selection of photos. In preparation you and your friend or partner will be asked to bring a set of (lightly censored) photos that include at least two holidays or events that you did together. **You will only be showing these photos to your friend or partner**, not to the researcher. After the prototype evaluations, I will conduct a small **interview with the both of you**. The session and interview will be held in the **UTS Data Arena** and will last **maximum 90 minutes**.

If you have any questions, please feel free to contact me per phone +316 1874 9143 or email m.j.broekhuijsen@tue.nl.

Please remember that you are under no obligation to participate in this study. You can also decline from participating at any stage without penalty. Research data from this project will be published in a form that does not identify you in any way, unless we ask for your consent explicitly. But if you are interested in participating, I would be very happy if you would contact me by sending me an email or giving me a call.

Thank you in advance for considering to participate.

Yours sincerely,

Mendel Broekhuijsen MSc.
Joint PhD Candidate
Department of Industrial Design, Eindhoven University of Technology
Faculty of Engineering & IT, University of Technology Sydney
+316 1874 9143
m.j.broekhuijsen@tue.nl

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 (phone: +61 2 9514 9772, e-mail: Research.Ethics@uts.edu.au), 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: ir. Karen Luijten-Hoffman (phone: +31 6 3360 4020, e-mail: k.luijten.hoffman@tue.nl) at the TU/e Innovation Lab, Eindhoven University of Technology. Please quote the names of the project and researcher.

CONSENT FORM

The experience of on-demand photo curation for photo sharing
(Part of the project Materialising Memories, program approval HREC 2015000629)

I _____ (participant's name) agree to participate in the research project "The experience of on-demand photo curation for photo sharing", part of the project *Materialising Memories (HREC 2015000629)* being conducted by Mendel Broekhuijsen, +316 1874 9143, of the Eindhoven University of Technology & University of Technology Sydney, for his joint PhD degree. Funding for this research has been provided by NWO *(Nederlandse Organisatie voor Wetenschappelijk Onderzoek / Dutch Organisation for Scientific Research)*.

I understand that the purpose of this study is to explore the usefulness of new photo curation tools that support photo sharing. I understand that I have been asked to participate in this research because I own a digital camera and/or a smartphone, and I am well acquainted with digital photography, online sharing services and social platforms.

I understand that my participation in this research will involve a session together with a self-chosen friend or partner, to evaluate the use and the value of one or more prototypes that are designed to support on-demand selection of photos to share with each other. In preparation for this session I have been asked to select a set of 300 photos that at least covers two holidays or events that I attended with my friend or partner. I understand that I will only show the photos to my friend, not to the researcher. After the study I will be interviewed together with my friend or partner. I understand that the time investment will be approximately 90 minutes for the study. During the session or the interview, it is possible that I will be asked either by the researcher or by the other participant to share photos, experiences or knowledge that is drawn from personal events, but I understand that I can always refuse to show a photo, and refuse to elaborate on topics or events that I do not want to talk about.

I am aware that I can contact Mendel Broekhuijsen (m.j.broekhuijsen@tue.nl), or his supervisor prof. dr. Elise van den Hoven (Elise.VandenHoven@uts.edu.au) 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. Moreover, I will not be penalised in any way for declining to take part or contribute in any stage of the research.

I understand that all the data that is collected during this study will only be available to the researcher and his supervisors. I agree that Mendel Broekhuijsen has answered all my questions fully and clearly. I agree that the research data gathered from this project may be published 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 (phone: +61 2 9514 9772, e-mail: Research.Ethics@uts.edu.au), 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: ir. Karen Luijten-Hoffman (phone: +31 6 3360 4020, e-mail: k.luijten.hoffman@tue.nl) at the TU/e Innovation Lab, Eindhoven University of Technology. Please quote the names of the project and researcher.

APPENDIX CHAPTER 6 – SESSION PROCEDURE

version 2.0 07/11/16

PROCEDURE "CURATION ARENA"

0 · 5 minutes Welcome

Have a seat in the lobby, and please hand me your **disks**
Please read and sign the informed consent, if you have no further questions.
I will copy the files and start the system. This takes a few minutes.

5-8 minutes: Introduction

Joint PhD in my final year, and you are about to take part in my final study. My research is about **digital photo curation, and how it supports shared remembering**. One of the starting points of the PhD is that people spend very little time on viewing their photos, despite the fact that they have so many of them! So I designed a system that allows both of you to share your personal photos collection.

8-20 minutes: Pre-Interview

If you have signed the consent form, I will start the **audio recorder**
I will first ask you some questions before we go into the arena:

1. *Can you briefly explain to me how you* **know each other***?*
2. *After reading the instructions for preparing this session,* **how did you agree** *to the events that you included?*
3. **Why** *these events?*
4. *After that,* **how did each of you selected** *the photos from your collections?*
5. *How do you determine what is* **relevant** *and what not? What were the main inclusion and exclusion* **criteria** *for the set?*
6. *Was it difficult to* **locate** *the correct photos? e.g. were there photos you wanted to include but could* **not find***?*
7. *How* **much time** *did you spend on selecting this set, and how did you spend it?*
8. *As part of that, how* **much curation** *did you do, and how did you do it?*
9. *Can you give me a* **percentage** *of the photos that you took out of the initial set?*
10. *Did you* **enjoy selecting** *the set? Why (not)?*
11. *In general, how are your photos* **organised***?*

20-65 minutes · The Session

1/4

1. *Please follow me into the data arena. Here is an iPad, touch the A/B icon please.*

2. *First, let's try if it all works, and let you* **familiarise** *with the system:*
   Please select a photo that **features your friend**, *and tap it once to show on the big screen. It will show a blue rim. Tap it again to hide it from the display.*

3. *Now you have seen how it works,* **I would like to invite you to freely use the system for the next 45 minutes to share the stories and memories surrounding the photos that you brought with you, or any other memories that come to mind.**

4. *You can use as many photos as you like, and if the screen is filled, you can scroll back and deselect photos to make room for more.*

I will start **recording**. I am around the corner if you have questions or issues. Please make yourself at home, pretend I am not here, and please do not touch the screen.

version 2.0 07/11/16

65-85 minutes · After-interview

I would first like to talk about the content that you shared with each other, and then about the use and interaction with the system itself.

1. *Have you* **already seen** *these photos together?*

2. *How* **many photos** *did you show to the other person? Can you give me a* **percentage** *of how many you showed from the ones you brought with you?*

3. *Did you* **contribute equally** *to the big screen?*

4. *What were the main* **considerations to show or skip** *a photo during the conversation? Can you give a* **detailed example** *of a photo that you showed, and of a photo that you did not show?*

5. *Were there moments where you were* **deliberately looking** *for a specific photo to support the conversation? Can you give an* **example** *of that?*

6. *How did you determine in the moment what is* **relevant***? Is that different than what you* **thought would be relevant** *when you selected the photos prior to the session?*

7. *Were there* **photos missing** *that you would have liked to show because the conversation took you there?*

8. *How did* **what you talked about influence what photos** *you selected?*

9. *And the other way around: In what way do you think the use of the* **photos influenced what you talked about***?*

10. *What* **kind of stories** *did the photos trigger? Was it one conversation, or many different short stories? Did you* **finish every topic** *before continuing with the next?*

11. *Did some photos* **trigger more** *memories, also not directly related to the content of the photo? Any idea why that happened with these photos?*

12. *Did the photos of the other person trigger* **forgotten memories** *and stories?*

13. *Did you* **tell the other person everything** *that you remembered around the photos, or did you leave irrelevant things out? What made these things* **relevant** *or not?*

14. *What do you think is the* **value of talking** *about these photos? Could you also have done without talking at all?*

15. *Suppose this system would hold* **all your personal photos**, *how would that change the experience?*

About the interaction with the system

3/4

16. *What are your thoughts on the* **interaction** *as you just experienced it? Can you give details on what you* **liked about it and what you disliked***?*

17. *Would you liked to have* **more options** *for selecting or showing photos in a different way? E.g. enlarging, editing etc? Would that* **change the relevance** *of certain photos?*

18. *Did you feel the need to* **interact with the screen** *at all? If so, what effect would you want that to have? E.g. enlarge photos? Scroll? Restructure?*

19. *What interaction do you think would* **enhance the experience***?*

20. *In* **general**, *what did you think of* **the whole experience** *just now in the data arena, can you tell me what you liked and disliked?*

21. *How did you like the* **ambiance of the data arena***?*

22. *Were you very aware that you were in a* **test***? Did you speak freely?*

23. *Can you tell me a little about how you think...*
    1. **preparing** *for the session,*
    2. *the* **ambiance** *and use of the* **system** *in the data arena*
    3. *the* **content** *of the photos,*
    4. *being with your* **friend/colleague/partner**

...influenced the experience of remembering the events around these photos?

85-90 minutes: Debriefing

The system that you just used is an example of what I would like to call on-demand curation: you determine in the moment which photos are appropriate and which are not, and you can do that while you are sharing them. In this study I am looking at the usefulness of such on-demand curation tools to support shared remembering. I aim to translate the findings from this study into feasible solutions for domestic photo sharing.

24. *So finally: what aspects of the whole experience would you like to have* **in your home** *in - say - five years from now?*

To conclude, can I please have your full name, age and occupation?

APPENDIX CHAPTER 6 - THEMATIC ANALYSIS

Iteration 1 & Iteration 2

Iteration 1	Iteration 2	
General organisation	General organisation	70
Photouse, Remembering, Experience	Viewing & related technology	21
	capturing	5
	Mediated memory sharing & storytelling	69
Curation	Pre-curation (criteria/process/ experience)	73
	Curation-in-Action (considerations)	86
	Contributions (to the screen)	14
	Collaging on screen	12
System feedback	Experience of Arena	55
	System feedback	69
	Future of system / favourite aspect	20
Other	Participant bias	12
	Total snippets	**506**

Iteration 3 (taken out of the analysis)

Related to PhotoUse (not in analysis)		
General organisation + Viewing & related technology + capturing	capturing	6
	collection	3
	triaging	5
	organising	18
	editing	4
	managing	33
	browsing	4
	viewing	14
	searching	2
	sharing	2
	printing	2
	tinkering	0
	collaging	0
	Total snippets	**93**

Iteration 4 - Curation & Pre-curation

Curation & pre-curation	***What photos? Decisions?***	*Social reasons*	photos of shared experiences, including trips and highlights	18
			photos that would interest the other, and/or to introduce oneself	8
		Other reasons	data arena as requirement (technological)	2
			photos that person wants to know more about (from the other)	1
			Non-photos	1
			Aesthetic reasons	3
	Curation process / decisions & influences		no curation, only selection	10
			anticipating a remembering experience	1
			avoiding duplicates & reducing total number	3
			technical & time constraints influencing pre-curation	7
			censor/filter for privacy	2
			proportionally representation of content / balanced set	2
			looking for chronological or specific event	2
			social media as curated source	1
	Other		Experience of pre-curation	10
			Have you looked at these?	9
			Total snippets	**80**

Iteration 4 - Mediated shared remembering

Mediated memory sharing & storytelling	***What did they talk about?***	changes (social / relatinships/life	11
		shared reminiscing	9
		visual dialogue	2
		storytelling (to introduce/get to know)	7
	what did they remember?	people	2
		places	4
	Process of mediation	story is determined by the photos	18
		importantance of speaking	7
	Session "result"	reflection leading to future plans	1
		reflection on capturing behaviour	2
	Total snippets		**63**

Iteration 4 - Curation-in-Action

Curation-in-action	***Process during session***		event-based	1
			thematic	1
			random	1
			use the screen to create something	4
			collaging is cool!	7
	Reasons to show/skip	*To support story /memory / narrative*	uniqueness of the event	1
			timing is relevance to current narrative	8
			relevant to other person	10
			to test others memory / check facts	4
			dialogue style /in reaction to previous photo (reciprocity)	15
			with people in the photo	3
			Because of the story/event/memory	9
		Appreciation of content	Aesthetic value	10
			private content they would otherwise not share	1
			positive/negative association with photo	7
			Total snippets	**82**

Iteration 4 - Other

Experience	Age of photos	3
	😊(comments praising the experience)	24
	time in CA influenced by number of photos	3
	immersive data arena	18
	Multi-user aspects:advantage of a second screen and both contributing	9
Feedback (improvements concerning curation, not arena)	Focus attention, e.g. size	2
	re-order (thematic)	6
	curation desires	2
	continuous sharing & storytelling	2
Factors influening the ease of finding the right photo	unfamiliarity with collectioin	9
	Total snippets	**78**

Iteration 5 & 6

Iteration 5	iteartion 6			supporting screenshots
Contribution		(Equal) contribution to screen	11	
General opinion	*Value of Curation Arena*	😊 (comments praising the experience)	43	3
		Reflection leading to future plans + Reflection on capturing behaviour	9	
Strategy 1 – shared reminiscing	*Pre-curation process and selection*	Photos of shared experience	16	
		Include trips & highlights/happy moments	3	
		Looking for chronology, Specific time	2	
		Motivation: Photos that person wants to know more about	1	
	Reason to skip/ show	To test others memory or check facts	53	5
		Private content they would otherwise not share	2	
	What did they talk about:	Changes, (social) relationships, life	40	1
		Shared reminiscing	29	7
Strategy 2 – Getting to know each other	*Pre-curation: Common ground*	Photos that would interest the other + and/or to introduce yourself	22	
		Censor / filter private material	2	
	Reasons to skip/ show	Relevance to the other person	12	
	What did they talk about	Storytelling (to introduce / get to know each other)	19	1
		Asking questions to elaborate + invite others to talk about photos	8	2
Curation considerations – pragmatic	*No curation*	NO curation, only selection (pragmatic) per process	12	
	Random selection	Random displaying photos	9	
	Content reduction	Pre-curation process: Avoiding duplicates reducing number	3	
Curation considerations – mnemonic / emotional	*Good story*	Because of the story event or memory	31	2
	Emotional associate	Positive negative associate with photo content	17	
	Friends & Relationships	People	14	1
		With people on them	9	
	Memorable events	Events + Happy times + accounts of anticipatory remembering experience	14	
		Uniqueness of the event	1	
Curation considerations - aesthetic	*Visual quality*	Aesthetic value/ no-value of content + Appreciation of content	33	1
		Aesthetic reasons	5	
		Data arena tech as requirements for including photos	2	
	Thematic fit	*Process during session*: Thematic	22	2
		Re-order (thematic) on screen	7	
	Collaboration creation	Use the screen to recreate something	18	4
		(Visual) Dialogue	5	
Factors - Behaviour	*Focus attention*	Focus attention feedback@ curator (e.g.-size)	23	6
	Timing content	Represent each event equally (proportionally) + Balanced set Timing relevant to the current narrative	36	2
	Narrating content	Story is determined by photos	26	
		Importance of speaking	12	1
		Elaboration	10	
	Reciprocal exchange	Dialogue style + reaction to a previous photo	39	2
Factors – Design/ system	*Juxtaposing photos*	Collaging is cool!	14	
	Conversation flow	Continuous sharing & storytelling	12	3
	Immersiveness	Experience + Immersive data arena + Curation arena as stage	33	1
	Second screen privacy	Multi user & second screen + Value of 2nd screen privacy	38	9
	Content familiarity	Have they looked as these before? (un)familiarity with photos	31	2
		Age of photos influences the experience	7	
		Time in curation arena determined by # of photos	7	
	Preparation time	Pre-curation time + Technical influence on ability of pre-curate	19	
		Number of snippets	**781**	**55**

SUMMARY

Nowadays, most people need to deal with increasing quantities of personal digital photos, resulting from the technological developments in capturing moments and experiences. The photos that people capture for their personal collections often acquire personal value as external representations that can cue autobiographical memories: memories related to one's own life. The autobiographical value of photos can support people's interactions with others, both when they are apart (remote) and when they are together (collocated). However, the large quantity of photos that people own make it difficult to fully enjoy the (autobiographical) value of the photos, because they simply cannot find the appropriate content when they need it. The challenge that emerges for designers of interactive systems is how to help people to better curate their collections of digital photos, in order to support the use of these photos for interpersonal communication.

This thesis describes design-driven research into photo curation tools, with the aim to inform the design of photo curation technologies to better support the use of photos, specifically for collocated shared remembering practices. The work addresses three research questions: *1) What kind of tools and practices exist around personal photos? 2) What do people want to do with their photos to support collocated shared remembering? 3) What kind of curation tools can support the use of photos during collocated shared remembering?* To answer these questions, we applied a mix of methods that are commonly used in design research. Research question 1 was answered using design ethnography and contextual interviews in the home of participants. Research question 2 was addressed using ethnography and research-through-design, which included the development of (early) prototypes and evaluations which led to knowledge about what is desired around photo sharing. Research question 3 was answered using generative techniques in a co-design session that explored what people need by studying what they make, which led to requirements for design, and by designing and evaluating an artefact that manifested our current understanding of a desired curation tool.

In Chapter 1 of the thesis, we define curation as *"the creative activity that is intended to add value to an accumulation of photos by means of purposive triaging, organising, editing and managing"*, which also represents our current understanding of photo curation as a concept.

By reviewing developments in the consumer electronics industry and a literature survey of related research prototypes in Chapter 2, we conclude that there appears to be an abundance of commercial tools for capturing media and remote sharing compared to a relative scarcity of curation tools, which we attributed to the worldwide adoption of social media platforms which seemed to have geared commercial interest towards remote sharing solutions using mobile devices, rather than collocated sharing in the home using dedicated tools.

Based on contextual interview data from 12 participants that was analysed qualitatively in Chapter 3, we have found that there are many different activities around photos that people engage in. The activities that we identified often take place simultaneously or are part of the same overarching goal. We also saw that from the photo curation activities that we identified in this study, people tend to tailor specific photo selections to different (social) contexts. The identified activities resulted in a model of PhotoUse to illustrate the dynamic and flexible set of photo practices that people engage in.

In a co-design activity described in Chapter 4, we explored design directions for tools to support collocated shared remembering practices. Based on a redesign exercise with 15 participants analysed qualitatively, we were able to formulate requirements for photo curation and sharing tools: when viewing photos together, content should be tailored to audience; the use of photos should be embedded in the narrative structure; multi-user content and interaction should be supported and when transitioning from physical photo sharing to digital photo sharing, intimate qualities of the practices should be preserved.

In a design exploration study described in Chapter 5, we explored how to design for reciprocal interaction with the goal to understand the pitfalls and opportunities of designing multi-user systems. Based on an analysis of four concepts from a social interaction perspective, we saw that 1) systems for photo-mediated storytelling should be able to support dynamic interaction needs, to allow people to rethink their behaviour or react to behaviour of others; 2) to support future collocated shared remembering, some level of preparation allows people to curate appropriate content for the anticipated context of use. This exploration also resulted in a four-step process that can support the implementation of reciprocal interaction in interactive systems.

A field-study described in Chapter 6 centred around the *Curation Arena*, a concept for collocated photo sharing that was developed to explore our approach to photo curation within a social context, which we termed *Curation-in-Action*. In 40-minute sessions, eleven pairs evaluated the system using personal photos. Thematic analysis of the transcript data allowed us to describe curation strategies, curation considerations and factors that influenced the experience of shared remembering. Finally, we formulated implications of our findings for the design of curation tools to support collocated shared remembering, which in short described that designers could 1) Centralize photo repositories; 2) Automate essential management; 3) Prioritize reciprocal sharing; 4) Support collaborative curation.

The thesis concludes and reflects in Chapter 7 that photo practices are changing with the rise of new mobile technologies and Internet-enabled devices. Our participants mainly wanted to use their photos to support social sharing activities, either remotely or collocated, and many of their practices were motivated and geared towards a social purpose. To accommodate these social purposes, we saw that people like to tailor specific photo selections to different (social) contexts, filter and tailor content based on social configurations, or react to the behaviour of others

during collocated sharing. We identified strategies for curation for a social context that relate to the underlying social purposes of the photo-sharing activity. We made the distinction between a strategy focused on shared reminiscing and a strategy focused on storytelling.

We argued in the thesis that curation with a social purpose should not be separated from use, and that the context of photo curation should be merged with the context of photo sharing. To support the use of photos during collocated shared remembering better, innovative curation tools could emphasise the purpose by bringing the activity of curation and its purpose (such as shared reminiscing) closer together, a notion that we conceptualised as *Curation-in-Action*. This new perspective on design for photo curation also supports the reconstructive nature of shared remembering, since dynamic photo selections that can be curated during the conversation can result in more appropriate content selections.

PUBLICATIONS BY MENDEL BROEKHUIJSEN

Peer-reviewed journal article related to this thesis

Broekhuijsen, M., Hoven, E. van den, Markopoulos, P. (2017). From PhotoWork to PhotoUse: Exploring Personal Digital Photo Activities. *Behaviour & Information Technology*, 36(7)[1]. Taylor & Francis. pp. 745-767 DOI: http://dx.doi.org/10.1080/0144929X.2017.1288266

Peer-reviewed conference articles related to this thesis

Zürn, X., Damen, K., Leiden, F. van, **Broekhuijsen, M.** and Markopoulos, P. (2017). Photo Curation Practices on Smartphones. In: *Proceedings of ACE 2017: 14th International Conference on Advances in Computer Entertainment Technology*, December 14 - 16, 2017, London, UK. Springer, Cham. pp. 406-414
DOI: https://doi.org/10.1007/978-3-319-76270-8_28

Hermans, L., **Broekhuijsen, M.** and Markopoulos, P. (2017). Memora: a Design for Teenagers to Connect Virtual and Physical Possessions. In: *Proceedings of ECCE 2017: European Conference on Cognitive Ergonomics*[2], September 20 - 22, 2017, Umeå, Sweden. ACM, New York, NY, USA. pp. 121-128 DOI: https://doi.org/10.1145/3121283.3121312

Broekhuijsen, M., Hoven, E. van den and Markopoulos, P. (2017). Design Directions for Media-Supported Collocated Remembering Practices. In *Proceedings of the TEI'17: Eleventh International Conference on Tangible, Embedded, and Embodied Interaction*[3], March 20 - 23, 2017, Yokohama, Japan. ACM, New York, NY, USA. pp. 21-30
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DOI: http://dx.doi.org/10.1145/3010915.3010959

Niemantsverdriet, K., **Broekhuijsen, M.**, van Essen, H. and Eggen, B. (2016). Designing for Multi-User Interaction in the Home Environment: Implementing Social Translucence. In *DIS '16 Proceedings of the 2016 ACM Conference on Designing Interactive Systems*[5], June 4 - 8, 2016, Brisbane, Australia. ACM New York, NY, USA. pp. 1303-1314
DOI: http://dx.doi.org/10.1145/2901790.2901808

[1] BIT 2016 Impact Factor: 1.388, 9th of top 20 HCI publications
[2] ECCE 2017 acceptance rate: 54% **Best Contribution Award**
[3] TEI 2017 acceptance rate: 27%
[4] OzCHI 2016 Short papers acceptance rate: 45%
[5] DIS 2016 acceptance rate 26%, 10th of top 20 HCI publications

Mols, I., **Broekhuijsen, M.**, Hoven, E. van den, Markopoulos, P. and Eggen, B. (2015). Do We Ruin the Moment? Exploring the Design of Novel Capturing Technologies. In *Proceedings of the 27th Australian Conference on Human-Computer Interaction (OzCHI'15)*[6], December 7 - 10, 2015, Melbourne, Australia. ACM New York, NY, USA. pp. 653-661. DOI: http://dx.doi.org/10.1145/2838739.2838758

Book chapter related to this thesis

Hoven, E. van den, **Broekhuijsen, M.** and Mols, I. (2018). Design Applications for Social Remembering. In: Meade, M. L., Harris, C. B., Van Bergen, P., Sutton, J., & Barnier, A. J. (Eds.) *Collaborative Remembering: Theories, Research, and Applications*. Oxford University Press. pp. 386-403. DOI: https://dx.doi.org/10.1093/oso/9780198737865.003.0022

Edited proceedings, not related to this thesis

Bakker, S., Hummels, C., Ullmer, B., Geurts, L., Hengeveld, B., Saakes, D., and **Broekhuijsen, M.** (2016). *Proceedings of the TEI '16: Tenth International Conference on Tangible, Embedded, and Embodied Interaction*[7]. ACM, New York, NY, USA.

Peer-reviewed article, not related to this thesis

Broekhuijsen, M., Delbressine F. and Feijs, L.M. (2011) Quality and rules for mechanical aspects of tangible interaction design. In: *DESIRE '11 Proceedings of the Second Conference on Creativity and Innovation in Design*[8]. October 19 - 21, 2011, Eindhoven, The Netherlands. ACM New York, NY, USA. pp. 351-354. DOI: http://dx.doi.org/10.1145/2079216.2079266

Conference presentations related to this thesis

Broekhuijsen, M. (2015). Curating Digital Photos to Support Shared Remembering. *Presented at Doctoral Consortium of OzCHI 2015*, December 2, 2015, Melbourne, Australia.

Broekhuijsen, M., and Mols, I. (2014). Materialising Memories: The Role of Media as Cues in Everyday Life. *Presentation at Amateurs and/as Experts: User Typologies*, held at Maastricht University, November 21 - 22, 2014, The Netherlands.

Broekhuijsen, M. (2014). Curating Digital Media Cues to Support Autobiographical Remembering. *Presentation at Things to Remember: Materializing Memories in Art and Culture*, held at Radboud Universiteit Nijmegen, June 5 - 06, 2014, The Netherlands.

[6] OzCHI 2015 acceptance rate 48%
[7] TEI 2015: 13th of top 20 HCI publications
[8] DESIRE 2011 acceptance rate: 54%

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CURRICULUM VITAE

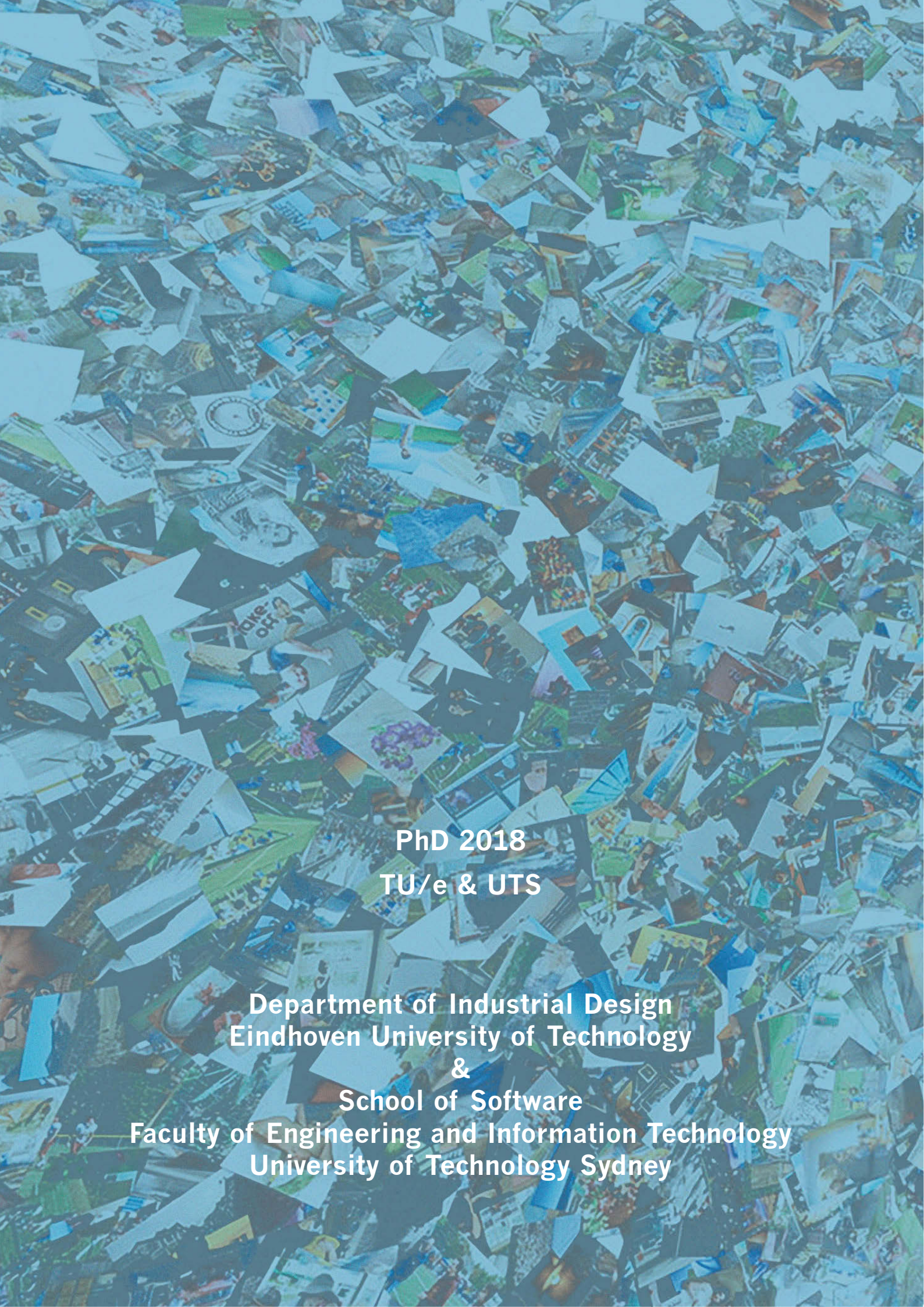
Mendel Broekhuijsen was born on March 3, 1985 in Zutphen, the Netherlands. In 2004, he obtained his high school diploma (VWO Natuur & Gezondheid) from Vrije School de IJssel. The same year he started at Maastricht University with the Psychology & Neuroscience Bachelor course, focused on human processes, perception and social behaviour. In September 2006, he switched to Industrial Design at the Eindhoven University of Technology. In 2009, Mendel was accepted into an internship at LEGO Education in Billund, Denmark, where he was part of the innovation team working on ongoing projects within Research & Design. He obtained his Bachelor degree in January 2010. For his Bachelor graduation project, he designed *Opus 4* for the public library of Amsterdam (Oba), a mood-based exploring system for listening and browsing music. *Opus 4* was exhibited at the Oba in 2010, at the Dutch Design Week of 2010, at the Domotica & Slim Wonen fair in 2011 in Eindhoven, and presented at the International Association of Music Libraries conference of 2011 in Dublin, UK.

In February 2010, Mendel continued with the Industrial Design Master course. His graduation project, titled *Future Nostalgia* (supervised by prof. dr. ir. Berry Eggen) was done partly in Amsterdam, at Muziek Centrum Nederland. The project concluded with the design of an iPhone application that enables people to create a personal collection of memory-inducing music. *Future Nostalgia* was exhibited at the Dutch Design Week of 2012. Mendel completed all four Master semesters with “excellence” qualification (top 10%) and graduated cum laude (top 5%) in January 2012.

In April 2012 Mendel accepted a job as product manager for Atos Worldline in Rotterdam, where he was responsible for guiding embedded software development for electronic payment terminals. Between June 2013 and January 2018, Mendel returned to the university to continue to work on his passion for the value of digital media as a joint PhD candidate at Eindhoven University of Technology and at the University of Technology Sydney in Australia. The research resulted in 8 high-quality publications so far, with exposure in the Netherlands, Australia, Japan, Sweden and the UK. This dissertation represents the outcome of the research into design for photo curation to support shared remembering.

Since February 2018 Mendel is employed at Qwiek in Heerlen, NL, a small company involved in designing products to bring more joy into the lives of people with dementia. As a senior innovation engineer, he is responsible for design-research to explore new opportunities together with healthcare experts, development of concept propositions, project management, and product validation research.

Mendel currently lives in Maastricht with Suzanne and their son Kaan.



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