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Design Directions for Media-Supported Collocated Remembering Practices

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ABSTRACT

Since the widespread adoption of digital photography, people create many digital photos, often with the intention to use them for shared remembering. Practices around digital photography have changed 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, commercially available tools for media-supported shared remembering still have many limitations. The objective of our research is to explore spatial and material design directions to better support the use of personal photos for collocated shared remembering. In this paper, we present seven design requirements that resulted from a redesign workshop with fifteen participants, and four design concepts (two spatial, two material) that we developed based on those requirements. By reflecting on the requirements and designs we conclude with challenges for interaction designers to support collocated remembering practices.

Author Keywords

Interaction design; design research; collocated sharing; PhotoUse; design requirements; remembering; storytelling.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

Sharing memories has been an essential part of people's social interaction for millennia. Traditionally, shared remembering and storytelling occur when people are collocated (e.g. [10,15]), 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 use them as support for shared remembering and storytelling [10,36], among other purposes (see e.g. [9,22]). Photos can be instrumental for memory sharing because of their ability to cue memories related to our lives, our autobiographical memories [6,18]. Although autobiographical memory serves several functions in our lives [4], for our research we are interested in the social function of autobiographical memory, e.g., bonding, maintaining relationships and making friends [4].

In the last decades the advances in media capture and media sharing technologies have changed the practices surrounding digital photos (e.g. [10,20,31,34]). 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, and cloud storages. While the practices change, the *purpose* of sharing practices is still primarily to share memories or tell stories [36]. Frohlich et al. made the distinction between these two kinds of conversations: *shared remembering* 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 [10].

In our research, we are interested in the changing practices around digital media for remembering purposes. Although much research was done in the early days of digital photography two decades ago, the tools that are available today for media-supported shared remembering and storytelling still have many limitations. One of the issues, for example, is screen size: smartphones have a limited screen size, making it hard to view content with multiple people at once. Another issue is privacy: people are reluctant to pass their phone or tablet around to share their photos, because of the personal nature of other content on the smartphone. Another issue is access to photo collections: many collections are distributed over several devices and cloud services, and not available at all times. Although storage is getting cheaper, the solid state drives

used in smartphones, tablets, and modern laptops are still expensive, as is consumer cloud storage. Therefore, users often don't have access to their entire collection. Even if they do have everything stored in the cloud, a slow or costly (mobile) internet connection can severely hinder the experience. Last but not least, since most people do not curate their photos, interacting with their collection is mostly limited to scrolling through the entire collection in chronological order, which can ruin the viewing experience for both the sharer and the recipient. Therefore, the objective of our research is to explore spatial and material design directions to *better* support the use of personal photos for collocated shared remembering and storytelling.

RELATED WORK

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

Collocated Remembering

One of the primary purposes of sharing memories is to engage with each other socially. Nelson [27] even argues, that our autobiographical memory system only exists *because* of its function in interpersonal communication. Van House [34] also argues that shared reminiscing reinforces shared past experiences, thus strengthening relationships in the present. Part of shared remembering is the notion of *cross-cueing*, or *interactive cueing* [35], where one person's memory and conversation triggers the memory of others. However, our autobiographical memory can also be triggered by external triggers, also referred to as *memory cues* [17,18,33]. Upon encountering a memory cue, such as a digital photo, our memories are reconstructed [13], and 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. [16]).

Media Tools

Tools to support cueing and remembering are naturally changing along with 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 opportunity to take photos has increased dramatically and therefore also the volumes of photos.

The technologies for photo sharing can be distinguished by their intended purpose. First, tools for managing and organising digital photos (e.g. [20,31]), which are essential for making the right content available for sharing. Secondly, technologies for remote photo sharing (e.g. [8,10,34]). Thirdly, tools that support viewing of photos. For *remote* photo sharing, there are many commercial tools available, such as Whatsapp instant messaging (whatsapp.com), and social platforms like Facebook (facebook.com). There are only a few technologies specifically designed for *collocated* sharing, e.g. streaming devices such as the Apple TV (apple.com/tv), which allow

users to show content from portable devices onto a large (TV) screen. However, generally speaking, all devices with a display and some storage capability can be used to display photos. Although we can use these commercial photo sharing tools, 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. The variety of examples includes *4 Photos* [28], a concept for shared viewing of Facebook content during dinner, and *Shoebox* [2], 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 [30], playful interactions with photographic content [26] and new software solutions that combine several existing devices to create a shared viewing experience [23]. 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. [1,25]). Various commercial tools offer a narrative structure: either automated, e.g. *Stories* in Google Photos (google.com/photos/about), Facebook's *Year in Review* (facebook.com/yearinreview) or more dedicated applications such as ICDL's StoryKit (childrenslibrary.org). These tools show promising directions for storytelling, but they also do not specifically support collocated shared remembering, because they focus on digital devices only, and they are geared towards a single person's activities, their photos and their interaction with the story.

Media Practices

Along with the technology, the practices around photo sharing are changing. In the early days of digital photography, Frohlich et al. [10] investigated the photo sharing activities that take place in the home, with the goal to identify opportunities for new photo technologies, which they termed *Photoware*. There they made a distinction between collocated sharing and remote sharing, and between synchronous and asynchronous sharing. A few years later, Kirk et al. [20] introduced a model outlining common photo activities leading to sharing, called *Photowork*. More recently, Lindley et al. [22] emphasised the influence of technology on social practices surrounding digital photos and vice versa. Moreover, Van House [34] argued that the experience of collocated sharing of photos and stories enacts the relationships between owner and viewer. New photo (sharing) technologies are being adapted by users to support these sharing activities [34] better. Our prior research emphasises that the complex set of practices, which we termed *PhotoUse*, should not be studied or addressed in isolation [5]. The holistic perspective also facilitates the design of tools that support sophisticated experiences such as media supported remembering.

Design Challenge

Despite the efforts in research to innovate the experience of collocated photo sharing, commercial tools have many limitations 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 that are *better* at supporting collocated remembering practices.

In the remainder of this paper, we will outline a redesign exercise with 15 participants that led to design requirements for photo sharing tools, followed by an iterative design process to integrate the requirements into four concepts. We conclude with a discussion on the challenges for designing tools for future media-supported collocated remembering practices and possible ways to address the challenges.

REDESIGN SESSION

To understand the participants' ideas, needs and desires for the future of photo sharing we did a redesign exercise with them, because co-creation methods allow people to express themselves through showing and discussing what they create (e.g. see the work by Sanders and Stappers [32]). We based the redesign method on the method described by Frohlich et al. [11]. They 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.

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. They were all enrolled in different courses (mainly law, business and medicine), none of them STEM or design-related. We recruited participants via a student fraternity. 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.

Procedure

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

Warm-up

The warm-up with the whole group consisted of 15 minutes of introducing the background of the research, followed by 30 minutes of practising 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 had 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 we briefly discussed all of them in the group.

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. The overview of collocated photo sharing scenarios can be found in Table 1. We assigned the first four scenarios to the four groups.

Redesign Exercise

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

Scenario	Example	Redesign
Looking together at photos on a *portable device*	Smartphone, Nintendo DS	Group A
Looking together at photos on a *fixed display*	TV, PC, laptop	Group B
Looking together at photos that are printed in a *paper photo album*	Printed photos in an album, holiday album	Group C
Looking together at photos on a *projection*	Projector	Group D
Looking together at photos on a *tablet*	Tablet	N/A
Putting a photo on the *wall* as decoration	Collage	N/A
Looking at photos in a *photo frame*	Frame with digital or printed photo	N/A
Looking together at *printed photos*	Printed photo, polaroid	N/A

Table 1: Overview of collocated photo sharing scenarios that participants came up with, of which four were redesigned

Data Gathering & Analysis

The group sessions were audio recorded, just as each group 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 our analysis of the recordings, we focussed on identifying the issues for the different areas of interest, primarily the

experience of sharing, but also on other areas such as curation and organising, and technical limitations of the technology. To support the audio, we encouraged participants to write all the aspects of their analyses on post-it notes, which we used afterwards to help generate an overview of the values, issues and opportunities for each collocated photo-sharing scenario. We used selective transcription [12] to gather the data from the audio. We looked for details about specific aspects of the scenarios that the participants talked about, as well as the pros and cons of the tools that were part of these scenarios. We collected the quotes that best described the different discussion points, and we used thematic clustering [7] to identify the themes that persisted between groups.

DESIGN REQUIREMENTS

In this section we will provide an in-depth description of the seven requirements (*R1-R7*) that we were able to formulate after analysing the recordings and notes from each group about the desired *experience of sharing*.

R1. Facilitate Spontaneity

Any tool that supports photo sharing should be simple and quick, to be able to illustrate parts of an on-going conversation spontaneously. 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 group A and B put it:

"People are looking for simple. The simpler, the better" - Group 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" - Group B

Participants especially did not want to boot a laptop just to show a single photo. Even less popular is 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 discussed 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.

R2. On-the-fly Content Control

Privacy is important, and the participants specifically wanted to hide certain photos from certain audiences. Most groups suggested to apply censoring, hiding or locking specific photos to address different audiences. Moreover, most groups agreed that it would be helpful if selecting shared content *on-the-fly* would be possible. Most participants 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 scroll to the next photo themselves, or they give their phone to a friend, who scrolls 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 group B a private queue with "delay" was hence part of the 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. MS PowerPoint presentations.

R3. Seamless Embedding 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 taking digital photos is free, people take multiple snaps to capture a moment, so that they can be sure to have a good one. This creates the need for them to select later the 'best' snap, 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 group B summarised:

"If you want to show a holiday, you want chronology, and no duplicates" - Group B

R4. Tailoring to Audience

Tools for sharing should *tailor* the content to the *audience* because different contexts require different photo selections. Group 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" - Group 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". - Group C

In the group discussion, automated "highlights" of events were mentioned that are offered by e.g. Facebook's *Year in Review*. However, 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.

R5. 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 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". - Group 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" - Group D

R6. Show Photos in Context

Photo sharing tools should provide support for *contextualised* photo viewing. One of the interesting discussions that was especially held in group C covered the aspects of thematic photos. In group C, all participants agreed that the value of the paper photo album was that you can see multiple photos at the same time. The smartphone typically displays a single photo, which does not provide the best support for stories because every photo appears to be as significant as any other.

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

Combining photos with related content to support the narrative is a typical practice when organising a traditional paper-based photo album, but this thematic or contextual aspect is not so much 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. Photo Sharing should be Personal and Intimate

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 is viewed together, in a homely atmosphere. Group C (given the task to redesign the experience of the photo album) was especially keen on ensuring these intimate qualities in the experience.

"It should stay homely, intimate, not become too slick" - Group C.

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 (sitting on the couch together). Group B shared the view of group 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.

Long-standing Design Challenge

Since we selected a convenience sample, we must be careful with generalising our findings from the redesign sessions, especially because of the unbalanced gender and the affinity with technology of this group. However, the requirements that we found all resonate with prior research in this domain: in line with our first requirement on usability, Van House [34] indicated that easy and spontaneous access to content is important, as did [29]. Participants in the study of Van House [34] also requested more flexible control over who sees which photo on online photo sharing services, similar to the desire underneath our second requirement. Bergman et al. [3] also worked on software tools for temporary hiding photos, which they called *demoting*. Our fourth requirement to adapt content to audiences is also in line with Van House, who stressed the importance of flexibility in photo sharing and flexible content as a way to support the performative nature of storytelling [34]. The fact that many valuable findings and requirements from the past decades have not made their way into commercial tools for photo sharing motivated us to investigated 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 iPhone. So much has changed for digital photography. But 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.

DESIGN DIRECTIONS

With our research, we aim to tackle this long-standing design challenge by addressing the user experience requirements, as formulated in the previous section. We used those requirements as input for the development of several concepts that we believe illustrate promising design directions for media-supported collocated remembering.

In an iterative design process (Figure 1), done mainly by the first author, the approximately ten ideas that came directly from the redesign session were matured towards detailed concept sketches in three iterations: I) the seven requirements guided the selection and clustering of early ideas. Some of the concepts also addressed other photography practices besides collocated photo sharing, such as curation and remote sharing, but those were excluded from this paper. II) also in consultation with fellow design researchers, we selected and combined those concepts to get to the four presented here. III) we detailed, described and visualised the four concepts. Because we are interested in holistic solutions for photo practices [5], the concepts are deliberately addressing multiple requirements. Two concepts incorporate more spatial aspects; two concepts incorporate more material aspects into the interaction. In Figure 2 we have mapped the concepts (labelled C1-C4) onto the requirements (R1-R7).
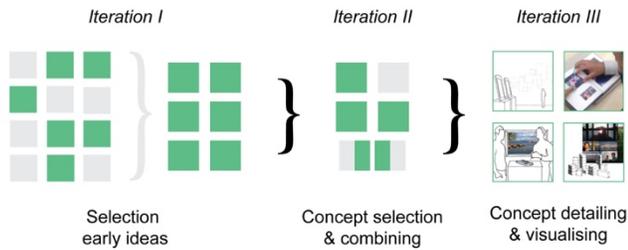
Figure 1: Iterative design process

Figure 2: Mapping of the four concepts on the left (C1-C4) and seven requirements on the top (R1-R7)

C1. Tailored Museum

The goal of *Tailored Museum* (Figure 3) 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 Group 1 and a website that was launched by Intel in 2011, called the *Museum Of Me* (museumofme.intell.com). 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* focusses 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, etc. To support social remembering, the collections of the people that enter together will be *merged* in rooms that show shared life-time 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 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 relevant photos will be enlarged, allowing to review the conversation that emerged in the museum.
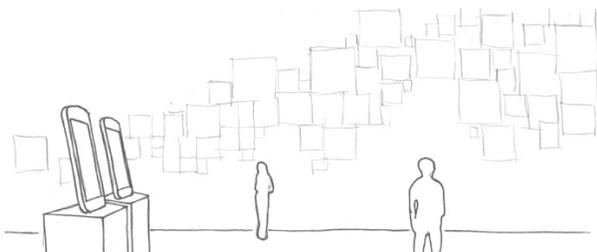
C2. Adaptive Album

Adaptive Album (Figure 4) 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 largely based on the concept that was described by Group 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" - Group 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." - Group 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, you have to trigger content generation via speech. E.g., ask the book for "Holidays with Simon", or "Italy 2015", and the content will appropriate itself to the audience that is facing it, based on face recognition. While viewing the photos, you 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 heavy 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 3: C1. *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

Figure 4: C2. *Adaptive Album*, an interactive paper photo album displaying the combined content of the audience

Figure 5: C3. *Single Share***, a smartphone showing a relevant photo is placed on top of a special dock, and the content is instantly displayed on a large screen**

Figure 6: C4. *Tangible Collaging***, tangible collaborative manipulation of digital content using interactive building blocks**

C3. Single Share

Single Share (Figure 5) is an easy photo sharing device for the home environment. As soon as you lay 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. Very important for the feeling of spontaneous sharing is that you do not need to configure anything and that any phone can be used with the system, setting this concept apart from configuration-intensive systems such as Apple TV.

"You should just put your phone somewhere and be instantly connected, no screen or wall needed, and no cables" - Group 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.

C4. Tangible Collaging

Tangible Collaging (Figure 6) 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 important aspect of the experience because it allows for a playful way to literally build up the story 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.
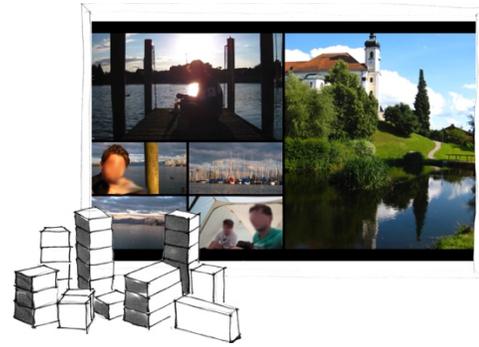
DISCUSSION

None of the concepts have been implemented or evaluated. Rather than developing any one of these ideas into a final prototype, the aim of this study was to step back and reflect on the requirements, ideas and the rationale behind them and to identify general design directions, that will be addressed in future design projects. In this section, we reflect on the implementation of the requirements into the design concepts. In our aim to include as many of the requirements as possible in each of the concepts, we realised that there are some trade-offs that designers need to consider when designing for media-supported collocated remembering.

Digital Experience vs. Physical Experience

Requirement R7 about 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, we do not believe designers should aim at replicating the practices from three 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 [14], a different perspective is needed for designers to reinvent the practices around evolving media collection. We believe a first step is 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 paper we want to illustrate that photo practices can be designed to support new kinds of intimate and personal qualities, based on metadata and other features that are unique for digital photos, allowing 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 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 (C2) or arranging blocks (C4) can limit distraction in collocated communication and even stimulate collaboration.

Digital Overview vs. Device Mobility
In line with research on graspable, tangible and hybrid interfaces (e.g. [19,21]), the goal of the *Tangible Collaging* concept was to bridge the gap between our physical capabilities and our digital possessions. Interacting with printed photos is very different from interacting on-screen with the digital photos [10]. Especially the limited screen size makes it hard to keep a good overview of the collection, and so in *Tangible Collaging* we separated the interaction and the visual representation. Currently, an overview of a complete photo collection can only be achieved by considerably increasing the size of the screen. Many people believe that, because of the digitisation of photo collections, curation will become easier. However, it does not seem feasible yet to provide the user with an appropriate overview of their entire collection.

In all our concepts we explored the use of screens for *displaying* content only, not as an *interface* for overviewing and selecting from large collections. We consider one of the big challenges for designers to find solutions to bring better overview in the digital space, without losing mobility of the devices. Some potential directions for solutions could be small projectors integrated into smartphones. Another solution is to leverage public screens (interactive walls in shopping malls, advertisement screens in the street, etc.) to display personal content temporarily. Augmented-, Virtual- or Mixed Reality technology might be an interesting next step (e.g. Microsoft's HoloLens (microsoft.com/microsoft-hololens/)), as long as designers at the same time innovate existing archiving structures and folder hierarchies, because otherwise, the digital files are as hard to navigate as books in an attic. Another direction for creating a better overview could be to innovate the interaction with digital elements on the screen. E.g., by using smart clustering (based on e.g. visual similarity), overlapping elements, stacked views (similar to e.g. [24]), summarising information, or other ways to manipulate large quantities of information.

Dedicated Tool vs. Multifunctional Device
One of the main threats for media-supported remembering is that digital items are hidden behind the technology on which they are stored [29]. Even a tablet or a smartphone usually needs up to 10 steps before a single 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 immediately started the (sharing) experience. Because of their form factor, tablets and other personal devices can be used for intimate sharing, but there is also a lot of distraction from other functions of the devices, both private and professional, which are not 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, there is a trade-off between a multifunctional device which offers photo viewing alongside other apps, and a dedicated device that needs to be carried, charged, kept up to date and synchronised. We see three directions for possible solutions: 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; c) applications that are capable of dedicating a device temporarily to the task at hand, e.g. unlocking the smartphone in a certain way renders it into a dedicated photo viewer, and none of the other applications or tasks on the smartphone will be able to distract the user for the duration of the activity.

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 photographic content selection to support remembering depends on the social dynamics, context, intentions of participants, etc. But 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.

CONCLUSION
In this paper, we have presented a design exploration into support for collocated remembering practices. Based on a redesign exercise we formulated seven requirements, which guided the development of four concepts to illustrate new directions for media-supported shared remembering. We concluded with a discussion of four trade-offs that surfaced after reflecting on the process. We believe that acknowledging the trade-offs described in this paper can help designers to address the long-standing design challenges and inspire the innovation of new tools for collocated media supported remembering practices.

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