

# Personal digital archives on mobile phones with MEO

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**Abstract** The multimedia capabilities of mobile phones offer great potential for people to record experiences as digital resources for memories. However, there are a number of challenges around such systems relating to *information overload and the effort to create order*, the *invisibility* of digital resources, and *supporting creativity* and the *(re)constructive nature of memory*. In this article, we report on the *media object* (MEO), a design concept for a new file format and associated research prototypes, for advancing an understanding of how people wish to record experiences with mobile phones. The MEO concept defines a *container structure* that invites the user to populate it with rich media. We report on field evaluations featuring 10 participants using MEO applications up to 28 weeks and reflect on the lessons learnt with the *media object* by referring to the identified challenges. The findings point to issues around creative or deliberate engagement in planning and capturing resources for memories, the cost of doing so and the rewards for those efforts.

**Keywords** Creativity · Design · Digital memory · Mobile phones · Photography · Rich media

## 1 Introduction

These days, people raising their hands and holding small electronic gadgets to trigger camera shutters is a common

sight. This observation is not restricted to some particular countries, say, to the western hemisphere. It has grown into a global phenomenon. Digital cameras have become affordable for many people now and by 2015 2 billion camera phones alone are forecasted to be in use worldwide.<sup>1</sup> Right back in the 1980s, Chalfen realized an exploding number of photographs were being taken and wondered about the cause of such action:

“There are no biological or physical pressures that require these kinds of photographic activities or accumulation of pictures. In contrast to physical survival, it appears that we are exploring a massive, but optional form of symbolic support for our existence and our lives.” [1, p. 15]

One human matter that certainly can be supported by photography is memory [1–3]. As technology matured, additional forms of capturing visual information joined conventional still photography, for example, video or integrated cameras such as mobile phone cameras. These modern mobile phones, in turn, come with a multitude of additional affordances that influence photography and the way we capture the things that are most precious to us.

With the research on hand, we aim to contribute to the knowledge about technology for supporting *digital remembering*. Special focus is on how digital resources for memories can be captured with mobile phones. This decision is motivated by the fact that mobile phones are now widespread and have a number of features that make them ideal devices for capturing experiences, namely video cameras, GPS sensors, large storage capacities, big screens. It is no surprise then that they are regarded as the future

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<sup>1</sup> <http://www.cavp.com/main/public/Content/Press/2011/06.23.2011.html>.

main facilitator in capturing digital life memories, e.g. [4]. However, there are a number of challenges around systems for supporting digital remembering with mobile phones that relate to *information overload* and the *effort to create order*, the *invisibility of digital resources*, and *supporting creativity* and the *(re)constructive nature of memory*, e.g. [5, 6].

To explore and to address these issues in a principled way, we conceptualize the *media object* (MEO)—a new file format for aggregating digital media, with corresponding applications that can capture and replay those files. In particular, MEO aims at helping users create a priori order over their digital content by setting up a *container* and capturing related media into that *container*. MEO's main strategy is based on reversing the conventional process of data capture: the *sorting* comes before the recording (because a specific container is created first and populated afterward) and not—as usual—the other way round. We propose that, enabled by this purposeful shift, the user can be put in a creative or anticipatory frame of mind when capturing digital resources, i.e., when filling their MEO containers. In addition, we further hypothesize that this shift can help the user to create order over his/her photo or media collections.

MEO hence provides a container structure that can be populated with different rich media content, enabling participants (P) to capture experiences with different modalities (e.g., photo, video, and digital crafting) on mobile devices. We also provide them with a way to revisit their digital material. The *media object* is designed for creating records of experiences of any sort, ranging from capturing important moments to mundane facts. (In the course of the article, for brevity, we may talk of *recording memories or souvenirs*, or *memorabilia* but of course recognize that these are in fact just digital resources for remembering.)

The article is structured as follows: We begin with a short review of related work and subsequently introduce the concept of the *media object* and corresponding applications. We then go into more details of the literature, as the design of the *media object* is carefully motivated from previous work. After this, we report on a user study ( $t = 24\text{--}28$  weeks) with the final implementation of MEO featuring 10 participants. Finally, lessons learnt from our research into capturing experiences with mobile phones and implications for future designs are elaborated.

The main contributions of this work come from insights facilitated by instantiating our MEO technology and exposing it to the field for a longer duration of time (up to 28 weeks). As mentioned above, MEO provides a frame for reversing and rethinking the way we achieve digital memorabilia. The study data indicates that a certain subgroup of users might well be ready for capturing resources for memories in a less conventional but more mindful and

engaged fashion. In our study they were prepared to invest originality, effort and also playfulness. In return for such creative and effortful engagement, they received meaningful digital souvenirs that promise to last. In this study, however, the focus is more on how they captured what kind of content and how they experienced this. Evaluating and making a final judgment on the long-term qualities of these digital resources for memory is out of scope for the work on hand.

## 2 Related work

MEO can be seen as digital support for remembering. A common starting point of HCI articles on digital remembering systems is Vannevar Bush's memex [7]. This hypothetical mechanical device is suitable for compressing, storing, and retrieving all sorts of an individual's data such as records, conversations, books. In recent years, many efforts have been made to “fulfill the memex vision” [8, p. 88].

These effectively implemented systems go by many names and have been engineered for partially different but related purposes, going in-line with and beyond the memex agenda. Researchers speak of life-logging [6], digital life memories [4], digital mementos [9, 10], digital memorabilia [11], recording experiences and personal digital archives [12], personal memory systems [ibid], augmented memory systems [13], and technologies for personal remembering [10], to name just a few terms. The systems have been conceptualized inter alia to provide users with resources for reminiscence [14] or reflection [9, 10], to try automatically record an individual's complete life on digital record [8] or to recall simple facts. Lately, systems solely relying on a mechanical archive model have been critiqued [5, 6, 15], and researchers have started building remembering tools based on the psychological understandings of (human) memory. The many names for digital memory listed above demonstrate the high level of interest in this topic in HCI. We see particular potential for mobile technologies and mobile phones to contribute to these efforts. We go on to highlight examples that are conceptually related to MEO or that have inspired MEO.

An often-cited research effort into personal archives is the *Living Memory Box* [12]. “At its very core, the *Living Memory Box* project is about people, their experiences, hopes, dreams, pains, and pleasures—and how we seek to capture these experiences” [12, p. 210]. By doing ethnographic work Stevens et al. elaborate a set of design guidelines that should be considered when designing systems for remembering. A paper that refers to the *Living Memory Box* looks into a device called *Family Archive* [11]. This is a technology probe for studying (digital)

archiving practices of families regarding sentimental memorabilia. *Memory Lane* [9] is to some extent similar to the *Family Archive*, but provides a more predefined frame for organizing digital memorabilia based on psychological research. In contrast to *Memory Lane* where images are inter alia arranged along a digital house, the *Memento* system [14] employs the classic photo album or scrapbook as the reference model for the storage of digital mementos. Here, the motivation is to combine the advantages of the physical world with those of digital tools, namely to have a tangible scrapbook with all the affordances of a real object and the possibility to share, copy, delete, etc. digital content very easily. *Memento* focuses on elderly users and employs its semi-digital scrapbook primarily for reminiscence.

Similar to MEO that we go on to describe in the next section, these latter four works share the aim to support digital remembering in a related way: they provide or conceptualize systems for the digitalization of multiple souvenirs and subsequent storage in some sort of container or aggregate as a personal archive. However, none of them fully exploit the potential of current mobile phones as they rely on custom-made and/or large-sized computing devices. MEO focuses on deliberate manual data capture with regular mobile devices and filling this data into a *container* or *album* defined a priori.

### 3 The media object (MEO)

We use the term *media object* (MEO) for two different but closely related things. First, we speak of MEO by referring to its underlying concept—the idea of aggregating rich media (and arbitrary file types) into a file or container that is defined a priori and having various applications and devices that can capture and replay such files. Second, we also name actual files, i.e., the instances produced by the applications, as *media objects*. When referring to files, we abbreviate them as *mob files* (plural: *mobs*), because the extension of such files is *.mob*.

#### 3.1 Description of MEO's file concept

As described in G ldenpfennig et al. [16], the *media object* can be seen as a novel file format that allows the bundling of a theoretically unlimited number of arbitrary files using XML for organizing the content. We have previously undertaken a short-term evaluation of the MEO concept with an earlier prototype and gathered requirements for advanced implementations [16]. This current article covers the resulting prototypes and focuses on the lessons learnt from a long-term study about the MEO concept with regard to its capabilities for capturing experiences.

A rich variety of media files (e.g., images, video, audio, text or additional *media objects*, i.e., *mob files*) and metadata (ID, date, location, access statistics, etc.) can be stored into one *media object* (*mob file*). The underlying concept of this new file format is to extend traditional media files, for example images, beyond common metadata information such as EXIF while keeping everything in one aggregate. Technically speaking, the *media object* is a container that can wrap any kind of information.

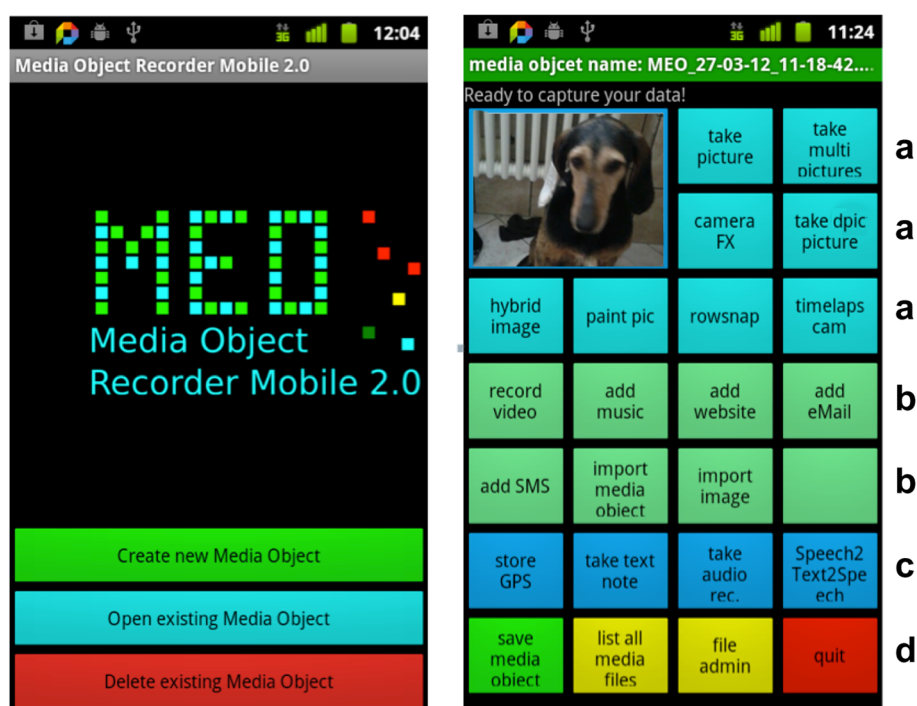
A commercially successful product that is to some degree related to our concept is a commercial platform for *remembering everything* called *Evernote*. Similarly, in 2013 Google introduced a service named *Google Keep* that can be used for taking (audio/text) notes, photos or creating checklists and *keeping* them in one central place. Yet another product that relates to the *media object* concept is the commercially successful micro-blogging platform *Tumblr*. Again, this service allows taking photos, video, and text notes, etc. and representing them as associated data or blog entries. Moreover, there are standards such as MPEG-7 that share common aspects with MEO and which also employ XML to describe multimedia material. However, the focus of this paper was not the technical implementation of MEO per se, but the way people make use of MEO and capture such *mob files*. The special feature of MEO is that it provides a container that exists a priori for data capture unlike, for example, conventional folders that are created mostly after data capture. Consequently, the users have to decide what (multimedia) data to fill into that *mob container* and are invited to populate it with their digital resources. Thus, MEO so-to-speak reverses the conventional way of archiving and provides a frame for rethinking the procedure of creating digital memorabilia. The users become the deliberate engineers of their future *digital memories*, which one day will hopefully become precious to them.

#### 3.2 Description of MEO software and MEO hardware

We go on here to briefly describe the features of the software and hardware that was created as prototypes of this study. In the subsequent section, the design rationale of these prototypes is further detailed.

We instantiated this MEO concept via two iterations into software and hardware components for *Android* phones enabling capture and replay: *mobRecMobile* (capture, 1st iteration, reported in [16]), *SimpleMobView* (replay, 1st iteration, reported in [16]), *Media Object Recorder Mobile 2.0* (MRM2, capture, 2nd iteration) and *Mobbox* (replay, 2nd iteration). MRM2 and Mobbox are the focus of this article. The MEO-capturing software (MRM2) enables the user to collect data and to store it into *media object* files. These *mob files* are saved to SD

**Fig. 1** Interface of the *Media Object Recorder Mobile 2.0* (MRM2): (left) new, delete, or load a mob file; (right, rows a–d) main screen with all options for data capture. All tiles are visible at once, because we try to avoid a hierarchy between different functions and aim to inspire the user to capture a moment with different modalities



card or to internal phone memory and can be transferred to a desktop computer in the same way as other conventional file types (via USB cable), e.g., *JPEG* images. Besides creating and storing *media objects* the user can edit and view existing mob files. Figure 1 shows the interface for MRM2. The concept of using tiles for displaying options is motivated by the outcome of the pre-study [16] and also reflects current trends in the software industry (e.g., *Windows 8 tiles*). In this pre-study [16] participants appreciated having all options visible at the same time as being inspiring. In addition, for the MRM2 study, we did not want to prioritize some functions over others by assigning better/worse visibility enforced by some hierarchy. The MRM2 interface is used to:

- Capture a new image/video/audio note/text note/location (GPS) etc. and add it to the current mob file
- Optionally annotate media (associate media data), e.g., add a text note to an image and/or add the GPS position
- List all files contained in the current mob file
- Open and display a specific file contained in the current mob. Play associated content simultaneously (e.g., fade in a text note to a photo or play back an audio note)
- Start a slideshow (Fig. 1 right column, big button top left with last image captured on display, in this instance a dog)

The three options/buttons on the left side of Fig. 1 are for managing mob files. The buttons on the right side of Fig. 1 are explained below:

- The top three rows (a) are all related to picture taking: *take picture* (regular camera), *take multi picture* (convenient mode for taking series of pictures), *camera FX* (retro camera with image filters), *dpic* (combine two photos), and *hybrid image* (another variant of *dpic*), *paint pic* (draw on a photo), *row snap* (four-parts photo mosaic). The 5 latter apps are more playful in nature and are summarized as *playful photo apps* in Table 3
- The subsequent two rows (b) trigger actions that are not directly related to photography: *record video*, *add music* (MP3 from the phone's memory), *add website* (browse the Internet and add a screenshot of a webpage), *add email*, *add SMS*, *import media object* (add another mob file to the current mob file), *import image* (any image from the phone's memory)
- The buttons of row (c) trigger content capture that can be associated with other content: *store GPS*, *take text note*, *take audio recording*, *Speech2Text2Speech* (dictate a text to be synthesized as an artificial voice)
- Row (d) is for administrative functions

As MRM2 is primarily intended for the recording of mob files, Mobbox was created for playing back those files. Mobboxes are stand-alone devices with a homely design to be placed somewhere on a table, shelf or wall (see Fig. 2). These devices are basically comprised of touch screens (10-inch displays) embedded into wooden frames and can either play a random mob file or the user can select one. Playing back a file means that all images, videos, and other content are displayed sequentially (chronologically) for a





**Fig. 2** Three different instances of Mobbox, put on display in a home setting

couple of seconds. Associated content is displayed at the same time, for instance, music is playing in the background, text notes pop up as image annotations or audio comments are played back. The user can open a browser and choose a specific mob or initiate the playing back of a random mob file by a long touch on the display. A short touch on the screen will show an options menu where specific files can be deleted, annotations and sound can be switched on/off and the speed (time each photo is displayed until the next photo or video is presented) of the slideshow can be set. Now three different Mobboxes have been made (see Fig. 2). The interaction with these boxes was designed to be simple, since the devices are intended for a more passive consumption of mob files that were created beforehand with, for example, MRM2.

#### 4 Design rationale

The approach we took in developing MEO was an iteration between literature-grounded research and feedback on technology probe use. In this section, we briefly detail how the review of the literature and the consideration of four key challenges led to the design of the *media object* concept to support the creation of meaningful resources for memory. These challenges relate to *information overload* and the *effort to create order*, the *invisibility of digital*

*resources*, and *supporting creativity* and the *(re)constructive nature of memory*.

##### 4.1 Information overload and effort to order

A common problem noted in the literature on digital archives is information overload and information being scattered across multiple locations [6, 17, 18]. For instance, in connection with archives for personal remembering, Whittaker et al. [19] identified a couple of factors accounting for their participants' poor performance in retrieving important photos. These comprise: taking too many images, poor organization (on multiple file systems), the inability to maintain collections and an overoptimistic belief in being able to relocate them. This predominant problem of unsorted, lost, scattered and too many digital images led to the primary concept of MEO. Here, the process around capturing photos is reversed. Since the mob file (the container) is created first and the digital material is filled in afterward, we hypothesize that this will result in presorted rich media aggregates and remove the need for later sorting.

##### 4.2 The invisibility of digital resources

A drawback of digital souvenirs compared to their physical counterparts is that they are perceived more and often as *invisible* [5]. Recent work has highlighted the importance of *providing the virtual a physical home* to know where these materials are and to have quick access [20]. While our software (MRM2) is designed in particular for capturing data on mobile phones, display can be on any device. This opens up the possibility to comply with a specific recommendation for designers of digital memory systems: to move away from the PC [12]. For this particular purpose, we designed dedicated Mobboxes (see Fig. 2), which should aid the user in revisiting and narrating their memories. These Mobboxes constitute some sort of physical complement to the digital mob files and play multimodal slideshows (photo, video, accompanying audio comments, etc.) without the need to prepare (e.g., assemble a set of images) such a slideshow in advance, as needed with digital photo frames; the MEO concept eliminates this work.

##### 4.3 Enable and encourage creativity

MEO aims at encouraging creativity, however, we use this notion to describe two distinct things here. Firstly, a creative act can denote *constructive* activities such as setting up folders, organizing photos or even bringing old memories back to mind—things are (re-)created, moments are captured and memories are reconstructed (see next section for details). Secondly, the term *creativity* can also be used

in a more artistic sense. For instance, there might be a lot of originality and engagement in the way people are using their camera to capture a moment [2]. Relating to this, within our work here we also understand *creative engagement* as taking the time and making an effort in fulfilling an action. We hypothesize that having to create a mob container a priori can put users into an anticipatory frame of mind since this is inviting them to plan their digital souvenirs beforehand. Further, this may also trigger more active creative/artistic engagement with how the material is gathered. To this end, MRM2 offers the user a variety of different choices, i.e., a variety of integrated apps or functions (see Fig. 1) that allow for the creation of *digital time capsules* (a set of souvenirs to be unpacked some day in the future [15]) and for supporting other sorts of creative self-expression and digital crafting if demanded.

#### 4.4 The (re-)creation of memory and retrieval cues

This leads to the next point relating creativity and memory cues. The predominant understanding in psychology is that memories have to be re-created by means of retrieval cues [13, 22] and that successful recall depends heavily on our access to appropriate memory cues [22]. In HCI literature, van den Hoven was among the first authors to emphasize that it is not memories that can be stored to disk, it is retrieval cues for recreating that experience:

“A cue (or trigger) is a stimulus that can help someone to retrieve information from long-term memory, but only if this cue is related to the to-be-retrieved memory. The stimuli most often used in studies are photos, smells or text labels. But anything could be a cue [...], as long as there is a link between the cue and the to-be-remembered event. A combination of cues increases the chance of retrieving a memory [...].” [13, p.435]

Regarding MEO and MRM2 our aim in the longer term is that the various integrated options of capturing digital memory cues will not only support the users in their self-expressiveness but also that the different modalities and the resulting rich *media objects* can serve as appropriate memory cues. To this end, we also assess the participants' judgment on the potential of the mobs as cues in the course of the study.

As already mentioned, it is not the goal of our prototype to (automatically) capture excessive repositories with cue data. Rather, we seek to slow the users down a bit and invite them to carefully plan and design their mob files that may then become useful resources for memories. Finally, these resources might then *be used by the human brain one day* to reassemble and reconstruct memories.

**Table 1** Participants involved in the evaluation of MEO: weeks participating in the pre-study (study 1 [16]) and/or long-term study (study 2); number of mob files created (also divided between studies) and number of media files contained in these mobs

P	Sex	Duration study 1/2 (weeks)	Study 1		Study 2	
			n mobs	Σ files	n mobs	Σ files
1	F	5/28**	15	226	21	621
2	F	5/28**	8	71	12	186
3	F	5/3*	22	77	3	10
4	M	2/28**	7	26	30	118
5	M	2/5*	6	36	4	20
6	M	-/24	–	–	28	112
7	M	-/24	–	–	3	27
8	M	-/24	–	–	30	449
9	M	-/24	–	–	7	210
10	F	-/24	–	–	11	175
11	M	2/–	3	10	–	–
12	M	2/–	5	36	–	–

Key: \* ...participant dropped out, \*\* ...participant provided with a Mobbox after 24 weeks

## 5 Study

The MEO applications were evaluated within 2 user studies: a short-term pre-study [16] for testing the first prototype (*mobRecMobile*) and a long-term study for an in-depth evaluation of the MEO concept. The pre-study [16] ( $t = 2\text{--}5$  weeks) involved 7 participants (P1–P5, P11, P12) and the user feedback encouraged us to create new software (MRM2) and devices (the Mobboxes). For MRM2, we added inter alia 14 new integrated apps or functions to the existing 5 integrated apps for capturing data. This was given to 10 participants (P1–P10) who were recruited for a long-term evaluation ( $t = 24\text{--}28$  weeks). As depicted in Table 1, 5 users participated in both the pre- and long-term study (P1–P5). We targeted young users (in their 20 and 30 s) who were already familiar with mobile phones and shared an interest in digital photography and recruited such participants from our social networks. Participants signed consent forms and were not remunerated.

This article focuses on the long-term study (though we include data from both studies in Table 1 to show overall use). For the long-term study, every participant (P1–P10) was provided with an *Android Galaxy Nexus* or a *Nexus S* phone, if they did not own a comparable device (P9, P10 had their own high-end *Android* phones). They were asked to use the phones as their primary mobile phone devices. Participants were also provided with our mobile phone application MRM2. They received explanations and demonstrations for how to operate the app. In addition, they

**Table 2** Different categories of mob files ( $n = 149$ )

Category	(Sub)category	$n$ mobs	Percentage
Remembering (reminiscing); $n = 114$ mob files total (~77 %)	(Day) trips	79	~53
	Social/special events	25	~17
	Sentimental collections	10	~7
Recalling (functional, mundane)	Practical collections	10	~7
Experimentation (artistic, playful)	Playful mob files	25	~17

While a number of mobs fit into more than one category, we did single assignments only (to the most evident category)

were shown pictures of the Mobboxes to familiarize them with one particular aspect of the MEO concept, namely that mob files were designed to be replayed on a variety of different devices that could potentially be located or built into the house at any place. In this study, we primarily focus on data captured by means of MRM2. We gave no instructions to the participants except the explanation of the software and allowed them to use it as they wished. We also avoided speaking of memories or souvenirs and named our concept *media object* (and not *memory object*) in order to not provoke biased usage behaviors.

After the duration of 24 weeks, the mob files were collected and analyzed. For this purpose, MRM2 also incorporates an interaction logging mechanism with time stamps. The mob files were iteratively inspected by the researchers and categorized across salient reoccurring topics (see Table 2) following a thematic analysis approach [23]. Participants were also interviewed about how they experienced our software; the talks were audiotaped, transcribed, and analyzed by the researchers. For analysis, the transcripts were repeatedly read by the researchers looking for common themes (also using the thematic analysis approach [23] as a guideline) or salient statements/observations. Each mob file was later assigned to one category only (the most evident one, see Table 2); however, multiple assignments to (secondary) categories would have been possible in a number of instances.

During the semi-structured interviews, participants were shown their own mob files on a Mobbox and they talked aloud about the content that they have created. They were allowed to interact freely with the Mobbox. Of particular interest during the interview analysis were questions such as whether they saw value in the MEO concept or not, on what occasions they used the software, whether they had suggestions for improvements. After this first 24 weeks, we also provided 3 voluntary and engaged participants (P1, P2, P4) with the available Mobboxes and let them live with them for an additional 4 weeks. Despite focusing on

MRM2 and mob capture in this study, we wanted to probe the reactions of a small number of interested participants to the Mobbox user experience in order to incorporate this feedback in future work. After these 4 additional weeks, another interview was conducted with each of the 3 voluntary participants on their experience with their Mobboxes.

To sum up, the study was aimed at illuminating the following research questions: Will the participants embrace the *media object* concept, namely to reverse the conventional process of capturing and sorting data? Will the *media object* be helpful for them in creating order over their digital material and do they consider mobs in combination with devices such as Mobboxes to improve the visibility of digital memorabilia? How will they make use of the different possibilities of recording experiences (different modalities such as photo, video, text.) offered by MRM2? Will the participants enjoy crafting their own mob files? Can MEO spur their creative engagement and increase their readiness to invest effort in creating digital resources for memories? Will the participants see a potential in the mob files as memory retrieval cues?

In summary, this is an explorative study on a novel concept attempting to identify opportunities and inspirations for the design of future digital memory systems. While we have designed MRM2 with a view to their potential value for later remembering, our focus here is on capturing digital resources as a first step in this process. Future work will build on this to evaluate the created mob files with regards to their precise quality as memory retrieval cues.

## 6 Findings

In this section, we describe the results of our long-term study. To assess the research questions outlined above, we report in particular how the participants made use of the provided systems, i.e., what kind of *media objects* they created and how they experienced the MEO concept including MRM2 and Mobbox applications. Thus, the focus is on overall usage patterns and feedback from the participants and not on a detailed analysis of specific files, for example, we are not particularly interested in categorizing objects contained within photos, but rather seek to develop a general understanding of MEO usage. For this purpose, we structure the remainder of this section as follows: first, we report on the general acceptance of our software including a brief reflection on MEO usage practices. Second, we turn to opportunities for improvements, focusing particularly on those participants who either dropped out or were not sure whether they would continue using the applications after the study. Third and finally, we

report feedback on features of the MEO concept that highlight its potential in capturing digital resources for remembering. Thereby, we refer to the four design challenges outlined in the design rationale section.

### 6.1 Overall uptake of MEO

Overall 149 mob files comprised of 1,928 media files were captured during the long-term study (see Table 1). According to the participants, most mob files were created as a digital resource for remembering. On many occasions, they used the words *photo* and *memory* almost synonymously throughout the interviews. P2, for example, commented on one of her photos as follows: “I think this is charming. I think this makes a very nice memory for the whole thing.” Thus, we identified two broad types of uses. Firstly, in most instances ( $n = 114/77\%$ ), mob files were about remembering (precious) things/persons/pets/events—mostly in a sense of reminiscing. Secondly, a smaller number ( $n = 35/23\%$ ) of functional (e.g., for recalling mundane facts) or experimental mobs (*playing* with the app, creative engagement etc.) were created. While most mob files ( $n = 104/70\%$ ) were centered on particular *events* (these are primarily for reminiscing and sentimental reasons), a number of mobs ( $n = 20/14\%$ ) were organized around a certain topic or theme. We denote these as *collections*, i.e., mobs that combine media files on a common topic or matter (not necessarily event-related). The following list illustrates exemplary mobs for both event-related mobs and mobs that serve as collections: “a nice walk on a sunny day” (event-related, P6), “my trip to Paris” (event-related, P2), “all about my dog” (collection, P10), “my stone collection” (collection, P1), “graffiti.mob” (collection, P9, see Fig. 3), “all job advertisements from a black board” (collection, P8), and “documentation of a dinner with friends” (combination of event-related mob and collection, P6, see Fig. 4). As can be seen in the last example, these categories are not mutually exclusive. For instance, collections can be used for reminiscing as well.

Table 2 provides a detailed view of all (sub)categories that were derived from the inspection of the mob files and from the participants’ interviews. The most prevalent subcategories comprised mob files of (*day*) *trips* ( $n = 79/53\%$ ), i.e., files recorded during a holiday or journey, and mobs of *social or special events* such as parties ( $n = 25/17\%$ ). In addition, the following subcategories emerged from the data set: *practical collection* of things such as notes about a book ( $n = 10/7\%$ ), *sentimental collections* such as images of cherished physical objects or videos/photos of pets ( $n = 10/7\%$ ), *playful mobs* ( $n = 25/17\%$ ) created for the sake of playing with the app and creative exploration in first line and not for capturing specific content.

The acceptance of the *media object* concept was high among all participants. However, the actual frequency and quality of usage of the technology varied. To reflect this, we characterize the participants into three broad groups: the *mob enthusiasts*, the *undecideds*, and the *mob rejecters*. Before discussing these in more detail, it is useful to note one feature around frequency: as mentioned above, in our study, *media object* turned out to be most appropriate for capturing special events such as weekend trips or, for example, the documentation of a dinner event (see Fig. 4). Consequently, small numbers of captured mobs do not necessarily indicate missing engagement of the participants. In fact, except for rare exceptions, every mob in our sample is comprised of a number of often deliberately captured media files. Due to the tendency to capture events and trips, it is hard to assess a potential novelty effect of MEO, since usage frequency is dependent on the points of time of these events. However, it seemed to be clear from the log data that at least the *mob enthusiast* and many of the *undecideds* were using the app on a regular basis until the very end of the study.

A general observation (derived from the interviews and log files) regarding the MEO usage practices is that the participants adjusted their mob recording usage according to events, i.e., normally they started a new *media object* file, populated it with data, and finalized it whenever the event was finished. Most events did not last longer than 1 or 2 days. When an event took place within another event, for example, the visit of museum during a trip, the minor event (visit to the museum) would be integrated into the more significant or longer event (e.g., the trip). Most of the time participants did not reopen and edit mob files on an event that was already over. An exception is *media objects* that are dedicated to collections (e.g., a collection of stones and minerals). These mobs were opened, edited and closed again and hence grew over the time. However, participants regularly returned to their mob files in order to review them. This was done on various occasions, for example, before going to sleep at night, while waiting for the bus or when showing impressions caught by MRM2 to friends. The participants reported that they usually made use of the automatic slideshow function to replay mobs. In addition, participants stated that they thought that the mob files would eventually become even more interesting and valuable as time passes by.

In the following we will describe the three different user groups (*mob rejecters*, *undecideds*, *mob enthusiasts*). Naturally, for every participant there were things regarding MEO that they liked and other features that they did not appreciate. Still, we use these groups as a reference for moving from more critiqued to more valued features of our software. The group names were chosen in a slightly exaggerated fashion to indicate a certain polarity regarding MRM2 that became apparent during the study.





**Fig. 3** “Graffiti.mob” (excerpt)—a collection of “interesting graffiti” in town (P9)

**Fig. 4** Making a mob about a dinner with friends (P6). *Left column top to bottom:* dish with beans, still image from a video on preparing the sauce, pan at the cooker. *Right side:* putting the ready meal on the table. This mob was created for both remembering as well as a collection since it contains a rigorous documentation of how the meal was prepared



## 6.2 Critique by the mob rejecters and undecideds

The *mob rejecters* (P3, P5, P7) did not use the software continually until the end of the test period. P3 and P5 even dropped out early in the study (in week 3 and 5). Interestingly enough, both participants were also involved in the pre-study and agreed to participate in the long-term study, because they liked mob and were interested to continue using it. However, after only a couple of weeks P3 stated that she was overwhelmed by the newly designed *Android* application that now featured a lot of new options for data capture. She preferred the much simpler software of the pre-study and primarily captured photos and some videos. P3 switched from MRM2 to the native *Android* camera app and took hundreds of photos. According to her, the reason for not using the mob app was that the regular camera app

was faster to open and from a conceptual perspective much simpler (“Touch one button and you are done”, in P3’s words). However, in the end, she regretted that she fell back into her old habit of accumulating a vast number of unsorted or unrelated photos that she found hard to access and make sense of. P5 dropped out of the study, because he was happy with his current photo taking and sorting practices and decided that he did not need new strategies for capturing resources for and getting order over his photos. He was the only participant, who stated that he would always sort and annotate his images after capture and never just dump them into a *DCIM* folder. P5 impressively proved his photo-sorting behavior by giving us a short tour of his well-organized holiday photo collection after the interview. The other extreme is represented by P7, who is also interested in having photos, etc.,

as souvenirs but was not ready to invest any more effort in capturing them besides a quick button touch for releasing the trigger. P7 would then store the images away without revisiting them. For him, the prospect to have the images on disk to maybe one day be able to revisit them was all that counted:

“I have been six weeks in Asia and captured tons of images, which I have never looked at again. I haven’t even sorted them out. Maybe this will happen one day in 10 years when you think: hey this was a cool vacation! - It would be fun to see some pictures. Maybe I will sit down then [and deal with them... Photos] is something of which I think: OK, I do possess them and I can work with them one day later [...]. And doing a mob is even more work than taking a photo.” (P7)

We denote another subset of our participants as *undecided* (P6, P9). While these mob users created quite a number of *media objects* ( $n = 35$ ), their usage frequency was either sporadic or they stated that they would not continue to use our software in its current state after the study. Still, they clearly indicated that they would consider continuing to use it after improvements. Their main criticism centered around the fact that reviewing mob files on the phone was not convenient due to the screen’s size and due to the fact that MRM2 was designed for capturing experiences and not for revisiting them or sharing. (This comment reflects back to an earlier design decision we made to avoid implementing a *Flickr for mobs* to reduce complexity from the study; this would also have required us not only to provide phones but also to provide data contracts including Internet traffic to 10 persons for 24 weeks, which was not feasible.) In addition, the 2 *undecided* participants (P6, P9) stated that they would rather not have all the features of MRM2 on the main screen, but preferred a solution where uncommon buttons were hidden in some sort of menu or secondary screen. Also there appeared to be a need for decreasing the startup time of the software, i.e., participants (P4, P6) wanted a reduction in the time or number of clicks it took until photo capture could begin. P6 suggested, for example, to open MRM2 in camera mode by default and overlay the photo preview with the remaining features of this app. Finally, *undecided* participants requested some sort of mob editor that would allow for easy and convenient editing of existing mob files.

### 6.3 Opportunities afforded by MEO

While there are clearly the improvement opportunities listed above, there were a number of features and characteristics that were still quite appealing to the *undecided users*. This leads to the third subset of participants that we refer to as *mob enthusiasts* (P1, P2, P4, P8, P10). We go on

to highlight why this group enjoyed the software and sometimes even gave *enthusiastic* feedback. The *undecided* or even *mob rejecters* also reported some of the same merits, but we will use examples here taken from the third user group.

#### 6.3.1 Efforts in creating mobs

The participants—in particular the *mob enthusiasts*—showed great interest, passion, and willingness in putting effort into the creation of mob files. However, at least the *mob enthusiasts* did not perceive it as a burden or real work. They acknowledged that creating mobs was more effort than taking regular pictures and a “slower process” (P8). Nevertheless, to them MRM2 still had a “low threshold” for taking it out and using it (P2). While they reported it was more work, they regarded it as well worth the extra effort since they used it to capture important or pleasant events. In addition, all of the participants stated that having the MEO container or folder in the beginning made obsolete the task of later sorting and hence seemed to be a promising solution for getting order over their digital souvenir collections.

#### 6.3.2 Visibility of digital resources enabled by Mobbox, enduring access to user data

P1, P2 and P4, who had access to a Mobbox for a month, reported that it was an appropriate way for “dwelling in the past” (P1) or “sharing experiences with friends” (P2). In P1’s words this was also due to the “permanent presence of the device,” reminding and inviting her to occasionally “just press the button and view a mob file.” The larger form factor was an important advantage over mobile phone screens. Having a device that does not look like regular technology or even like a PC also made the mob files more accessible and helped to “put them into the right mood” (P1) when revisiting memories. All 3 participants reported that they used their Mobbox very frequently during the test period, both alone and with friends.

In the final interviews, when those participants who did not capture a lot of mobs were confronted with a Mobbox that included their own and some prepared demonstration mob files, they regretted not having realized the potential of MEO or having created more mob files.

The fact that a Mobbox automatically plays a kind of slideshow including overlaid annotations was well received by all participants and it reinforced their impression that MEO can in fact save time and effort in preparing resources for memories. In addition, not only did the rich media content give more details, it also made the mobs more attractive to look at compared with regular

slideshows on, for example, digital photo frames or photo albums according to our participants. P9 made the following ironic comment during his play with Mobbox, which highlights one of the reasons why at times (conventionally) captured data tends to become *invisible* because of the work involved to make them *visible*:

“I think the overall concept is great ... the sorting beforehand and so forth ... However, the things and souvenirs that I craft with my premium tools at home are even better than the Mobbox slideshow. They do only have one small drawback: I never finish them and hence they do not actually exist.” (P9)

An important fact that was appreciated by all participants, and that allowed in particular the *enthusiasts* to capture their many mobs without hesitation, was the confidence in having future-proof access to their data. This was because the technical implementation of the container envelope was basically a *ZIP* file, which meant that all mobs could be extracted by a common *ZIP* unpacking program and hence be made *visible* in the future.

### 6.3.3 Creative engagement, freedom of choice and holistic impressions of the moment

The *mob enthusiasts* made extensive use of the different tools provided by MRM2 for capturing digital resources. They repeatedly stated that having all of the tools on display on the main screen spurred their *creativity*, a term often used unprompted by them. These tools encouraged them to capture a situation in new but meaningful ways:

“Often I started a mob by taking a photo and was then inspired to try out something else. This is my playful nature. Also my motivation was to capture not only photos but having other media for the same context as well. Often my motivation was to document intentionally and well. [...]his can give a more eclectic impression later on, a more holistic impression.” (P4)

This participant went on to further reflect on his video-capturing behavior:

“Usually I never do videos. However, when I am doing a mob and I have—say—three images, then I will also do a video, because it is a nice complement and unlike earlier times I can be sure that it will be played back again in the course of revisiting the mob file.” (P4)

Similarly P2 said:

“I try to depict things in a more specific fashion compared to when I only do normal photos. It is the

variety of information...this is one of [MRM2's] most attractive features.” (P2)

She went on to elaborate on one specific feature in more detail (see Fig. 5):

“What I like best is the photo app with the four images in a row and the little time delay. In my opinion it is perfect for capturing a thing and everything that surrounds it. [...] I think its special charm is about being able to see that things belong together albeit you are capturing distinct motifs at a time. I think it is livelier than a normal panorama image. [...] I think precisely because things don't fit together perfectly it is more personal than one of those perfect photos, because I know that I don't take perfect pictures. In my opinion it opens whole new perspectives.” (P2)

MRM2 was also compared to an empty “virtual memory album” (P3) that invites one into fill it with memories (e.g., “A *media object* is like an empty album that is inviting me to fill it [...] and showing me all the tools and possibilities at the same time”, P1). Table 3 shows in detail what kind of media content has been captured. From this distribution, it is obvious that photos were the most important resource during the long-term study. It also shows that a relatively large number of 299 text or audio annotations were added to the files. Still, participants reported that at times they wanted to do more annotations but were not able to, because of the time it took, for example, when they were traveling in a group and needed to keep the pace.

As briefly addressed above, the participants demonstrated creative engagement in different fashions: they showed interest in putting playful and artistic mobs together, they deliberately constructed their resources for memories, and they also took their time in doing so and invested quite some effort. While P7, a *mob rejecter*, noticed that “[MEO] can demand quite some creativity of its users”, the *mob enthusiasts* experienced exactly this feature as a big advantage of the system: “The many different buttons [=different apps] inspire me to be creative in framing the moment that I want to capture”. (P1) Fig. 6 demonstrates how P10 deliberately assembled a mob to capture the holistic impression of a visit to a park.

### 6.3.4 The (re-)construction of memories

Solely the fact that a number of files were bundled into one mob file supported the participants in recreating memories. As would be expected, dedicated and associated annotations, for example, for images, were identified by the participants as potentially good memory cues. However, the awareness alone that a bunch of files belonged together



**Fig. 5** Four instances of *row snap* mosaic images. Each image is comprised of a series of four photos arranged along one line (*row*). *Row snap* is one of the more playful possibilities to capture photos by means of MRM2 and gives photos a *lomographic* appeal



**Table 3** Distribution of mob content by participant (long-term study)

P	Img	Vid	Play	Text	Aud	Mu	Int	GPS
1	478	17	50	42	27	4	2	1
2	131	13	19	9	10	0	0	4
3	8	1	0	0	1	0	0	0
4	35	12	38	10	15	0	1	7
5	10	1	5	2	1	1	0	0
6	57	2	16	4	16	0	0	17
7	5	4	5	11	2	0	0	0
8	409	19	5	5	9	1	1	0
9	85	4	25	90	4	0	2	0
10	105	4	19	38	3	3	3	0
Σ	1,323	77	182	211	88	9	9	29

Key: Img...regular photos, Vid...videos, Play...photos made with a playful photo app, Text...text annotations, Aud...audio annotations, Mu...music, Int...Internet/network content (email, Webpages, SMS), GPS...GPS coordinates

(because they were part of one mob file) and hence were created within the same context stimulated the participants:

“If you have many different memory formats, they can re-assemble much more lively memories. You have various sources of information which cover various aspects ...emotions as well as side

information such as what I have done at this moment or where. The photos or things don’t have to explicitly refer to each other. It is enough that I know that they were intentionally put into the same container together [...]. Knowing all of this again creates images within the head [pauses]. Everything assembles into one colorful memory-aggregate.” (P1)

## 7 Discussion

We have designed a digital capture system for mobile devices named *media object* (MEO), with the longer-term aim of supporting remembering. This concept and corresponding devices allowed us to study the needs, desires, and usage patterns of 10 participants ( $t = 24\text{--}28$  weeks) around capturing digital resources for memories in the field. In particular, the *mob enthusiasts* (5 out of 10 individuals) produced many mob files ( $n = 104$ ) at a constant rate and hence related closely to the MEO concept. The feedback of these 5 participants points to the importance and value of mobile phones for capturing durable digital testimonials of life for some people. We return now to the initial research questions and discuss them in relation to the findings of the field study. We also point out implications for the design of future memory systems as we revisit the research questions.



**Fig. 6** “Schönbrunn-Park.mob” (excerpt, P10)



### 7.1 Will the participants embrace the MEO concept?

As seen in the data set, there was a polarity between users and MEO appears to be something that is not made for everyone or for every occasion. While 5 users strongly embraced the concept, 3 participants either dropped out of the study or did not use the provided phone until the end. However, this polarity can be valuable to us as researchers, since it contains information: It points at features that are especially appreciated and disliked at the same time and highlights aspects of remembering systems that are delicate or hard to design for (see following paragraphs). Van Dijck [3] observes a general tendency of photos no longer being deliberately captured as memories, but being shot to give fast report of experiences to be posted on a social network and soon to be forgotten. We think this goes in parallel with society’s general longing for fast and easy experiences or entertainment and hypothesize that MEO received mixed feedback, because its concept of slowing things down a bit and requiring a priori effort might appear provocative for some people in a time of short-lived smartphone photography, automatic tagging, and life-logging.

### 7.2 Is MEO useful for creating order over digital memorabilia and how effortful is this?

A point that every participant agreed upon (across the *mob rejecters*, *undecided* and *enthusiasts*) was that getting order over digital souvenir collections is an effortful and burdensome process. In addition, all of our users recognized in the end that the MEO concept has the potential to remove

at least some of this burden. Nevertheless, MEO comes at its price. There are certain efforts that also have to be invested in *planning* and creating the mob files. Interestingly, not all of the participants (especially the *mob enthusiasts*) perceived this as a problematic effort. Instead, it was regarded as beneficial in two ways: first, as said before, the digital data get sorted on-the-fly and also keeping everything in one aggregate can assist in making sense of the material compared to having completely loose collections of data. Second, the study data hints that creating such mob content can be a pleasant experience and spur creativity or playfulness or even lead to a more mindful and deliberate data capture. This again could lead to better memory performances, since a more mindful encoding of cues has been shown to result in better memory performances [22].

As we saw with our participants, however, not every user is prepared or willing to make this investment. Let us cite P7 one last time for characterizing an exemplary user for whom MEO might not be a suitable solution:

“To me creating souvenirs is work that I don’t enjoy doing [...]. Yes, you do have all the apps right there and you don’t have to do it afterward. Still, for me it is also work to—say—choose some music and add it to the mob [...]. I think this also involves some sort of creativity. Snapping regular photos is one thing, but assembling a complete mob that is nice and contains good information and that will lead to a good result - ...this also involves creativity. And well, creativity is not really my area of interest.” (P7)

Nevertheless, those who made the investment did by no means regret their decision and it might well be possible that their mobs will even be more valued as time passes by.

One thing that might also be of value for certain groups of users is to integrate mechanisms that deliberately slow them down when capturing memories and result in a more mindful engagement when framing their world. This could lead not only to more valuable, but also to a decreased number of digital materials that is already presorted and hence support tackling the problem of information overload, and to make sense of digital material as well as provide enhanced cues. The mechanism that we have proposed for this purpose is the reversing of the process of data capture, namely creating the container first and then filling it. This mechanism is strongly connected to the concept of the bundling of data and this might be also of value for future memory systems. We assume, pointing at the general laws of Gestalt Psychology that one reason why this worked for our participants is that the human mind cannot help but to make sense of the things that have been seen together and the intentionality entailed in putting these collections together enhances this effect.

### 7.3 Can MEO and in particular the Mobbox increase the visibility of digital data?

As MEO is a file type definition, the technology operates *cross-platform*. This means that any device with corresponding software implemented can interpret mob files. For this purpose, we introduced the Mobboxes as an example of devices for playing mob files. They were perceived positively, since they brought MEO *away from the PC* [12]. Concluding from our observations and participants' feedback, we would like to add to this design recommendation by Stevens et al. [12] that researchers should consider implementing *portable* file designs. This would not bind the user-generated data to particular systems, for example, to the technology probes in [9, 11, 12, 14], but would ensure that digital memories can be played on different devices and are interchangeable. This again would increase the visibility and accessibility of digital resources for memories.

The concept of bundling data into one aggregate also had an influence on the visibility of virtual data. It came along with two interesting side findings: First, from the participants' perspective *media objects* received a *kind of personality*—they talked affectionately about their “Paris.mob” (P2), their “graffiti.mob” (P9, see Fig. 3) or their “dogs.mob” (P10) and so on. This indicates that they closely related to their mob files, in which they invested quite some effort when putting them together. Hence, they created digital souvenirs that they could cherish more than

regular files such as digital photos [21]. Second, we found that people tended to capture different media content than they usually did. In our study, this was primarily video. Participants stated that before MEO they had no big interest in video, because of its bad *visibility* (“Usually I they never look at them again”, in P8's words). With MEO, this was different since they knew that they would revisit the videos again when dealing with their mob files. More common formats (photo) and less frequent modalities (video) were mutually supportive.

Furthermore, designing MEO in a way that mobs can be *unzipped* by regular software turned out to be a wise decision, because participants were not afraid of *locking data* in the mob files. Thus, the likelihood of MEO's long-term visibility or accessibility was increased. This suggests a design guideline, that engineers of digital memory systems should consider a *sustainable* design of their technology that grants the user-independent long-time and secure access to their precious data.

### 7.4 How will the participants make use of the different possibilities to capture data and can this spur creative engagement?

From our observations, it is clear that people are very diverse regarding the way they want to capture their digital souvenirs and this should be taken into account for the design of future systems. This is illustrated, for example, by P2, who considered the fact that mob images were not perfect and highly individual as a great benefit, while P5 decided to switch back to his *DSLR* camera, because it allowed him to capture more brilliant photos. Tables 1 and 3 give further evidence of how differently people adapted the integrated apps or functions of MRM2. Thus, we conclude that certain users can benefit strongly from tools that support their creativity and suggest that designers should consider providing a variety of tools for digital crafting. Interestingly, quite many images ( $n = 182$ ) have been captured with MRM2's built-in *playful* photo apps, for example, with row snap (see Table 3; Fig. 5). Participants repeatedly stated that those apps were suitable for self-expression. In addition, they liked to use them, because this enabled them to draw an easy and playful picture of the past event, i.e., they used them to create mobs that were appealing and accessible and hence recreated a pleasant or enjoyable memory.

As already outlined, some of the participants (especially the mob *enthusiasts*) were ready to invest efforts in the creation of mob files. This kind of deliberate and committed act of creating or building can also be understood as *creative engagement* next to the more artistic or playful actions, described earlier in this section.

### 7.5 Do the participants see a potential in MEO for providing valuable future memory retrieval cues?

According to our participants they saw great potential in MEO for delivering valuable memory cues. During the interviews we also observed them employing the content of the mobs step-by-step (or file-by-file) to reestablish their memory of a certain event and tell us the story of a specific mob file. To put it once more in P1's words: "If you have many different memory formats, they can re-assemble much more lively memories". Thus, despite being out of scope of this study's evaluation, we assume that MEO is able to provide potent memory retrieval cues. Participants also thought that the mob files' value as memory cues will grow, as these files get older.

#### 7.5.1 Broader reflections

We sum up now by reflecting on a number of issues and approaches to digital memory systems that were brought up by MEO and might also be relevant for the design of future remembering technologies. As outlined in the preceding sections, we did not instruct the participants to use the MEO app for any particular purpose. In addition, we carefully chose the name *media object* (instead of, e.g., *memory object*) to have a neutral label and to not suggest any particular types of remembering. Our primary objective therefore was to provide a technology probe (open to the participants' interpretation and appropriation) to support the recording of experiences and to gain insights about the *wicked problem space* of designing for supporting human memory by means of newly available technologies. Our first observation then was, as apparent from the collected data (mobs) and interviews, that the participants' primary use in MEO and its rich sensors/capture capabilities was to capture events (e.g., parties or journeys) and not to record, for example, practical facts. According to them, they created the majority of material for later reminiscing, i.e., revisiting the mob files and re-experiencing the captured moment. At least to the *enthusiasts* and some of the *undecideds*, MEO did particularly well in providing tools for this. This leads to our second observation. The concept of carefully crafting one's mob files, along with the side effect of being slowed down, was highly appreciated by some of our users. This is in-line with recent concepts of *slow technology* and alternative frames to efficiency or productivity in interactive system design that were brought up by the HCI community, e.g. [24]. The deliberate and manual work involved in MEO is to some extent opposed to current automated approaches of life-logging, automated facial extractions, automated semantic processing and tagging, and so on. There seems to be a space for the

crafting of digital materials, creative engagement, and even effortful work in everyday remembering systems besides smart or efficient storage and retrieval algorithms. This was already indicated by the study of Petrelli and colleagues [15], where the participants were willing to invest time and originality in the creation of their *time capsules*. There was also some evidence that this *manual* engagement and investment can *give personality* to virtual materials and make them more cherished, a design challenge that was brought up in the literature only recently [21].

MEO targeted the early phase in the process of creating a rich archive of memory cues, namely when the participants attempted to assemble a holistic impression of the moment. As a number of systems attempt to *get the data set right*, e.g., by automatically adding tags and preparing the digital material for optimal later retrieval (as proposed, e.g., in [5]), MEO tries to *get the focus right* when framing and capturing resources for memories. In future, it will become apparent if this strategy leads to valuable memory retrieval cues; however, earlier research showed that psychological stimulation or activation (e.g., being focused, motivated and interested, filtering irrelevant information, etc.) as demanded by the process of creating mobs leads to better memorization [22]. For the assemblage of the mobs, a blend of tools or apps was necessary, which was adapted by the participants to their own ends. This contrasts to some extent with current approaches in HCI, where remembering systems are often engineered toward one particular purpose, for example, supporting reminiscing or reflecting. Hence, it might be of value to provide remembering tools that are flexible with regards to their end goals. This can also be useful in accounting for another observation made during the study. Our participants differed greatly in the way they captured and wanted to capture experiences. The MEO study indicates that supporting this diversity with regards to digital memory systems might be crucial.

Of great importance to the participants was also, that the mob files could be *unzipped* and thus a durable access to the content was granted. This is related to the (potentially) cross-platform capability offered by the mob files. Taken together this can provide more visibility of the digital materials that otherwise easily can end up locked away on some storage medium or being scattered across multiple incompatible locations [18].

## 8 Summary and future work

MEO revealed a couple of interesting trade-offs between easy capture and presorting. While the *enthusiasts* appreciated the possibilities offered by MRM2 to capture holistic impressions, other participants rejected the idea of



prospectively organizing materials, because it was too much of effort for them and they were not able to anticipate the benefits that mob files will provide in the future. Likewise, there have been certain situations in which capturing a *media object* was not practical even for the *enthusiasts*, for example, when there was a lack of time to record a mob and things had to go very quickly. Nevertheless, when there was a specific event to be recorded or some sort of media collection on a topic to be made, the MEO concept received very good or even enthusiastic feedback from a number of participants.

In our opinion, addressing the needs and wishes of the participants (especially of the *enthusiasts*) for capturing digital resources for memories identified by the MEO study will have a great prospect, because many chances afforded by modern mobile phones for recording meaningful memorabilia are still not fully exploited. The user data highlights a couple of interesting starting points. One of the most interesting future research questions is to investigate how a file type like the *media object* fits into a wider ecosystem of files, that is today scattered all over the Internet. For example, what would users do, if we provided them with a comfortable mob editing software, which allows them to easily integrate data from other sources, for example, files shared by friends over the Internet? What would it be like, if we would automate certain aspects of data recording to populate the *media objects* and to create a fusion of deliberate manual capture and life-logging? As a next step, we plan to further develop the user interface of MRM2 and pick up recent participant feedback. In addition, we want to provide Mobboxes and mobile phones with Internet access to all of the participants, which would allow them to push their mob files directly to the replay devices. We are interested to see how this might be used for the sharing of digital memories and whether it would spur the frequency of mob use. For this purpose, we also began to implement a sharing service called *MobCloud* that is similar to a weblog. Here, mob files can be viewed, shared, and edited. This *MobCloud* can also be a good entry point for integrating Internet content into the mob files.

We also plan to revisit the *media objects* recorded in the course of this study with the participants in the future. As mentioned in the findings section, participants anticipated that these files would become even more valuable as time passes by. Thus, doing a detailed evaluation of the quality of mob files as memory cues will be an interesting endeavor that can be undertaken when these files grow older.

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