# Technology Heirlooms? Considerations for Passing Down and Inheriting Digital Materials

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## ABSTRACT

Material artifacts are passed down as a way of sustaining relationships and family history. However, new issues are emerging as families are increasingly left with the digital remains of their loved ones. We designed three devices to investigate how digital materials might be passed down, lived with and inherited in the future. We conducted in-home interviews with 8 families using the devices to provoke discussion about how technology might support (or complicate) their existing practices. Sessions revealed families desired to treat their archives in ways not fully supported by technology as well as potential tensions that could emerge. Findings are interpreted to detail design considerations for future work in this emerging space.

### Author Keywords

Technology Heirlooms, Memories, Digital Inheritance

### ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

## INTRODUCTION

Material artifacts are passed down across generations of family members as a way of sustaining social relationships and bolstering ideas of shared heritage, history and values. These heirloom objects often offer connections to the past that extend before and potentially beyond the current owner's life. As we live more of our lives "online", it is interesting to ask how digital content will find its place among these physical collections of things that connect us to the past. After all, digital technology makes it possible for people to accumulate vast and diverse digital archives. In the future will children look back over their grandmother's digital photos or Facebook content to explore what her life was like? Will these digital things be passed down the same way as physical things are?


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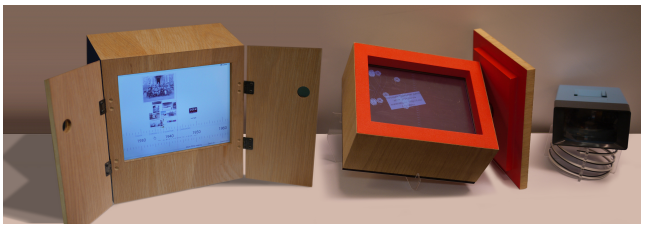

**Figure 1.** The three 'technology heirloom' devices: the Timecard (left), BackupBox (center), and the Digital Slide Viewer (right).

Research in the HCI community has illustrated a diverse range of ways people are drawing on digital objects to reflect on and reminisce about the past [e.g., 14]. Very recent work has described new complications that are emerging as loved ones pass away and leave complex assortments of digital remains for the living to come to terms with [e.g., 16, 19]. Many of these issues point to the fact that we are seeing a proliferation of personally meaningful digital artifacts. However, little work to date has progressed beyond explorations of current practice to explore how these sensitive materials might persist over time, across owners and across generations in the future.

With this in mind, we designed three devices (see Figure 1) as a way of encouraging people to think more concretely about how digital materials might be inherited in the future. The aim was to use these design artifacts to explore how the processes of passing down digital materials among family members might be better supported as well as to reveal potential unintended consequences that could emerge. They are: the *Digital Slide Viewer,* which packages treasured family photo albums in the form factor of a traditional slide viewer; *Timecard*, a device that enables people to assemble, present and hide away digital content of multiple family members along a chronological timeline; and *Backup Box*, which locally stores a person's Twitter archive on a daily basis in a form that can be handed down. We conducted in-home interviews with 8 families, using the devices to provoke discussions about how technology might fit within (or complicate) their practices of inheriting and passing down digital collections in the future. These sessions opened up discussions that provided insights into how families desired to treat their archives in ways not fully supported by technology. They also revealed emergent tensions as members critically considered futures embodied by (and beyond) the devices and reflected on consequences that could emerge. With these findings in mind, this paper concludes with a

discussion of four design considerations aimed at sensitizing the design space toward better supporting the work of inheriting, living with and passing down significant digital materials: designing technologies to be put away; supporting the moral work of safeguarding; enabling multiple roles; and enabling multiple representations in the archive.

## BACKGROUND AND RELATED WORK

Artifacts play important roles as triggers for personal and shared memories. Over time these things signify our relationships with each other and can mediate how people remember their loved ones. The roles material artifacts play in supporting personal and familial memory [2] as well as ideas of family history and heritage [10] have been central concerns across several disciplines in the social sciences and humanities. Currently, there is a growing literature exploring the process of *passing down* objects as not merely reflecting our relationships with loved ones, but in essence *constituting* them over time [6]. A special emphasis has been given to how objects signify human relationships with the living as well as stand in as proxy for the departed [17].

With the increasing presence of digital artifacts and systems in everyday life, the nature of human interactions is shifting—people now commonly mediate between material things and digital technologies. It is not surprising then that research related to the effects of digital artifacts being left behind by departed loved ones is starting to emerge in quite a vital way. Based on an empirical study of bereaved families, Massimi and Baecker [16] speculate on future challenges related to digital inheritance, including: the claiming problem—digital materials lack clear affordances for inheriting, and the afterlifelog problem—reimagining the role of digital materials representing the lives of departed family members could provide opportunities for family members to remember loved ones. In a related study, Odom et al. [19] describe how relationships with the departed loved one continues to evolve, often mediated by inherited objects. It suggests concerns such as supporting the endurance of a cohesive archive and developing richer tools for contextualizing inherited digital content.

More generally, there exists a history of research in the HCI community exploring the recording and archiving personal or family memories. Kaye et al. [13] describe how digital archives could better support the work of self-reflection and understanding. Kirk & Sellen [14] present a values-oriented approach to support the archiving of families' cherished digital materials. Importantly, they highlight how the movement and storage of artifacts around the home plays central roles in preserving them for future generations.

Additionally, several projects [e.g., 8, 24] have designed and studied devices in laboratory environments that, in varying ways, enable families to attribute audio annotations to physical objects and digital photos. These studies speculated that shifting interaction away from the PC and toward dedicated devices may be more appropriate for supporting social practices of storytelling. Outside of the lab environment, Petrelli et al. [21] present a rare example of how reminiscence could be triggered by encasing audio recordings of family events in the form of a vintage FM radio.

Collectively, these strands of research have made important contributions to understanding how interactive technologies could better support digitally capturing family memories and revisiting them. They also reveal how new problems are emerging as members attempt to make sense out of inherited digital content, and consider how they themselves will pass down their digital legacy. Our work attempts to bring these strands of research together. We want to investigate how digital technology might fit within (or complicate) families' existing practices, and how the design space could be critically developed through and sensitized by these understandings. Beyond work that has gone before, we do this by grounding discussion around a set of working prototype devices that aim to make concrete new ideas for dealing with families' growing legacies of data.

## METHODOLOGY

We designed three working devices to critically explore potential future interactions, experiences and practices surrounding the inheritance of digital content. Although these objects offer some diversity in design we synthesized a methodological approach that united them. Specifically, we used them to provoke reflection on the materials themselves and encourage a dialogue about (and beyond) the stances and potential futures they embody. Our methodology drew from a number of approaches, including speculative design [9], critical design [3], reflective design [23], technology probes [12], and design-oriented HCI [5].

The process leading to the development of these devices consisted of the following. We conducted review sessions of theoretical literature and empirical studies (many are noted previously). We then ideated many design concepts and progressively refined and clustered several conceptually related sets to construct an understanding of the overall design space. Comparable to Schön's notion of design as a reflective conversation with materials [22], we engaged in a reflective dialogue with theoretical and empirical materials, and iterative development and critique of the design concepts themselves, to arrive at our final devices.

We intended the form and presentation of each respective device to be resolved to the extent that, at first glance, they might appear relatively familiar in comparison to other domestic artifacts. We wanted the devices' material aesthetics to, on the surface, evoke a sense of the warm qualities associated with antique or heirloom objects (e.g., veneered oak composing an old chest compared to plastics encasing many contemporary appliances). The three devices are designed as a visual family, each encased in a European Oak veneer with a single surface of color. Further, the digital technology of each artifact is integrated into a form characterized by affordances that enable them to be fluidly opened up and

put away. These design choices were influenced in part by prior work illustrating how the qualities of certain materials, such as wood, can inspire a perceived sense of durability [20]; and how the invocation, experience and putting away of inherited objects—digital and physical—appears central in supporting meaningful, self-determined interactions with them [19].

Nonetheless, it is important to point out that the notion of 'designing an heirloom' can seem contradictory. The ways in which an object achieves heirloom status is highly idiosyncratic and heterogeneous; what one family may regard as an heirloom will likely not retain the same meaning for another. Additionally, heirlooms often directly owe to the people that possessed them previously and the material histories inscribed through their use over time.

Thus, it must be stressed quite crucially that we did not aim to evaluate our design concepts *per se*. Indeed, a more traditional 'evaluation' would require a deployment for many years—if not decades—to understand how the devices shaped people's practices and experiences as they accumulated digital content and were (or were not) passed down to another generation. Rather, we used the devices to provoke discussion around—and beyond—the potential futures they might embody and inspire; and to explore issues and insights that emerge through these discussions. Additionally, we populated the devices with digital content from a research team member's personal collection, as opposed to each family's specific content. This team member's digital content captured years of personal and family experiences, as well as materials left behind after the loss of a close elder family member. Nonetheless, this clearly has limitations. The digital materials left behind by, for example, a teenager or middle-aged person would be different. However, this approach did appear effective in providing families with enough context to understand and relate the devices to their own lives, while remaining open enough to encourage them to envision new ideas or uses. In what immediately follows, we describe each of the concepts in turn, and then provide details on our participants and study.

**The Digital Slide Viewer** is a device for the local archiving of different collections of a family's digital photographs (see Figure 2). The device is an augmented vintage analog slide viewer popular in the United Kingdom in the 1970s. Physical slide tokens, laser cut from acrylic, symbolically correspond to photo albums previously stored online or locally by a family. The slides and viewer are stored and organized in an oak case. Each slide has a unique strip of color on its back, which is recognized by a color sensor to determine which album should be made viewable from internal memory. When a slide is inserted, the photos in the corresponding album become viewable, which may be sequentially explored by tilting the device left, to move backward, or right, to move forward, in the set. The digital slide viewer is driven by a Gadgeteer [18] microprocessor board, which several sensors and devices are plugged into, including: a 100x100 pixel display; an SD card (in an internal SD reader) for image storage; an RGB reader for detecting a unique color present on each slide token (to invoke different photo collections); and a breakout board with two tilt sensors for supporting navigation. A mini USB connector powers the device. Content for the photo albums was supplied by a research team member and models their exact organization. These 20 albums cover a diverse range of events over several years, including family trips and moments in a young child's life as well as mundane experiences (e.g., a family informally creating artwork together).

**Figure 2.** From left to right: The viewer in case with the slides; View of a photo; Families often desired to store the slide viewer in spaces where other significant artifacts were kept.

Issues framing the rationale for this concept included: How would the form and presentation of this device be perceived to support or complicate participants' existing practices of viewing family photos, against the backdrop of their own physical and digital albums? How would integrating digital photo albums into an artifact that may already be familiar to some members shape perceptions of these digital materials?

**Timecard** enables family members to construct and present a timeline representing the life of a loved one, which is stored and displayed on a dedicated device (see Figure 3). Timelines can be created for a departed family member as a form of memorial, or simply to map the lives of several family members as a matter of preserving family history. Family members can add digital content (e.g. text, images) to the system via a web interface and backend online service, which is used to transfer content locally to the device. During the upload phase, people are able to attribute specific dates to the content, which dictate where items appear on the timeline. The Timecard case includes doors that enable it to easily be opened up or put away; the touch screen sits behind the doors. It is stand-alone and can sit of a shelf or on display elsewhere in the home. A fanless mini-PC runs the Timecard application displayed on the screen.

**Figure 3.** From left to right: Children from F4 interact with historical metadata; The timeline UI view; Several families placed Timecard (closed up) on display with other things in the home.

Photos can randomly cycle in full screen mode. Touching a photo brings up a timeline view of all the images of a person chronologically; the timeline (and collated content) can

then be explored via the touchscreen. In addition to personal annotations, family members can attribute metadata of historical events (scraped from Wikipedia) to the timeline to help better contextualize the life and times of an ancestor. We speculated this design choice might make the life stages of different ancestors more meaningful for future generations. A research team member that had recently experienced the loss of an elder close family member provided the content Timecard presented in this study. This included physical objects and photos that he had been bequeathed (which were later scanned), as well as photos over the years that depicted the member in different life stages.

Issues framing the rationale for this concept included: How might technologies fit within, extend or complicate families' practices of remembering and commemorating the lives of loved ones? How could these narratives be passed down and how could chronology affect these practices? We were also interested in where families perceived they would keep an artifact like this in their home and how it would be treated considering its potentially sensitive nature. For example, would enabling content to be made public shape perceptions of its placement in storytelling practices?

**BackupBox** is a digital store of a lifetime of Tweets posted to the micro-blogging website Twitter.com (see figure 4). Through a WIFI connection, it copies messages from the internet to a self-contained hard drive. There they are preserved for a future time when they might be drawn on as a resource to revisit the mundane and extraordinary moments of a family member's life captured by their Twitter account. We selected Twitter in contrast to other social media accounts (e.g., Facebook) as we speculated the 140 character limit for each entry would produce more concise and easily accessible entries. However, during the study participants speculated on how their own digital materials (e.g., Facebook content) might relate to—and extend beyond—the BackupBox concept, which we will discuss in detail later.

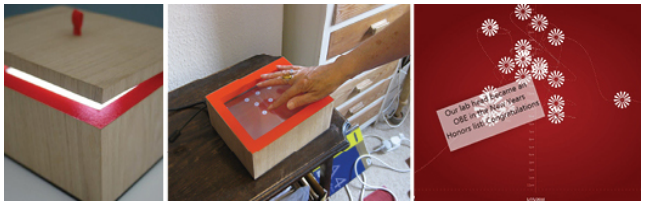

**Figure 4.** From left to right: The removable lid; Mom2 presses a icon to open a Tweet; UI design for an opened Tweet.

The physical form consists of a box with a removable lid, intended to conceal the growing archive of digital materials so as to not attract attention, while still inviting exploration if a family member chooses to open it up. The user interface presents Tweets in chronological order along the X axis; the Y axis indicates the time of day each Tweet was posted. The interface is navigated via a touch screen and each Tweet item in the timeline is symbolically represented as a non-descript flower; touching a specific element will present the contents of the message. A fanless mini-PC runs the BackupBox application displayed on the screen. Considering the potentially sensitive nature of some messages, we speculated this design choice could provide an additional layer of comfort by requiring people to physically invoke the content beyond just removing the lid. The Twitter content on BackupBox at the time of the study was archived from nine months of the device routinely backing up one of our research team members' Twitter account.

Issues framing the rationale for this concept included: Would the BackupBox surface tensions around the processes of passing down personal digital content that is created and stored online? Would family members perceive a physical instantiation of a digital service to be valuable? Would family members perceive social media content, such as Twitter data, to be similar or different to existing perceptions of materials to be passed down in a family archive?

### Participants and Data Analysis

We recruited 8 families (F1-F8) from the southeastern region of the United Kingdom to participate in our study. This approach clearly has limitations; for example, it makes the results hard to generalize to another population of users. However, we wanted to focus on a specific group to gain a richer descriptive understanding of the space as a whole to inform what might be salient issues for future research. Two parents from each family participated (with the exception of (F5); only the mother participated). All families had at least 1 child; F2, F4, F5, F6 and F8 all had young or teenage children, all of whom participated in the study. F1, F3 and F7 had children in their early to mid-twenties which all lived outside of the parents' home; 4 out of 5 of these young adults participated. Three families (F1, F6, F7) had members representing two generations that participated (i.e. children and parents); the remainder had members representing three generations that took part in the study (i.e. children, parents and grandparents). 5 of the 8 families had experienced the loss of at least one grandparent in the past 5 years; all inherited objects from these experiences. In total 36 people participated in the study—15 children (ages ranging from 9-25), 15 parents (mid 30s-early 50s), and 6 grandparents (late 60s-late 70s). The occupations of parents ranged from schoolteacher to IT consultant to plumber; occupations of non-student children included sales attendant, law clerk, and barista; all grandparents were retired. We recruited this participant pool as they could offer a range of experiences with physical and digital objects.

All interviews were conducted at the parents' home, where family members collectively convened prior to the interview. The choice of the parents' home appeared most appropriate as they typically housed an assortment of artifacts ranging from heirlooms that had been passed down over at least one generation, to objects that were anticipated to be passed down to their children. One home visit was conducted per family and lasted between 2 to 3 hours. Visits began with parents (at times together with grandparents

and/or children) giving us a tour of their home, with emphasis on where they kept heirlooms or objects that might become heirlooms. They were asked to describe stories associated with these artifacts, how they were received, who is responsible for them, and reasons for keeping them in particular spaces. We also explored if members possessed digital collections they desired to hold onto (and potentially pass down), and where they were kept. We then asked members to gather a selection of artifacts emerging in the tour and to arrange them in a central room in the home. This was to provide a rich backdrop of participants' possessions that could serve as a basis for comparison when exploring the devices.

All participating members then reconvened in the central room (often living room or kitchen). We conducted a brief discussion to clarify experiences surrounding the artifacts arranged in the room. We then began sessions using the devices. We were careful to make clear that all the devices are concepts to be used as starting points for discussion about and beyond them; family members were encouraged to envision what they would (or would not) want them to be. One device was introduced at a time, and each had a specific semi-structured session conducted with it. However, members were free to go between devices if desired. For each device, researchers offered a short narrative providing background context, illustrating how it could be interacted with in the process. These introductions were kept brief. Emphasis was placed on family members exploring the device and coming to their own interpretations of it; they were encouraged to imagine what kind of future each device projects and consider what that would be like.

At appropriate moments during sessions of exploration and discussion, we posed open-ended questions. Questions were designed to critically elicit reflections on topics including: how narratives persist with personal artifacts as they are passed down; how and when cherished objects are used; what kind of family 'image' they construct; how physical and digital archives are maintained and how the social roles of members surrounding their care may change; and where they will go when they are passed down. Members were asked to contrast their descriptions with how the device might or might not fit within their practices. We altered the order devices were introduced to families across the study. After all devices had been discussed, we asked members to take us on another tour of their home, this time considering where they would keep them in their home and why.

All interviews were audio recorded, which resulted in nearly 20 hours of recordings; photographs were additionally taken to document objects and spaces discussed during the interview. We listened to recordings and transcribed segments relevant to heirlooms and interview questions (as opposed to general chat), which were organized into themes. Meetings were held with the research team to discuss and corroborate emergent themes; we coded the textual documents using these themes. In addition, we created affinity diagrams using sticky notes to order findings across families and reveal unexpected connections.

## FINDINGS

In what follows, we present several examples taken from field observations with families, which we feel capture the core themes emerging across our interviews. We refer to participants by their role — GF (Grandfather), GM (Grandmother) Mom, Dad, S (Son), D (Daughter) — followed by a number indicating the family. In the case of children, the reference includes a second number indicating the child's age. For example D4-13 would stand for a 13-years-old daughter from family 4.

**Figure 5.** Family members interacting with the Technology Heirlooms during in home interview sessions.

### The storage and safekeeping of family heirlooms

Interviews in families' homes revealed a diverse range of material and digital artifacts members kept and desired to pass down. In what follows, we first describe families' perceptions of their material heirlooms and their digital collections. We then detail how families drew on the devices to envision alternatives to better support their practices.

Despite representing some of their most valued possessions, families commonly described 'using' their heirlooms infrequently, at times several years lapsing in between these instances. It was also common for families to clearly differentiate heirlooms from other domestic objects: "*We don't use them like you'd use a* [television] *remote. …Their purpose is something bigger.*" (Mom3). Instead, practices surrounding heirlooms were bound up with having them present and ensuring their safekeeping. Dad1 describes an album containing photos and memorabilia of his family's ancestors: "*we rarely go back to them. …it's having that peace of mind that they're there* [motioning to bookshelf] *and we'll see to it that they're there until it's time for my kids to take them.*"

Safekeeping was understood as occurring across generations and was bound up with the passing on of items. In

some cases, older members preemptively passed down heirlooms to ensure their transfer to the next generation: "*...making sure* [they] *make it through time, that feels as important as the things themselves. ...telling my daughter what they mean, the people they represent, while she has them, that's going to help them last*" (GM5). Similar to their material heirlooms, families sought to safeguard treasured digital collections for future generations. These included things such as: digital photos, videos, documents, and to some extent, artworks and music.

Various tensions were bound up with the notion of safeguarding digital collections, however, especially relating to practices surrounding their backing up. For example, it was a common strategy for families to use external hard drives to back up their digital collections. However, in some cases the extra task (and hassle) of updating a secondary storage location led to the external hard drive being routinely neglected. In others, families described a general distrust over the longevity of their personal computers, which led them to create extensive backups on physical media (e.g., CDs or DVDs). Tensions also emerged with this approach, namely due to doubts over how long these media would last and the physical space their storage required. Other concerns included the potential to lose the physical media: "*the problem with CDs is if we lose one ... we'd lose a whole a chapter of the kids growing up*" (Dad8); as well as concerns that the aesthetics of physical media failed to convey the preciousness of the content. As Mom7 put it: "*they deserve better than that.*"

The use of online services to store digital family collections is an alternative to creating local backups, and members from all families reported using photo sharing services (e.g. Facebook, Flickr) or email to share select family photos with specific people to varying extents. However, these services were viewed as supporting *sharing* rather than the *safekeeping* of sentimental content: "*We put things online to share them, not to preserve them. ...all our intimate* [digital] *memories, we want to know where they are, keep them in order. ...the thought of them being where someone could get at them. That makes us uneasy*" (Dad6). Parents in two families (F4, F7) maintained accounts through the cloud storage service dropbox.com, and similar concerns also emerged: "*I'll put things for my work or my music in dropbox, but I wouldn't put anything too valuable to us there. What if our account was hacked or deleted? ...it feels too risky*" (Dad7). When possible, we probed teenagers' perceptions of storing content online. They typically reported fewer immediate reservations about hosting personal content online, but tended to react strongly against integrating their own digital content into family collections.

Unexpectedly, some families drew on the physical forms of Timecard and, especially, BackupBox to propose alternatives that might help alleviate some of tensions mentioned above. While these ideas varied, they were united insofar as they proposed that a storage system distributed among people was an appropriate way to preserve familial content. Consider Dad4's reflection: "*my brother, my wife's brother. ...they would be the guardian of our kids if we passed away. We'd do the same for them. ...it makes sense that they could guard our* [digital] *things and we could do the same. ...So if one of our homes burned down or our thing* [i.e. device] *died, there'd still be one or two copies out there, like at my brother's or at Mum's place. Same would go for them.*"

Dad4's reflection captures how some families drew on the devices to propose potential uses of technology that might better support their desires to safely preserve precious digital archives over time.

**Embodied digital forms: settling in and setting the tone**

The embodiment of digital content in physical forms conveyed through our devices provoked discussions across home visits. Below we detail how families saw ways in which physical properties might enable them to treat, relate to and live with sentimental digital content.

A primary theme across interviews centered on how capturing digital family archives in forms distinct from the computer might both project and engender a deeper sense of care for these materials: "*Putting our family photos and videos and all in a different folder* [on our computer] *doesn't do them justice. There is so much on* [our computer] *that we won't give a toss about in a year. ...our photos, videos, that's the bit that matters. ……*[The devices] *get away from all the clutter. ...they show you care and makes you want to care for them, tend to them*" (Mom3). GM5 similarly noted, "*there's something about being able to say 'what's important, it's all in here' and pick it up, give it to someone or keep it in a special place that suits it.*" Other families speculated on potential benefits of storing digital content in domestic spaces populated by their treasured material things. For example, when considering where the Digital Slide Viewer would be stored in their home, F1 selected a small living room cupboard that housed several sentimental items: "*...having it packed up next to the Chinese boards and albums and medals. ... seeing it age with them, the things we'll always have. It feels right. ...we want to hold onto our* [digital] *family photos like those things I suppose. Putting it there makes it feel like it's findings its place. ..with our things, in our home*" (Mom1).

Four of the eight families (F3, F5, F6, F8) we interviewed possessed only a single computer, all of which were desktops set up in home office or kitchen locations. These families in particular reflected on how moving their sentimental digital archives to other domestic places could better prime interactions with them: "*we have this chest. …It has little trinkets and bits and bobs that we've saved over the years, some old stuff from me Mum. ...this is where it* [Digital Slide Viewer] *should go. Opening* [the chest], *seeing those things and bringing out the* [digital] *slide box, that'd be a more natural way of coming to them* [photos] *than booting up the computer*" (Dad6). Mom6 then continued: "*We've*

*got this habit about the chest. When we get into it, it sets a tone. It's time to take a moment and look through them. …having it* [Digital Slide Viewer] *in the chest, it'd blend right in. …with what we're already doing and the things that've always been there.*" Mom8 contrasts Timecard's location in her living room with the home office-based computer: "*I don't walk by our computer in the office and think of the memories that're on it. …This feels somewhere in between. …it'd remind me of the memories in there, but if it's closed up, we could walk past it and leave it at that. …That makes it feel like a more complete part of our life.*"

Additionally, the vintage form factor of the Digital Slide Viewer itself appeared to help set the tone for reminiscing about the past. Members of several families recognized its form, which led to discussions about their lives when they last used one. After one such discussion with her son and granddaughter, GM2 noted: "*seeing something familiar from the past, it triggers all these memories and associations I haven't thought about in a while. …it feels like a real way of starting to get back to the past and remember it, with the photos and all.*" Often younger members were actively included in these discussions as the device was passed around; in some cases, they initiated discussions themselves: "D4-13: *Mummy you had one of these. Is this what you used to look at pictures?* M4: *Yes I did. It was* [grandmother's]*, she can tell you where she got it from*."

Collectively, this sample of reflections helps illustrate how giving digital collections physical properties might better support the dynamics of living with them over time, from intentional engagement to simply letting them persist among other significant domestic possessions and spaces.

#### Curating, Integrating and Changing Roles

Families adopted several practices to construct a meaningful whole out of collections of heterogeneous artifacts they desired to pass down. In what follows, we provide an overview of these practices, before detailing how Timecard in particular provoked discussions about potential benefits and complications technology might present in this context.

A common practice we observed across families was the use of notes and other materials to explicitly detail the history of family artifacts to preserve their meanings. These instances ranged from Dad2's collection of his great grandfather's medals and other artifacts from World War One, to Mom6's scrapbook owing to her own life as well as to several departed ancestors. Across these examples, family members included short notes and, at times, materials detailing local and historical events occurring when specific artifacts were in use to help communicate their significance to future generations.

It was also common for families to consciously prune collections of important physical materials to avoid creating an archive of undesirable size and scale, and to underpin a sense of coherence. We found both parents and grandparents engaged in this practice and while at times difficult, it was considered an essential part of ensuring cherished familial artifacts made it to the next generation.

However, the constraints families imposed on their material archives did not always translate to their digital collections. Mom5 contrasts her family's physical photo albums with their digital collections: "*With the* [physical] *albums we have to decide what to put in there and what's not quite worth it. …On our computer they pile up. We have so many photos on there now and we keep taking more. …It starts to feel endless, really.*" In two cases (F5, F6), families elected to print out physical copies of digital photos and integrate them into physical albums, to make them easier to manage and pass down. However, when posed with the question of how (or if) families would wish to cull their digital collections for the future, most members were ambivalent.

While archives of material things supported heterogeneity in a way that digital archives did not, they were typically associated with one branch of a family. Discussions of Timecard highlighted that having a place to collate content from multiple sources would also be desirable: "*…thinking about when my Dad passed away. I have some digital photos of him and my sister does, and we both have some of his things. …If we were able to put some of them* [digital things] *together, when we're feeling up to it, that would be meaningful. …We could have something celebrating his life, and us with him"* (Dad7). Mom1 speculated on the potential benefits of distributed curation of sensitive digital materials over time: "*having a place where my brother could add an event in one of our parent's lives and I could leave it for a while, and then add something. …let things come out slowly over time, that would be valuable. …it would create a new record of our family.*"

Digital archives were also noted for supporting collaboration within nuclear families. However, this also raised concerns. Some families perceived that this could complicate meaning: "*If everyone is putting in things like moments in history or notes about a person, it's going to make things confusing. There has to be some kind of quality control*" (Dad1). Timecard triggered other families to consider how social roles of members would be supported: "*We* [parents] *take most of the responsibility for preserving things about our parents' lives and our lives with the kids. …I like how we could all see it and add to it. That is useful for everyone. But we* [parents] *need to be able to make sure it doesn't become a mess*" (Mom6).

In some cases Timecard triggered intergenerational discussions among living family members in the room about past experiences and family history. For example, after interacting with a metadata tag relating to the date of India's independence (15 August 1947), D4-13 felt prompted to ask her Grandmother about her life during this time period. After describing what her life was like as a young girl then, GM4 reflected on what she remembered of her father immediately following World War II. At the conclusion of GM4's story, Dad4 remarked: "*well, that's a bit of our family his-*

*tory I haven't heard. I wish we could've recorded* [it] *in this box* [Timecard]*, right then and there.*" Dad4 highlights the potential value of capturing emergent conversations about family members' own lives; this opens a space to consider how such records could make interactions with the device richer in the future.

However, some discussion emerged about how perceptions of past experiences can shift over time and how technology could pose challenges: "*Even if we remember things from the past the same, the way we feel about them can change. …like if a photo or summit later reminds us of a falling out we had with a relative. We chuck it in the bin to be done with it. …So if I put something in there* [motioning to Timecard]*, I should also be able to take it out*" (S3-25). His remarks represent discussions that emerged with the Timecard and the Digital Slide Viewer: the need to take things out of digital archives as fluidly as they are put in.

**Tensions over new digital materials in the family archive**

Our aim with Backup Box was to provoke family members to consider the potential role of social networking data, such as Twitter updates, within family archives. Backup Box was highly contentious across families. Several related kinds of criticism emerged, as we describe.

Several families possessed diaries written by ancestors now considered important parts of the family archive. These diaries tended to contain mundane information (e.g., a list of household chores completed on any given day) with a sprinkling of extraordinary events (e.g., marriage of family member, birth of child). When asked to speculate on similarities and differences among the diaries and Backup Box, family members drew strong distinctions. Dad7's perception of the difference between his father's diaries and social media content is exemplary of members of several families' sentiments: "*when I open one of his diaries and see what he wrote, I know he sat down and thought for a moment, and that feels significant. …with stuff like Twitter, people rattle things off, sometimes without thinking …the intention is different and I suppose that makes a huge difference.*"

Backup Box also raised issues over the potentially vast amounts of social networking content other family members would have to reconcile with. D3-22 prospectively considered what it would be like to receive her brother's social networking archive: "*He posts stuff to Twitter and Facebook literally all of the time. I can't imagine how many updates there would be for one or two years, let alone a decade. How would we deal with that?"* Other participants speculated on how years worth of Twitter data could trap a small amount of meaningful insights from a person's life within a sea of trivial entries, potentially making it difficult to explore or let go of: "*If I got, say, Mum's Twitter. I'm sure there'd be some stuff I'd enjoy seeing, but I'd have no idea how to find it. …I'd probably keep it, but not know what to do*" (D1-21).

When D3-22 concluded reflecting on her brother's social media content (mentioned above), she noted: "*And it's so much about him, but not all that much about us. …or our family.*" This statement captures deeper concerns echoed by members of several families: that social media content is often targeted at different audiences, which could make its place in the family archive controversial. Mom2 describes how this quality could lead to undesirable experiences: "*online it's easy to act* [in] *very different ways to different people. Even I confess to that, and I wouldn't exactly want other people to know about this. …it feels a little scary that we could learn something about someone that maybe we weren't supposed to know, or didn't want to.*" Teenagers in the families we interviewed typically were frequent users of social networking services, and also reacted against the inclusion of their content in the family archive. D6-17 reflects on her personal social media content: "*I could see looking back on it myself, but it would be weird if other people in my family used it to think about me. I'd rather make myself something that would go in it. …something that'd show my family something special about me.*"

Related concerns also emerged around how a device like BackupBox could cause family members to self-censor the social networking content they posted, or paralyze these practices completely. Some families proposed ways to work around these tensions, such as using a special hash tag or a specific application to send updates only to Backup Box.

## DISCUSSION AND DESIGN CONSIDERATIONS

It is clear physical and digital objects hold significant places in families' lives, and that these are envisaged as retaining this significance over time and across generations. A key contribution of our study is to surface insights on how technology might open up new opportunities for passing down and inheriting digital materials, as well as new complications that they could introduce. Our findings reveal a range of ways families desired to treat and live with their significant digital materials. Several of these cases were characterized by their desires to treat these archives differently, integrate them into more appropriate places in the home, and tend to their care and safety. Other instances suggested how technology might better support social practices of creating more cohesive sets of materials to be passed down, creating archives from multiple branches of the family, and documenting conversations that emerge around them. The devices also raise a range of potential consequences that could emerge if careful consideration is not given to new technological interventions. In what follows we present several research and design considerations for the HCI community that emerged from the study.

**Designing technologies to be put away—** Similar to material heirlooms, participants perceived value in supporting the dynamics of living with treasured digital collections, from knowing their location, to tending to their well being, to actively interacting with them. That the physical forms, material qualities and affordances of our devices enabled

them to be packaged away, discretely displayed, or actively explored seemed to resonate with families and some of their existing rituals, practices and values. Reforming digital materials in this way allows them to fit into the wider ecology of archived materials in the home and situates them within a familiar context of artifact-mediated reflecting, remembering and learning about the past. Beyond designing explicitly for 'use', this consideration emphasizes the aesthetics of integrating treasured digital materials into environments as a whole over time, a notion parallel to 'slow technology' [11]. Collectively, these findings suggest that to support more sensitive and nuanced engagement with cherished *digital* familial content requires the artful design of technologies that can be put away, drawn on alongside others, and which evoke rich experiences when interacted with. This is more complex than it sounds; comments about the fractious intrusions of waiting for machines to 'boot up' are indicative of this.

**Supporting the moral work of safeguarding—**Notions of the value of 'deep storage' [14], redolent in our interviews, highlight clear unresolved tensions between digital and physical materials. For example, the encasing of our devices may last 100 years (or longer), while their technological components may last for only 5 years. This highlights the need to design new storage systems that are extremely robust and can handle sporadic use. There are opportunities to explore combined advances in solid-state storage and low power consumption. Although even with hardware innovation it is hard to imagine end users not having to engage with some degree of archive maintenance, as such advances will not resolve significant issues of evolving file format standards and ensuing compatibility issues. We suggest the ritual work of preservation may accommodate issues of safeguarding. Several instances from our findings suggest that tending to material heirlooms is itself a significant act: rituals of care could therefore be appropriated as opportunities for the physical maintenance and updating of these technologies.

While the Cloud offers a technical solution to problems of storage, our findings reveal that knowing *where* one's sensitive digital materials are located is bound to the sense that one is keeping them safe. 'Storing' these kinds of sensitive materials in online places raised concerns, especially in terms of ceding the higher-level social and moral work of safekeeping to a third party service. An approach to safeguarding raised by participants themselves, which lends particularly well to digital technologies (as opposed to physical possessions), is the distribution of storage devices and the (redundant) copying of familial archives across multiple homes and branched families. This would leverage the value of existing social-familial networks and could help alleviate immediate concerns over the loss of cherished content, while supporting the higher-level work of safekeeping content in morally and socially appropriate ways.

**Enabling multiple roles in the archive—**The solution pointed to above would need to be nuanced, however. One of the largest issues our devices provoked families to consider was the various roles members play in maintaining family archives, and how they would be supported in these roles by future technologies. From contributing new materials, to curating collections (organizing and editing etc.), family members play important roles in sustaining the family archive [15]. So while technologies might open up opportunities for mirroring archives across homes, richer combinations would need to be carefully considered.

Families suggested Timecard's indirect, distributed nature could create an opportunity for mapping family history "slowly over time". In other cases it seemed to open the opportunity to support storytelling and the recording of family history. Both of these opportunities potentially illustrate how a digital artifact from the past might accrue value through repeated interaction, and resonate with prior research [8, 24] suggesting the prospect of integrating multiple family perspectives as beneficial.

However, it was clear that family members' approaches to archiving were expected to differ, and this raised concerns over how 'quality control' could be upheld. These issues raise significant questions for future research. How does the architecture of new technology reinforce the moral accountability of access to the content? Who has the right to delete or edit entries? How is this accountability represented in the system? What is the communicative structure that envelops the archive and provision of material within it, and how is this negotiated through technology? Better understanding these concerns seems a crucial part of designing new systems to support the persistence of a family's digital legacy across generations. Research proposing implications for 'forgetting' as a feature in system design [e.g., 1] could be leveraged in future explorations, as could emerging research on multi-lifespan design [7].

**Enabling multiple representations in the archive—**While previous research suggested people desired to pass down their social networking content to other family members [19], families across our study reacted strongly against having a technology like the BackupBox. In particular, these instances highlighted tensions around integrating social networking content from members within the collective family archive. Participants made key distinctions between the thoughtful recording of one's life believed to be reflected in their ancestors' diaries, and their own practices of posting less mindful social networking content targeted at multiple audiences, often outside of the family. These reactions surfaced clear boundaries members had for how they wanted to author their presentation of self within the family archive. Prior work has explored how technology could productively support members in presenting different representations of their selves to each other through novel tools for curating family photo collections [4]. While there are clear differences between curated photos and social net-

working data, this work could be leveraged to further explore how different aspects of unique social bonds between family members could be preserved, while also leaving space for authorship of one's self image in the family archive as a whole.

## CONCLUSION

We designed three devices aimed at provoking families to consider how technology might fit within their practices of inheriting, living with and passing down digital collections in the future. Families' reactions revealed several ways digital materials fall short of supporting the values and practices they associated with physical heirlooms, and highlighted new opportunities for design. While researching in this space is inherently challenging, our methodology provided a way to engage family members in confronting potential benefits and tensions projected by our devices and draw on their own experiences to make sense of possible futures—and envision ideas beyond them. These reactions provided salient points to consider as people increasingly acquire cherished digital collections that they may desire to pass down alongside material heirlooms. Based on these findings we proposed *designing technologies to be put away*, *supporting the moral work of safeguarding*, *enabling multiple roles*, and *enabling multiple representations in the archive* as considerations for future HCI research and practice. Importantly, our devices did not explicitly explore how to address the challenges that the sheer size and scale of meaningful digital content pose as families increasingly amass larger archives. Designing new forms and ways of interacting with massive archives of sentimental materials marks a clear area for future research. Ultimately, we hope this study will inspire future research into how technologies can better support the range of experiences that come with inheriting, living with and passing down treasured digital possessions over time and across generations.

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