Digital Artifacts as Legacy: Exploring the Lifespan and Value of Digital Data

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ABSTRACT
Legacy is the meaningful and complex way in which information, values, and possessions are passed on to others. As digital systems and information become meaningfully parts of people's everyday and social relationships, it is essential to develop new insights about how technology intersects with legacy and inheritance practices. We designed three interactive systems to investigate how digital materials might be passed down in the future. We conducted in-home interviews with ten parents using the systems to provoke discussion about how technology might support or complicate their existing practices. Sessions revealed parents desired to treat their digital information in ways not fully supported by technology. Findings are interpreted to describe design considerations for future work in this emerging space.

Author Keywords
Inheritance; legacy; digital artifacts; design; interviews; technology probes; reflective design; speculative design

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

General Terms
Design

INTRODUCTION

The concept of a legacy is a complex issue involving the creation and dissemination of identity across generations and time. When this concept is applied to individuals, it is comprised of some combination of intangibles, such as life experiences and values, and physical artifacts, such as houses, books, vehicles, and furniture. Though a person's legacy is not exclusively at the discretion of the person to whom it refers, the curation of one's legacy is a way in which individuals can highlight meaningful aspects of their life [38]. Through the transmission of this legacy, a person is given the opportunity for these ideas, possessions, and values to be passed on and considered by future generations.

However, even in the context of this established practice, digital information systems are rapidly changing what comprises the meaningful possessions reflective of a person's life. The artifacts and collections that people own, the media through which information is transmitted, and the ways in which people experience relationships with others are increasingly becoming shaped by interactive technologies and systems [35]. As people share more information online, and form deep attachments to digital data and artifacts, these virtual objects are becoming more deeply integrated into our lives, and subsequently our legacies. Today's children are growing up in a context that places a high value on that which we capture and share digitally [29].

Given these changes, it is critical that we examine how digital artifacts and information are integrated into existing practices related to death, family, and inheritance. Prior related work has explored how people construct value with their virtual possessions [29, 14], the roles technology can play in both death and bereavement [26, 41], and differences in the qualities of virtual and material possessions [28, 25]. Our work builds on these findings through an in-depth examination of how people perceive and consider digital artifacts in the context of their personal legacy, against the backdrop of other material practices and physical heirlooms.

To explore these ideas and ground our own thinking in this emerging space, we designed and developed three fully functional systems to provoke participants to consider how their digital legacies might be treated in the future, and to envision ideas beyond the designs themselves. They include: (1) *BlackBox*, a file archiving website; (2) *DataFade*, a website that causes photos to decay based on physical phenomena; and (3) *BitLogic*, a website through which images decay along a digital spectrum, from photographs to bits. These systems, displayed in Figure 1, were shown to participants as part of qualitative interviews where we explored behaviors and perceptions of digital legacy. Before arriving in participant's homes, we asked them to select 10 to 20 photographs that were meaningful to

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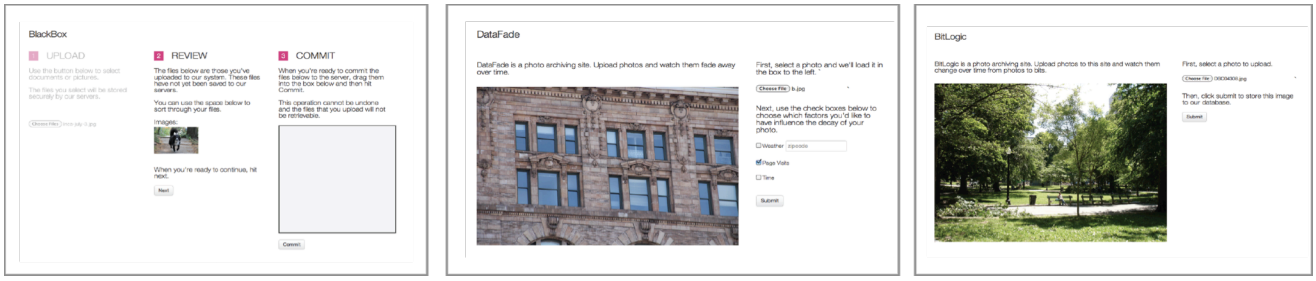

Figure 1. Screenshots of our three working prototype systems: *BlackBox*, *DataFade*, and *BitLogic*

them. We presented our three systems to participants, asked them to upload the selected photos, and had them reflect out loud about how these interactions made them feel.

In what follows, we first present an overview of related work. We describe the design and deployment of the three technological probes, and our methodological approach. We unpack themes emerging across our in-home sessions. Our findings take a step towards understanding how digital materials are shaping—and in some cases complicating—people's inheritance practices. This paper makes two contributions. First, it details the design and implementations of three working interactive systems that were used as provocative, reflective artifacts during sessions with participants. Second, it details three opportunity areas for moving forward in this space: creating family-oriented archives, developing systems that encourage purging of digital information, and changing perceptions about the nature and value of digital data.

BACKGROUND AND RELATED WORK

The concept of legacy has been explored across many different disciplines; there has been a special emphasis in the social sciences at the intersection of the elderly, death and dying, and family organization. This work highlights how the creation of a legacy provides a way for people to curate and designate aspects of their life and identity that will be passed on after death [38]. In concept, a legacy is comprised of three related categories – biological legacy, material legacy, and values [1]. In practice, an individual's legacy is representative of some subset of these larger categories, and is influenced by the relationship between the dying and those who survive. Generally, people desire to be remembered positively and choose to pass on artifacts and information that reinforce that identity [38]. Despite these efforts, the lasting impact of legacy is experienced by the bereaved, who are often tasked with sorting, maintaining, remembering, and even dispossessing objects and information left behind [8]. Even for cherished goods, these expectations can be a burden for survivors, who are now responsible for their safe-keeping.

In the digital realm, there exists a vast collection of work examining personal file and information management. This work illustrates how people often feel overwhelmed by the process of managing their digital files [6]. This problem is two-fold: computers lack the affordances of the physical world that help us find and organize things [1]; this problem is compounded by the rate at which we produce digital data [37]. Today people create, distribute, and consume vast amounts of digital information. Future generations will inhabit a world that increasingly uses digital technologies to produce and distribute information, dramatically challenging the material traditions and practices of past generations.

To cope with the difficulty of finding files both online and offline, people have developed a number of strategies for organizing and managing digital information [5]. These vary according to source, context, and location of the information and include techniques such as printing things out in physical formats [21], intermittent filing into digital folders [43], creating complex hierarchies of digital folders [16], and so on. Even so, people produce digital files and data on such a large scale that they are limited in their ability to manage their digital data [7]. The practice of passing down digital information is entwined with serious concerns about providing recipients with the tools to sort through and make sense of increasingly large collections of virtual information [26], and withholding things that we do not want loved ones to encounter.

These issues are made all the more notable when placed in the context of work that examines the value of our digital information. Interactive systems provide objects and collections through which people construct and express aspects of their identity [36]. Increasingly, this personal content is kept online, in the form of social network accounts [44], game systems [4], personal websites [33], and photo collections [39], all internet-based resources that people draw on to explore, establish, and express aspects of their identity. Digital information is also kept offline, in memory structures ranging from top level files to typically hidden or ignored information and preferences. Recent work has highlighted how people use these different contexts to convey different aspects of their identities [11, 10]. Clearly, people increasingly desire to pass down valued digital records to future generations alongside material possessions traditionally passed down across generations, such as memoirs, diaries, letters, and wills [30].

Looking to digital preservation, work from both HCI and library sciences have explored differences between the ways in which physical and digital artifacts age and decay over time. This work is usually framed in the context of

preservation, and differences include the cause of the decay, the ways in which decay is exhibited, and people's expectations regarding the lifespan of the object. Depending on their material compositions, physical objects can decay through processes that can be considered rich and graceful; they can exhibit signs of a decay that occurs in response to exposure to factors such as touch, weather and time [9]. These processes are both physical and chemical, and naturally inform how people think about the lifespan of their objects. In contrast, digital objects are threatened by an entirely different set of processes. One major issue is the rapid rate with which formats change and become obsolete [24]. Another is that small amounts of damage to the code of a digital object can render it instantaneously and entirely inaccessible.

Other work explores how people's existing practices with physical objects can be productively leveraged in the design of new interactive systems aimed at archiving valued digital things. Kirk and Sellen examined how people organize their belongings and build family archives, and suggested that there was an opportunity to create meaningful digital artifacts through an exploration of the affordances of physical and digital things [22]. Petrelli et al. investigated how physical mementos in the home can help guide the design of systems that create or elevate meaningful digital artifacts [31]. More recently, these researchers and others [23, 27, 31] have designed interactive appliances and devices to create spaces for people to experience more meaningful relationships with their cherished digital information. The systems that we developed, described in detail in the following section, were influenced by these projects; we were inspired to create interactions that push the boundaries between physical practices and digital data.

Collectively, these strands of research have made important contributions to understanding how legacy practices unfold and how interactive technologies are increasingly intersecting with these practices. In particular, they reveal how new problems are emerging as people attempt to make sense 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 through an investigation of how interactive systems could support the existing practices of parents, and how the design space could be further developed through these understandings.

METHODOLOGY

We created three functional systems for this project, which were developed iteratively over the course of several months. They were developed with a focus on the longevity and value of digital artifacts, and were intended to allow participants to explore potential ways to curate digital things and to reflect on their relationships with the digital; this technique was drawn from prior work by [27].

We conducted qualitative interviews in the homes of ten participants from the Pittsburgh area. Prior to the interviews, participants were told that the interview would center on the perceived value of digital information and about how that information might play a part in one's legacy and family life. They were also told that they would be uploading photographs and documents to systems we had made, but we did not specify what the systems did in advance. When we introduced the probes in the interviews, we asked participants to think of them as thought exercises.

Interviews took approximately 90 minutes and, in addition to interacting with the systems, participants discussed inheriting things from their families, how they organized and curated digital information, and their plans for the lifespan and transmission of their digital data.

System Design

It was our goal to design systems that could be used as speculative, provocative artifacts as a part of our interactions with participants to explore their feelings about digital legacy (i.e., *probes* [12]). This methodology was inspired, in part, by prior work by Odom et al [27].

For these artifacts, we focused on the topic of digital decay, inspired by previous work calling for the creation of systems that explore how digital objects age and decay over time [30]. Decay and aging are an integral part of the legacy of physical objects, although these processes seemingly exist in opposition to the longevity and safety of the digital. Importantly, the goal of this work is not to assess the functional feasibility of applying concepts like decay to digital things. Instead, aging and decay were chosen because they provide a provocative counterpoint to established thinking about digital things. These processes are in contradiction with the permanence and safety that people often associate with digital data [42] and have been highlighted as design opportunity areas [30]. However, little HCI research has moved beyond studies of current practice to embed decay and aging into working systems.

Given these initial criteria, we looked to the physical world for inspiration to examine imagery associated with decay and aging: how decay processes occur, and what they signify. We created eight small vignettes describing these characteristics as exhibited in the physical world. Ideas drawn from these vignettes, two of which appear in Figure 1, were then used to inspire our system designs.

Figure 1: Two vignettes about physical decay used to inspire the design team.

The three systems we created are called *BlackBox*, *BitLogic*, and *DataFade* (Figure 1). All three systems were programmed for the web using javascript, PHP, and mySQL. Each system was designed to explore a specific aspect of what aging might mean for a digital file. In some

cases, this was a literal appropriation of concepts from the physical world, such as weather and touch, and in others, we attempted to push the boundaries of what it might mean for there to be digital processes that deliberately lose digital information (but not necessarily meaning or value) over time. The development of these systems drew most heavily from the practice of reflective design, which emphasizes the value of reflection for both users and designers as a way to reexamine perceptions, beliefs, and experiences [34]. Development was also influenced by recent work with speculative design [12], critical design [2], and technological probes [20]. We describe each system below.

BlackBox

BlackBox is a file and photo archiving site. Users are prompted to upload documents and photographs, which are organized by the system. The user selects which of these files they would like to upload, and drags visual representations of those files into a large box on the right hand side of the screen. Figure 2 shows an example of the files before and after they've been dragged into the box. Upon hitting submit, any files that have been dragged into the box are then processed by the system, and the user is given a link they can use to "re-visit" their files.

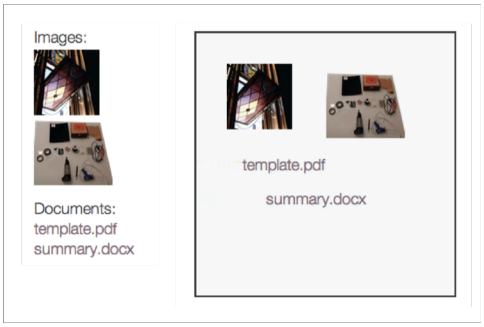

Fig. 2: Uploading two pictures and two documents to *BlackBox*.

Unlike a traditional archiving service, however, users who visit the link provided to them when they uploaded their files do not have the ability to access the files. Instead, they are greeted by a message describing the uploaded files and providing information about how long the files have been there.

In presenting only data *about* the files, this system plays on the idea of "purging" through storage. People often place objects in a box, and store that box out of sight, as a way of reducing clutter, keeping things safe, and fulfilling obligations to hold on to mementos [22]. *BlackBox* intentionally pushes this idea to an extreme, provoking users to contemplate how they view the ownership, lifespan, and safe-keeping of their digital files.

DataFade

DataFade is a photo archiving site that allows users to upload a picture and watch it decay over time. Upon visiting the site, users are invited to upload a photo, and to select from a number of agents of decay. These agents are the weather at a zipcode of the users choosing, the number of online visits to the photo, and time. If a user chooses to have a photo decay in accordance with the weather, the system tracks the number of sunny and rainy days in the zip code provided. If the user chooses page visits, the system keeps track of how many times the web page is loaded. Finally, if the user chooses time, the photo will decay at a steady rate over time.

Each of these agents was chosen as a digital approximation of a physical process. In the physical world, for example, a photo will decay due to exposure to the elements, through handling, and through chemical changes over time. In our system, we chose particular visual effects to represent each of these processes. These effects are demonstrated in Figure 3. Sunshine increases the brightness of a photo, rain decreases the saturation, visits decrease the opacity, and the passage of time changes the colors of the photo to a more sepia tone.

Figure 3. Effects from *DataFade*. The top photo is the original, photos below represent the effects of weather, time, and visits.

BitLogic

BitLogic is a photo archiving site that allows users to upload a single photo at a time. The photo will, over the course of 30 days, decay along a digital spectrum that we devised. In contrast to the process of physical decay, which generally occurs in a familiar manner through exposure to various agents, digital decay is a less familiar process. Digital files typically exist in one of two states: either they are accessible or not. With *BitLogic*, however, we wanted to explore what it might mean for digital things to decay over time and to exhibit signs of decay without relying on affordances from the physical world.

Photos uploaded to this system decay from their original state, in which they have evocative and personal meaning to the user, to digital data, which is far more meaningful to a digital system. This process is shown in Figure 4. In our

system, the process of digital decay consists of two stages. In the first stage, the photo is increasingly distorted by noise and loses opacity. In the second stage, as the noisy photo nears transparency, the photo is slowly replaced by a field of binary 0s and 1s, representing bits.

PARTICIPANTS AND FIELD STUDY

Our participant group was comprised of 10 adults (7 women and 3 men), ranging in age from 25 to 55 (average= 39.8, sd = 9.635). All of our participants were parents, and their children ranged in age from 8 months old to 21 years old. We chose to study parents because they are typically old enough to have experienced inheriting or being given physical artifacts from family members. Furthermore, people with children are in a position that often necessitates a consideration of their own legacy. Additionally, the process of documenting family life is a major way in which people generate media (e.g. photographs, videos, etc.) and possessions that might be passed down as a part of a legacy.

The decision to focus exclusively on parents was influenced by research that illustrates how our relationships with objects change over the course of our lives. Whereas young adults put the most value on objects that do things, adults in middle age are more likely to identify artifacts that remind themselves of their accomplishments as the significant objects in their lives [3]. A third group, older adults, typically places value on evocative objects that provide them with the ability to reminisce [3]. Confining our subject pool to this group allowed us to focus on people who are in transition between valuing their personal accomplishments to people looking back on their life experiences.

Recruitment and Selection

We submitted advertisements and messages to craigslist, local listservs, and local groups on *reddit.com*. Respondents were screened to confirm that they were parents in our local area, that they used the Internet at home, and that they had digital photos on their home computer. Beyond those selection criteria, we deliberately worked to ensure that our participant group represented parents with children at different ages, and both single and married parents.

In Home Sessions

For each session, one or two investigators met with the participant in their home. Conducting these interviews in participant's homes provided us with the opportunity to observe and ask questions about topics, such as digital file management, the selection of cherished inherited objects (and objects desired to be passed down), and the integration of physical and digital media in the home.

The sessions lasted between one to two hours and were comprised of a semi-structured discussion, in which we asked participants questions about their use, creation, and management of digital things and physical artifacts, and exploration of the three technological systems we developed on their respective home computer. Prior to our arrival, participants had been asked to select 10 to 20 digital photos from those available to them online or on their computers. Participants were free to choose any photos they liked, though we suggested that they choose photos that were meaningful to them. For the remainder of each session, participants uploaded the selected photos to our systems and were asked to reflect out-loud on their feelings and thoughts as they explored each system.

Data Analysis

All of the information collected as a part of our sessions with participants was transcribed from audio recordings. Interviews were coded using an iterative grounded-theory approach to evolve themes [15], followed by affinity diagramming to organize and interpret the findings.

FINDINGS

The findings presented below are notable and representative of the information contributed by our participants in response to the three technological systems and to our questions. We present findings that are directly related to the systems first, and then point to some general findings supported by participants reactions to the systems and the interviews we conducted. In each case, we note how many participants contributed to that finding. Participants are referred to by their participant number, from P1 to P10.

Nine of our ten participants chose to upload photos to our systems; P1 opted out of using the systems but instead reflected on our explanations and demonstration of how the systems worked. All of our participants were shocked by, entertained by, or skeptical of the systems we presented. We encouraged them to avoid making usability or visual critiques of the systems and to instead focus on the service being provided. In this way, we gathered participants' reflections on the characteristics of digital data and their nuanced feelings about the value of digital media.

Importance of authenticity

Participants were particularly critical of the idea that a person would have any reason to get rid of any digital media that had made it into their archives. When describing the systems, P9 said "*I guess it's just a, like a bad road map or something, or is it trying to fix something that's not broken*?" The prevailing belief was that the act of deleting a digital file went against the nature of digital devices and systems: "*I wouldn't want to use it because it goes counter to every reason I use digital*" (P6). That is, with cheap or unlimited storage available both online and offline, why get rid of anything at all? Given this belief, our participants questioned the role that such systems would play: "*It just seems like there is no utility like that's kind of the value of [digital files], so it loses its value. It's interesting to me that*

Figure 4: A photo decaying in the *BitLogic* system.

you can even to do that. Would I choose to do that? No" (P5). These quotes are demonstrative of the ways in which participants pushed back against a set of processes that contradicted their understanding of what it meant for something to be digital.

Participants were also skeptical of the appropriation of physical concepts for digital media. This included the application of physical practices (i.e. *BlackBox* and *DataFade*) and processes (i.e. *DataFade*), but extended to the very idea that digital media would decay in the first place. This is an astute observation, since digital media is often venerated for its ability to resist decay. Regarding such digital decay, P2 said: "*But it's possible to not have that happen. And so like, in terms of practicality, this is something that's more fun to watch and see what happens over time, but not the ideal because I would think that if you want to save your pictures for a long period of time, you want them to be as pristine as possible*." Correspondingly, one participant commented that BitLogic more appropriately reflected the way in digital information should decay because it expresses that decay in terms of a digital transformation.

Whereas patina and wear often contribute to the value of physical objects and heirlooms, our participants were not interested in a digital patina that they felt detracted from the artifact. Four participants suggested that the real value of systems like these were as thought exercises or art, which offer an opportunity for reflection: "*I could see using it as an evocative art project and throwing away the original. As a, more as a thought experiment than anything else*" (P7). During our interviews, we used this strong set of opinions as an opportunity to discuss other ways in which digital media could reflect use, ownership, and relationships. Two participants responded more enthusiastically to the idea of a digital system that added information as a form of patina or aging: "*Yeah, I like data. Data being added to it is great*" (P6). However, this process of adding data to a digital artifact is tied to its own set of complications: How do we choose what information is meaningful? How do we balance the addition of information with the desire to sort and curate? And how do we incorporate this information into different types of digital data and media?

Contradictions regarding value

At many points during our sessions, participants questioned whether their personal digital data might be worth anything to their children. This line of inquiry spanned all of the digital data we discussed, including email accounts, social network accounts, and digital files. P6, responding to a question about the value of all of her digital data said "*I can't think of how it would be that valuable to my descendants or whatever anymore than it is to a random stranger right now*." In many cases, this opinion seemed to be in opposition to their personal experiences, in which they expressed fondness and attachment to artifacts, in particular photos, that had been passed down to them by their parents, friends, or older relatives. During the course of our interviews, four of the participants showed us family albums and scrapbooks that were an established part of their family history and legacy. Additionally, participants talked about the desire to have more information about their family members: "*If my mother had an external hard drive with photographs of her entire life I would absolutely want to have a copy of these files*" (P2).

Uploading photographs to our systems also highlighted a contrasting set of opinions regarding the value of digital photographs. When choosing photographs to upload, users were wary of selecting photos of their loved ones or that represented precious memories. It seemed difficult for them to subject the photo to a process that would cause it to disappear: "*I guess it's a little heartbreaking to see this deteriorate over time. Part of that is just that emotional attachment you have, particularly with your kids*" (P9). Similarly, participants highlighted their reluctance to delete digital media in the absence of an accessible backup. P7, when asked if he would upload content to one of these systems asked "*Can it be retrieved?*" Finally, P2 talked about how he would feel if he found out that his son had used one of our systems to get rid of digital photos he had taken: "*If that was the only places where those files existed anymore, I might be a little disappointed*."

This attachment to and concern for the safety of digital files is interesting when put in the context of the suggestion that these files wouldn't have value to their children. Clearly, participants struggled with the idea of discarding digital files despite questioning to whom they would have value.

A generation in transition

All of our participants described having inherited or coming to own possessions given to them by other members of their family. These possessions included jewelry, large pieces of furniture (e.g. an organ, a piano, a grandfather clock, etc.), and photographs. Few of these objects were in use by the participants, though some were present in the main areas of their home. In many cases, the participants felt as though the objects were too fragile or outdated to be regularly used. That being said, these objects were given elevated status as objects that represented relationships and experiences. Participants were uncomfortable with the idea of throwing away or getting rid of these heirlooms, despite their low financial value, and their plans were to pass them on to their children. In contrast, not a single participant had ever experienced inheriting any form of digital media or information.

Despite not being personally familiar with the process of inheriting the digital, nine of our participants were open to the idea that their children might some day come to inherit or own digital things as a part of their legacy. With six of our participants, this awareness was accompanied by the absence of direct preparation. For example, P8 described positive feelings about passing down digital photographs to her kids, but had not yet considered how that process might

occur. When asked if she would pass down a hard drive to her children, she responded "*I don't know, maybe we'll all have computers in our brains by then. I haven't really thought about that, no, to pass down a digital form*." On several occasions, participants disused how, in contrast to the systems we presented to them, there might be value in creating online services that guarantee the safe-keeping of digital media.

In a similar vein, it was a common practice for participants to have digital media stored in physical media such as external hard drives, CDs, and DVDs. In these cases, participants talked about leaving those objects to their kids. Though the CDs and DVDs had been created as a way of creating backups, the act of passing down these objects had been integrated into traditional practices regarding the transmission of physical objects. P9, who had burned many of her images to CDs and DVDs, described her hope that her children would be able to access information stored on these discs: "*...I'm assuming we'll have jpegs and gif files for eternity and all that is created today can be translated 25 or 50 years from now. So even if it's on the CD, they can still access it*."

A small number of our participants were directly engaged with the process of establishing their digital legacy in addition to their children's digital legacy. In all three cases, these participants were tech-savvy individuals whose jobs involved working with technology. P3 was heavily invested in making a concerted effort to manage both the quantity of his digital photographs and to make the information accessible to his children: "*... as part of my will, I will have an envelope with passwords so my kids can get into my passwords and into those files*." Two other participants described having created websites for both themselves and their children, on which their digital information could be stored and managed.

This acceptance of the place for the digital as a part of an inheritance or legacy is evidence of a major shift in how people's family lives are being changed by new technology. Even the participants who expressed the least familiarity with technology were aware of how the ways in which we share and collect information about ourselves are changing.

The burden of inheritance

Across all of our sessions, there was an awareness regarding the scale of participants' digital collections. When asked to describe the number of digital photos or emails they had, participants often responded with numbers in the thousands ("*Several tens of thousands*" (P2), and "*There's over 2000 photos on this memory stick*" (P8)) or were unable to put an exact number on their collection ("*I don't know, I wouldn't hazard a guess and there's many duplicates because they're just all in folders on my external hard drive*" (P3)). Similarly, when asked if there would be value to a person who wanted to look through the collection of his digital information, P7 responded by saying "*As an archeological dig, sure*," indicating his perceptions about the difficulty of extracting significant information from his email, files, and other digital accounts.

The size of their digital collections is strikingly similar to the ways in which people purge and curate physical and digital photographs. In both cases, eight of our participants were reluctant to discard photographs, regardless of media. When pictures were deleted, it was typically because they were blurry or because they had been taken by their children. When describing her practices regarding getting rid of digital photographs, P4 said "*I mean, if they are blurry or her face is like weird, because she was half way blinking… I will go through and delete the ones that didn't turn out all that great*." Additionally, the ease with which people can take and store digital photos contributed to this behavior. P7 explained that "*Disc is cheap*.", and there was therefore no reason to delete digital data. This finding was reinforced by the ways in which participants challenged the value of the systems we had developed.

This type of digital accumulation is a well-documented phenomenon, but is cast in a different light when it is put into the context of a legacy. Five participants expressed the belief that it was up to their children to manage their collection of digital photographs and information: "*I feel like, well, I put some organization into it. I feel like they'd be able to. It would take time, but the kids can figure it out*" (P8). Nine of the ten participants described using organization systems no more sophisticated than sorting events by season and year, with named folders for special events. Without more detailed information about the content and people that appear in the photographs, it may be difficult for their children to derive significance from the photos. This is especially a concern when the scale of the collections is considered. Even for people who don't intend to leave digital information for their children, they will often have a digital legacy that exists as a result of their interactions with technology. As a result, participants are creating a digital footprint that might make it difficult for their children to manage this inheritance and extract things of value.

Content, intention, and disclosure

Our participants expressed different comfort levels with regard to sharing aspects of their digital information with future generations. This was influenced by both the content of the information and the reasons it was created.

On the most acceptable side of the spectrum, participants expected that their kids might see digital photographs featuring family members or events. In some cases, these photographs were taken with the intention of being passed down to the children. Similarly, two of our participants maintained blogs on which they posted updates about their family life and pictures of their children growing up. P10 described the ways in which she was documenting her child's life using *Tiny Beans*, a blog service geared towards parents, in combination with physical books to document her son's life: "*We have these books, and we have the Tiny Beans. I think [those] are the main records that we keep. So one*

electronic and then these two in written format… So yes, I will want him to have access." In both these examples, we see the expectation that children would someday have access to the information and media that documented participants' lives.

Other types of accounts elicited entirely different responses. Email was a common topic of discussion during the sessions with participants, and was offered in comparison to the practice of saving old letters. Seven participants thought that their email accounts might contain individual conversations or threads of conversations that their children would value, such ones with their family, friends, or partners: "*I think that some of the emails I've kept were from when B and I were dating, those were kind of sweet. A couple from my mom, I think. I might print them I don't know what I'd do with them. Maybe worth passing down*" (P8). However, participants were also wary of the idea that their children might someday have access to their email accounts. P3, when discussing his email account, said "*If I were to do that I would go through my email account and delete a lot of things. There are probably some things in there that would be embarrassing to me… I wouldn't be leaving my password in a will to somebody, I don't think, because those things are particularly more personal."*

People were least comfortable with the idea of passing on passwords to their accounts, which would provide unrestricted access to their children: "*If I knew for a fact that, you know, on my deathbed my Facebook was going to become the property of someone else, I may want to go back through and curate it a little bit more to make sure I had control over the kind of images of myself that I was leaving behind*" (P3). Certainly, in terms of existing practices regarding the passing on of physical objects, people often make choices about what to share and what to leave behind. Even with careful consideration, it can be difficult to manage and sort through the contents of one's physical possessions. This problem is exaggerated in the digital realm because of both the depth of our digital identities and the ways in which we separate facets of that identity using different accounts and networks. Like many internet users, P6 maintained digital identities that she intentionally separated from her anchored, offline relationships: "*I had a journal that was almost totally anonymous and I had I guess friends and followers on there who, the vast majority of them who did not know me in real life. It was true and it was all me, just a side, that, okay, people on that account didn't know any of the normal me. And all of my daily friends didn't know about that account*."

This example, and the contrasts between participants' interest in sharing different types of information, highlight a significant challenge regarding the transmission of the contents and character of a person's digital identities. People intentionally curate digital accounts and files in order to represent different aspects of their identities [36]. Taking a long term view, this opens up two oppositional potential hazards: (1) the loss of digital information that could have been valuable to future generations despite the personal or private nature of the information, and (2) the chance that future generations may find or be exposed to information that the creator intended to remain separate and hidden from their curated collections of information.

DESIGN OPPORTUNITIES

In summary, the findings from our work are that our participants were: (1) critical of systems that seemingly defied their perceptions of digital things, (2) grappling with the issue of assessing the value of digital media and information, (3) aware of their status as harbingers of new traditions and practices regarding digital media, (4) responsible for generating a vast digital archive their children will be responsible for managing, and (5) sensitive about the exposure of different aspects of their online identities. Given these findings, we developed a set of three design opportunities that point to a number of ways in which technology can be used to help participants establish, curate, and derive meaning from their digital information.

Family-oriented Archives

Participants found it difficult to conceptualize how their digital information would be valuable to future generations. This problem was partially attributable to the abundance of data they had generated across networks and identities, but was primarily tied to their uncertainty regarding who might be interested in the wholesale contents of even a single facet of their digital identity. As such, participants thought their data might have value, but struggled to answer the question of *to whom* it might be valuable.

This points to the opportunity to create systems that allow people to sort their digital information in terms of who will receive it after they have passed on. This practice is similar to established traditions related to the passing on of physical mementos; selecting individual artifacts to pass on to particular people conveys a sense of importance surrounding that person and their relationship with both the artifact and the deceased. In a digital system, designers could develop add-ons, plugins, and data scrapers that pull from the different places in which people generate or collect digital data and allow them to assign that data to particular people or groups in the context of their personal legacy. In doing so, this would provide users with the ability to elevate the importance of pieces of digital information and share them with particular individuals.

File Management through Selective Archiving

Another obstacle faced by participants was the sheer quantity and diversity of their digital data. Participants had thousands of photos, multiple digital identities, and a large quantity of emails that were saved online in social networks and digital accounts, and offline in folders on a collection of hard drives. In many cases, there were duplicates or redundant information captured across networks.

One way of addressing this issue is to expose people to the idea that they should be more selective about their personal

archives and, furthermore, to provide them with the tools to do so. Such systems could change the expectations that users have around saving digital information, helping them transition form the practice of saving everything to a more nuanced curation of the digital. As such, they could help participants generate more manageable digital archives for future generations.

Comfort with Long-Lasting Digital Legacies

Finally, our participants' creation of meaningful digital legacies was hampered by mixed feelings regarding the potential longevity of their digital data. Despite the desire to remove unflattering or uncomfortable information and media, provocative and uncensored information might offer the most compelling insights into a person's life and identity.

Given the potential value of this information, designers have an opportunity to develop systems that encourage the archiving and safe keeping of digital data, particularly when it is focused on experiences that fall outside of daily activities. Though potentially embarrassing or revealing, this is a meaningful collection of data in that it represents a perspective that might not have been available or understandable by children as they were growing up. As such, it is important to push people to think deeply about the sacrifices they make by excluding pivotal aspects of their lives and identities from their digital legacy.

LIMITATIONS

These findings also illuminate two areas in which there is room for further consideration.

Culture plays a major role in one such area of inquiry. Our participants were located in the same US city; practices and mores regarding privacy, death, and family vary greatly across cultures. Further research with people from other cultural backgrounds may expose additional nuances related to how people place value on digital information and consider the implications of their digital legacy.

Additionally, longer-term deployment of the systems will also yield information about how these systems might be integrated into a person's life and practices. Without a long-term study, we can only draw from our participants' experiences using existing technologies and prior work. In particular, it might be helpful to look at work that has examined people's relationships with representational objects [18] and material goods [17], much of which emphasizes the value of photographs and other media as valuable representational artifacts.

CONCLUSION

This study focused on discovering practices and values related to digital legacy. Through interviews and design probes, we provoked discussions about how technology might affect one's digital legacy. Our findings begin to shed light on the inheritance and value of digital information. We also discovered a number of open questions that represent a rich space for future work.

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