

A Death in the Family: Opportunities for Designing Technologies for the Bereaved

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ABSTRACT

Following the death of a loved one, bereaved family members use technology in several ways to respond to their loss. However, very little is known about how technology intersects with the lives of the bereaved. We present a survey and interview study which examines how the bereaved inherit personal digital devices, use technology to remember the deceased, and reflect on their own digital estates. The study provides one of the first characterizations of technology use by the bereaved, and presents a set of empirically-grounded design opportunities and challenges.

Author Keywords

Death, inheritance, bereaved, memory, thanatosensitive design.

ACM Classification Keywords

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

General Terms

Design, Human Factors.

INTRODUCTION

When a person dies, the bereaved family members contend with a series of emotionally-charged and stressful circumstances. They must hold memorial services, inter the body, communicate the news to far-flung friends and family, distribute the possessions of the estate, and handle a multitude of other tasks, all while undergoing their own personal grieving processes. These processes can take years to complete, and some of them (such as commemorating and grieving) can continue for an entire lifetime.

While we often consider these processes to be governed primarily by religious and cultural practices, technology too

can play an influential – yet often invisible – role. From seeking information online about available burial options to creating multimedia presentations for use at a memorial service, technology can inform, comfort, confront, and connect the bereaved in the years following a death.

To date, however, very little is known about how bereaved families actually use technology. In this paper, we examine how bereaved people currently inherit, use, and reflect on technology, with the goal of identifying design opportunities to support this population. We examine three major areas in this work.

- **Inheriting technology:** Like physical possessions, digital artifacts can carry significant sentimental value for bereaved family members. Inheriting tangible items (such as clothes or jewelry) is a straightforward act of physical repossession. However, for digital assets, practices surrounding the inheritance of data are nascent and diverse. How do people inherit personal digital technologies? How do they reconcile the dual digital/physical nature of electronic assets such as computers? What data stored on these devices is considered private or public? What new kinds of practical problems occur as a result of inheriting data? How can designers make the inheritance process more inclusive and straightforward? This line of inquiry stems from a modern recasting of issues surrounding the concept of the “Death of the Author” [6], and from articles in the popular press which speculatively pose this question [13].
- **Using technology to remember:** Remembering and honoring the dead is a custom that exists in almost all cultures, with symbolic items representing the life and corporality of the deceased [6]. Examples of such symbols include grave markers, photographs, personal possessions such as jewelry and clothing, and gifts symbolizing an exchange between the deceased and the living. Increasingly, these symbolic markers may digital, and intersect with physical mementoes in important ways [11]. How do technologies help people remember, commemorate, and reminisce about the deceased? What types of data are meaningful when commemorating the dead? What technologies are

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appropriated for this purpose? Can digital artifacts support or replace more material ways of remembering?

- **Changes in behavior and attitudes:** The death of a family member can prompt changes in the behavior and attitudes of the bereaved; for example, a surviving spouse may take on new housekeeping responsibilities [1]. However, little is known about these attitudinal changes in the context of personal technologies. Do the bereaved become more aware of their digital estate after the death of a loved one? Do they take action to prepare their digital estates for distribution? How do we conceptualize and design for varying attitudes towards death and distribution?

This paper offers one of the first explorations into this phenomenon, and presents evidence from an empirical survey and interview study. Closed-form survey responses are reported first, with interviews and open-ended survey responses comprising the discussion section. We conclude with design opportunities based on our results.

RELATED WORK

Exploration of the end of life as a site for technological innovation, intervention, and study has just begun in the HCI community. While few scientific studies have examined this area, people have long been appropriating technologies to accommodate the circumstances of death. One of the earliest reports comes from Sofka in 1997 [14], who reported on how the internet could provide numerous opportunities for the bereaved for social and functional support. She identifies the use of online forums, mailing lists, websites, and chat rooms as places where individuals can share stories about the dead. Since that time, people have continued to create online spaces dedicated to exploring issues surrounding death – examples include memorial sites like Remembered By Us [www.rememberedbyus.com], fatalistic novelties such as The Death Clock [www.deathclock.com], and bereavement support forums [www.bereavement.co.uk]. Even popular social networking sites now acknowledge the mortality of their users: Craigslist provides a “dying” discussion forum [www.craigslist.org], and Facebook has implemented a “memorial state” for profiles of people who have died [4].

While the internet is the primary site for innovative applications surrounding death, other efforts in ubiquitous and desktop computing have begun to realize the importance of this domain of inquiry. Kirk and Banks [9] describe how technology designers might begin to create familial intergenerational heirlooms. They raise critical issues such as how families bequeath content and how one’s digital estate accumulates. Their design-oriented approach is supported by other researchers, who assert the value of design as a means for understanding the ethical, technological, and social concerns surrounding the end of life [5]. Specific design projects which embody these principles have included “tilting frames” and “mourning stones” which communicate family commemoration across

time and distance [15]. Many of these ubicomp design projects are inspired by material items – such as clothing, jewelry, relics, and grave markers – which mediate the ways in which members of Western cultures remember the dead [8]. While these innovative projects continue to emerge and challenge our conceptualizations of death, much less is known about the reality and practicality of using technology when a person in the family has died.

To place the current study in a more historical context, it is useful to examine Walter’s [16] analysis of the public acknowledgement and handling of death. He observes that modern society is returning to the agrarian custom of dying in the home (as opposed to on the battlefield or hospital, which he argues characterizes most of the 20th century). As dying becomes more visible, there becomes a new need for expression, dignity, and acknowledgment. Better understanding of how the bereaved use technology provides designers with opportunities for meeting these needs; the study described in this paper is a first step in that direction.

Finally, at CHI 2009, Massimi and Charise described *thanatosensitivity* as an approach to HCI research and design which actively engages with issues of death, dying, and mortality, and as a way to characterize the new wave of systems which acknowledge these as topics of substance [10]. This work concludes with an enumeration of empirically-grounded thanatosensitive design opportunities.

METHOD

The study included a web survey and a follow-up semi-structured interview. Both instruments investigated the research questions in the three categories above, and also provided opportunities for open-ended responses. Participants were recruited through convenience and snowball sampling, and via postings to Craigslist and local newspapers. To be included in the study, participants must have been over the age of 18 and have experienced the death of a family member within the past 5 years.

The survey received 41 complete responses (17 incomplete responses were omitted from analysis, but participant numbers in this paper retain their original numbering from the survey). From these respondents, 10 participated in follow-up interviews with a researcher. Interviews were conducted in person, by telephone, or by instant message depending on the preference of the respondent.

SURVEY RESULTS

Respondent Demographics

Of the respondents who completed the survey ($n = 41$), most were middle aged ($M = 35.1$, $SD = 11.9$, $min = 18$, $max = 65$), female ($n = 28$), and North American ($n = 40$) (Table 1). Occupations of respondents varied widely, with students being the most common response ($n = 16$). Respondents were adept with email, the internet, and mobile phones; between 90% (email) and 73% (mobile phone texting) of respondents rated themselves familiar or very familiar with these technologies.

Deceased Demographics

Each respondent represented a different family and reported on the single most recent death in that family (Table 1). The median number of years since that death was between 2 and 3, with the remainder normally distributed across the span from 0-5 years. The average age of the deceased at the time of death was $M = 72.3$ ($SD = 17.95$, $min = 25$, $max = 95$). The gender of the deceased was roughly split, with 21 female and 18 male responses, and 2 not reporting. The occupations of the deceased varied, with homemaker ($n = 11$) the most frequent response. The deceased was most frequently the grandparent of the respondent ($n = 16$), with parents ($n = 6$) and aunt/uncle ($n = 6$) also reported frequently. Compared to the respondents, the deceased were reported to be less familiar with technology. Most respondents assessed the deceased's pre-morbid comfort with technology to be "somewhat familiar," ($n = 17$), with the remainder of assessments distributed roughly equally between familiar ($n = 11$) and unfamiliar ($n = 13$).

Inheriting Technology

Before asked to report on technologies left behind by the deceased, it was asked whether or not the deceased had a will. About half (58%) of respondents reported the deceased had a will, 22% did not, and 20% had no response or were not sure. No respondent indicated that the deceased individual made specific arrangements for their personal technologies in the will.

After death, technologies were handled in a multitude of ways (Table 2). PCs, TV/VCR devices, mobile phones, email accounts, and online banking accounts were the most commonly possessed types of technologies. Of these, PCs and TV/VCR devices were most likely to be inherited, while email and online banking accounts were likely to have indeterminate outcomes (*i.e.*, the respondent did not know what happened to them).

Using Technology to Remember

This section asked respondents about their use of technology as a means of commemorating or remembering deceased loved ones. On Likert scales (5-point, level of

agreement), respondents indicated that they treasure mementoes (78% of respondents), think that reminders of the dead are important (82%), and do not associate reminiscing with negative affect (61%). About 54% believed that digital mementoes could be as meaningful as their physical counterparts (*e.g.*, digital photos vs. printed photos). Slightly less than half of respondents (43%) expressed no preference for physical mementoes over intangible mementoes. Thus, participants were roughly split about the value and utility of digital devices when compared against physical mementoes.

After the death of a family member, about half (51%) of respondents digitized possessions of the deceased. When asked what they digitized, almost all respondents indicated photographs (90%). Other items which were digitized in some manner in addition to photographs included: furniture, jewelry, letters, journals, bills, voice mails, videos, obituaries, newspaper clippings, art, and silverware.

Of all respondents, the majority (65%) reported using their computer and the internet to help them remember, commemorate, or reminisce about their deceased family member. Specifically, participants described using their computer and the internet for the following activities:

- searching for genealogical or biographical information about the deceased (2 responses)
- sharing photos (*e.g.*, Facebook, Flickr) (4 responses)
- creating a quilt square to represent the deceased in a memorial quilt for victims of drunk driving (1 response)
- using digital pictures frames in the home (2 responses)
- reminiscing in emails to relatives (3 responses)
- eulogizing the deceased on memorial websites or Facebook (3 responses)
- completing administrative tasks (*e.g.*, comparing funeral homes) (1 response).

When remembering or reminiscing, respondents reported that they most valued photographs (92% of respondents),

Measure	Respondents	Deceased
Age	$M = 35.12$ ($SD = 11.94$, $min = 18$, $max = 65$)	$M = 72.3$ ($SD = 18.0$, $min = 25$, $max = 95$)
Gender	Female = 28, Male = 12, N/A = 1	Female = 21, Male = 18, N/A = 2
Occupation	Student = 16 Other academic (professor, researcher, teacher) = 4 Technology professional = 3 Social worker = 2 Consultant = 2 Other (homemaker, accountant, architect, health and safety mgr., nurse, mathematician, sales mgr., newscast director, photographer, disabled, unemployed, quality assurance analyst, project mgr.) = 13	Homemaker = 11 Retired (non-specific) = 7 Trade skill worker (farmer, mechanic, carpenter, electrician, factory worker) = 5 Academic (teacher/educator) = 4 Businessperson/entrepreneur = 3 Engineer = 3 Other (film maker, mathematician, nurse, border agent, newscast director, student) = 7

Table 1. Respondent and deceased demographics.

	Total	Inherited	Sold	Given away	Charity	Disposed	Unknown	Other
PC	19	12	0	0	1	3	2	1
TV/VCR devices	19	13	1	1	1	2	0	1
Mobile phone	15	7	0	0	2	3	2	1
Email account	15	2	0	0	0	4	7	2
Online banking	11	2	0	0	0	1	5	3
Digital camera	6	4	0	1	0	0	1	0
Social networking	4	0	0	0	0	2	1	1
IM account	4	0	0	0	0	2	2	0
MP3/music player	4	3	0	1	0	0	0	0
Video game console	3	2	0	1	0	0	0	0
Online photo sharing	1	1	0	0	0	0	0	0

Table 2. Frequency of ownership, and what happened to the technology after its owner's death. The most frequent outcome is shaded.

followed by video of the deceased (41%), journals or written works (39%), music (29%), and non-musical sounds (e.g., voice recordings of the deceased) (29%).

While about half of respondents (53%) reported that they tried to keep a “connection” to their deceased loved one alive, and 95% thought that talking about the deceased was socially acceptable, they did not appear to desire significant changes in the way they reminisce. Respondents reported that they had enough time to reminisce (73%), and only about one-third (36%) desired more opportunities to reminisce. Only 14% thought that they should be thinking about their deceased family member more frequently than they currently do.

Changes in Behavior and Attitudes

The final section asked participants to reflect on the passing of their family member, and answer questions about their own attitudes towards their digital estate. Most respondents (65%) had never thought about how they wanted their digital devices to be handled upon their own death. Consistent with this, 80% have not made plans for their technological possessions upon death. Despite this lack of thought and action, a little more than half of respondents (56%) reported that they were concerned about how their personal technologies would be handled after they die.

Respondents varied in their privacy attitudes regarding their personal files. Slightly less than half (46%) of respondents reported that they have files on their computer which they would not want their family members to see if they were to die. A similar number (51%) indicated that they have files on their computer which they would not want friends to see.

Participants were asked to estimate what percentage of files on their personal computer they would want released after their death. In the aggregate, respondents reported that they did not want to share $M = 19\%$ ($SD = 24\%$) of their files with anyone (i.e., these files should be deleted permanently upon death). Respondents desired that most of their files (M

$= 50\%$, $SD = 35\%$) be released, but only to specifically designated individuals. A slightly higher percentage of files ($M = 61\%$, $SD = 33\%$) should be available to family members generally, while a lower percentage ($M = 36\%$, $SD = 30\%$) should be accessible to friends generally.

DISCUSSION: INHERITING TECHNOLOGY

In this section we revisit the question of how individuals inherit digital technologies, illustrating with items from the interviews and open-ended survey response items.

Generational Differences in Technology Possession

The average age of respondents was 35 years old, while the average age of the deceased at the time of death was 72 years old. While the sample of deceased individuals did include a range of ages (from 25 to 95), respondents overall rated the deceased as being less “tech savvy” in comparison to themselves, and this was reflected in the interviews and survey regarding technological comfort.

“No [files or online accounts], she died roughly at the age of 95, so her generation...I’m 33 myself, so I was born into a digital era in a way.” – P56

Examining the occupations of the deceased gives insight into the types of possessions that they held. The deceased sample included 5 individuals working in trade skills (farmer, mechanic, carpenter, electrician, and factory worker). These trade skills result in the production of physical items which can be easily inherited by family members. In comparison, respondents in the younger group were more likely to have occupations which do not produce tangible artifacts – for example, as knowledge workers.

“Being the youngest in the household, plus being involved in the IT world, I took possession of any item that ran on current.” – P49

While problems with technology inheritance are currently minimal for older adults who die, these problems will be more profound for future generations.

Physicality in Inheritance

Table 2 indicates an interesting trend: physical items were most commonly inherited by a family member, while non-physical digital assets commonly went missing or were destroyed. Why might tangible technologies be inherited so much more frequently than intangible ones?

The first reason is that many online accounts require passwords. Passwords can prevent people from inheriting or distributing assets associated with this account (unless circumvention measures are taken, such as hacking the account or making a request to a service provider).

“We just left it, I couldn’t get into [my brother’s] account... his school account was deleted obviously, but I left his personal account.” – P58

A second reason physical items are easier to inherit is because they are more easily claimed than digital files. For instance, P8 and her siblings claimed her mother’s paintings by writing their names on the back of each one they wanted.

“She was a good artist, and they are just small paintings she did...all of them have been scooped up. Someone’s got their name on the back of it.” – P8

There is no equivalent claiming affordance for digital files. While files could, conceivably, be marked by the user to be distributed in a particular way, it isn’t a common occurrence. Further, it is conceptually more difficult to earmark many files spread across a file system than it is to claim a handful of physical items kept in a household.

A final reason why physical items are more likely to be inherited is because they bore personal touches, such as handwriting. These personal touches imbued objects with meaning and made them unique [11]. Participants were more motivated to retrieve these kinds of one-of-a-kind assets.

“This postcard was written by hand, with photos – it’s more romantic than nowadays...” – P56

Many of these touches are lost in modern digital versions. Because these files are less “special,” family members may simply delete them or dispose of the entire disk.

Domestic Data: Inheriting from the Home

We often think of computer files as assets which are owned by a single person or user. In reality, many assets are owned by the household of which an individual is a member [2]. Participants remarked on how assets – both tangible and intangible – belonged to the house and to whomever lived there: usually, the widowed partner.

“My dad is still living, anything that was in the house goes to him, and all of her investments, all the money, goes back to him.” – P8

What does it mean to inherit a digital device when it is shared among many members of a household? In many cases, the devices are not so much “inherited” as they are

“used by one less person” – PCs and televisions are good examples of this. As a result, digital devices accumulate data from multiple members of the household over time. By the time someone external to the household comes into contact with the device due to a death in the family, they may wish to simultaneously inherit data from multiple people from the same device. For example, a daughter might inherit data from both her mother and father at the same time from the same family computer.

Participants also remarked on how one person was the “gatekeeper” for household data. Activities performed by the gatekeeper in this role can be part excavation, part privacy advocacy, and part “grief work” [17].

“My dad, literally immediately following her death, he took a few weeks off and we organized stuff, and went through every single paper and organized it... It was something he wanted to do...he might have felt it would be more difficult for me so he protected me...or maybe it was something he wanted to do because it was a way of reconnecting with her.” – P21

When designing personal domestic technologies, we must keep the role of the household and its “gatekeeper” in mind.

Inheritance, Emotion, and Aesthetics

When people inherit possessions from a deceased loved one, they frequently feel an attachment to the possessions which honor, commemorate, and preserve the identity of the deceased [8]. It is easy to understand why, for instance, a son would cherish his deceased’s father’s wristwatch – it was something personal, kept close to his body, and unique to him. But these properties are shared with other objects as well – for example, his mobile phone. Despite the culturally prevalent “disposable technology” paradigm, and the idea that the data matters more than the substrate it is stored on, do people attach emotion to inherited digital devices?

The results of the study suggest that it depends on the individual. Some people did find personal technologies to be vehicles for maintaining an emotional connection with their deceased loved one, and were comforted by inheriting a loved one’s personal device.

“She was using her father’s cell phone after he died. She asked if she could use it as a token to remember him by, because it was his, and it was a good way to remember. It had sentimental value.” – P26

The mobile phone is an interesting example because it is so personal, used so frequently, and is carried close to the body (properties shared with some religious relics [8] and jewelry). While this intimacy might make an object more valuable, it does not appear to be necessary. For example, another participant was surprised by how strongly she valued a laptop that her mother never even used.

“One of the computers, she let me have before she passed because she wasn’t using it. After she passed away, the same year, I spilled tea on the keyboard... it totally froze

and shut down. I freaked out...because it was her computer, even though it wasn't something she used, she had given it to me.” – P21

Interestingly, the emotional attachment here appeared to be connected to the functionality of the device, more so than the data it contained or its actual form. This participant then describes her desperate efforts to fix this inherited laptop.

“I raced to work and corralled my techie friends...and I was bawling at work...they fixed it, and I was thrilled and I felt much better. I had reconnected again, even though there was nothing saved to that computer that was hers, but I felt closer to her because of it.” – P21

It is striking how strongly the proper functioning of the device was connected to its meaningfulness as an inherited keepsake; it is as if the continued functioning of the device worked to “keep alive” the memory of her mother. At the same time, this same functional property of computing devices (*i.e.*, the idea that they are replaceable tools) was grounds enough for other participants to completely discount the idea of caring for a computer.

“There’s no emotion attached to a computer, no memory attached to a cell phone – they’re very easy to get rid of after death I think. It’s not like a favorite vase or something that has a family history to it. It doesn’t have beauty or genealogical significance. It’s just functional.” – P9

These disparate attitudes echo the tensions between functionality and aesthetics in interaction design; devices may need both functionality and aesthetics to be treasured.

Discovery and Privacy: Browsing the Files of the Dead

Whether the deceased had a will or not, there were no respondents who found specific instructions about how data stored on digital devices was to be handled. This was the case even for the most computer-literate in the sample. Because there were no directions, respondents found themselves combing through hard drives full of the deceased’s files, trying to find important pieces of information without invading their privacy. This proved treacherous at times for both practical and ethical reasons. Practically speaking, respondents had trouble deciphering the filing system their deceased relatives had created.

“She had no sense of directories or computer sense...all files were in one directory.” – P25

This lack of organization caused P25 to review every file to determine if it contained important information or not. But even if they had been better structured, it would still not be immediately clear which folders contained important information. When respondents were forced to look through documents one by one, they sometimes encountered information they wish they hadn’t.

“With my mother, she had personal files on there. I skimmed and looked it over...I tried to handle things like I would like it handled in my own case, but from a child’s

perspective, there are things you don’t want to know. There are close things that are awkward and odd to see as you go through, and you don’t know if there is something later that you should see. It’s tough. At least with diaries you can recognize that they are a diary, and act accordingly.” – P9

As P9 notes, the ethical problem was exacerbated by the interface representations. There was no way to flag files as being private or sensitive, and it is unclear whether the deceased would have made this provision even if it were available. Personal computers are thought to be just that – personal. The bereaved family members had to guess as best they could which files were meant for their eyes to see. This search was guided by the privacy attitudes – spoken or unspoken – that their family member might have held.

“She was completely ambivalent about this kind of stuff, never thought about it. If she had thought about it, she would have left instructions that it should be wiped clean because she was private... but she never thought about the implications of owning a cell phone and numbers on it as a threat to her privacy.” – P8

At the same time, this uncertain and cautious searching sometimes revealed new things about the deceased person.

“You think of your parents in a certain way...and you forget they’re just like you. Sitting at her computer and getting a feel for it... it gave a bit of a window into their true life rather than what you thought their life was... the technology gives you that snapshot that physical things don’t necessarily give you.” – P9

Just as with physical possessions, participants discovered new identities, roles, goals, and fears about the deceased person when they went through these files. These discoveries confronted participants and forced them to reconcile their concept of the person’s identity with the newly discovered information. For instance, P25 disliked her relative who passed away, but expressed some regret and surprise after looking through her files and discovering new aspects about her life.

“We discovered after she died that she had another job we didn’t know about, and that she had huge health problems like breast cancer that we didn’t know about, and she refused treatment. There’s lots of revelations coming out of this.” – P25

As with physical possessions, excavating the computer files of the dead can be a process which confronts the bereaved with new insights, feelings, and ethical dilemmas.

One Computer, Multiple Roles

People commonly use the same computer for both personal and professional activities. For example, a single PC can be used for playing video games, coordinating a volunteer group, and telecommuting to work. Respondents discussed how the multiplicity of life roles as enacted on a single PC raised issues when their family member passed away.

One situation where the computer serves both personal and professional roles is when the individual works at home or independently. When P14's father died, he suddenly found himself responsible for his father's filmmaking business because he was now in possession of the videos.

"Now I'm in charge of that [movie] catalogue for him... [clients] send me a check instead of him... people have emailed me asking for one of his tapes." – P14

The number and types of roles that a computer plays in the life of an individual can change across time. This can make the prospect of bequeathing a computer to another person an uncertain prospect: an individual must not only reflect on how the computer is used currently, but also anticipate how what types of data might be on it in the future. When asked about how she would like her assets distributed upon her own death, P8 – a home business owner – pointed out that her home computer was also her business computer, but she saw herself slowly changing its primary purpose as she moves from the work force into retirement.

"I have a home business...it's busy and so when I am in front of the computer, I am working. I can see when I retire that I'd leave a lot more records and organize pictures and use the computer...to record lots of things, my thoughts, my stuff, my wishes, before I ever go." – P8

For other people, the situation could be reversed, with personal data stored on a work computer. This prevented the bereaved from accessing these personal files stored on business property. For example, P21's workaholic mother had personal files at work that her daughter wanted to see.

"The school never talked to us about anything, at least not to me, maybe to my father..." – P21

Feeling cut off from one of the most important roles in her mother's life, P21 could only hope that her mother's co-workers would make good use of the contributions hidden away on her mother's work computer.

"When someone dies and you have to replace them – they've done all this work, and who knows, it could be leading to the completion of a new project." – P21

As this demonstrates, data on a computer used primarily in one context (e.g., work) could be important to people in another context (e.g., family). When receiving digital assets, inheritors get more than just data – they inherit the roles and responsibilities associated with that data.

DISCUSSION: USING TECHNOLOGY TO REMEMBER

The bereaved commonly use technology to remember their deceased loved ones. This section examines the social and technological mechanisms through which this is achieved.

Remembering Together, Even when Apart

As Olson and Olson put it, "distance matters" [12]; and this distance becomes a large obstacle following the loss of a loved one. Bereaved family members, living in many

places, must offer emotional, functional, and informational support to one another despite distance. Group commemoration is an important aspect of bereavement, and different technologies are used for this purpose, depending on group size and distance (Table 3).

For small, co-located groups, participants described intimate, highly symbolic commemorative activities which highlighted the mourners' shared memories of the deceased. A common activity was joining together to look through photos (digital and physical). A more involved activity was digitizing, repackaging, and distributing the deceased's assets as gifts for other family members.

"I selected photos...I scanned them...and printed them out and made gifts for my siblings." – P21

When these small groups moved apart, shared histories remained important, but photos became less of a focus. Instead, verbal storytelling and conversation became more pronounced. Some families communicated by group emails to express their emotions, and others used the phone.

"I get my sister on the phone and we'll talk about [mom], and we'll talk about what she'd do." – P8

In larger co-located groups, such as when the entire family is present or when friends are involved, the symbolic nature of commemoration is diminished due to fewer shared, intimate memories. Instead, mourners preferred to use easily-apprehended audiovisual technologies such as photo slideshows or videos. The deceased's social involvement is highlighted through retellings of family history.

"[Using] videos, emails and scanned photos, [we have] get-togethers where we use technology to 'paint' pictures of our family and their 'doings'; videos of anniversaries and stuff that happened." – P8

One key instance when a large co-located group joins together to commemorate is a funeral or memorial service. Participants described using computers and the internet to create audiovisual assets for use at such an occasion.

"You know when you go to a wake, they have those collages made, with young and old pictures? We made a huge one of those." – P30

This occasion serves as a starting point for further group remembrance at a distance, possibly after attendees return home or for those who could not attend in person.

	Small group	Large group
Together	<ul style="list-style-type: none"> - Technology gift-giving - Photo review 	<ul style="list-style-type: none"> - Photo collages - Family videos
Apart	<ul style="list-style-type: none"> - Telephone - Email 	<ul style="list-style-type: none"> - Social networking - Online memorials and obituaries

Table 3. Remembrance activities by group size and distance.

“You see a lot of these online sites now, from the funeral homes or even from newspapers where the obituary is online, and you can post comments. Some people respond well, others don’t...It was nice for my mother-in-law to read through things that people couldn’t say face to face, or to hear from people too far away. On the internet it’s nice to share with other people besides the family – you get a stronger sense of the ripples of the person.” – P9

As this quote shows, web technologies become the primary mechanism for sharing memories with many people at a distance. These range from completely public online obituaries (as above), to social networking websites where bereaved family members can more selectively share thoughts and photos with close family and friends.

“Sometimes on Facebook I see my cousins will have a photo album dedicated to him...I think it’s nice, it’s a good way to remember.” – P26

No matter the group size or distance, the primary “task” of group commemoration remains the provision of social support. These technologies convey the message “I am mourning too,” and may comfort the bereaved.

Reconciling Digital Legacies with the Reality of Death

An important part of the reflective process for participants was to reconcile the persisting digital representations of the deceased with the reality of their death. Participants responded to these digital representations with a range of emotions – including regret, surprise, or even horror.

We have already remarked on the benefits and importance of photos for the bereaved. However, photos are purposefully taken, and often explicitly meant to be items for remembrance. One type of media which reveals more surprising findings, and opportunities for technological innovation, is that of voice recordings.

“I wish I had a recording of her voice, it’s the one thing I miss the most.” – P21

Voice recordings, unlike photos, are often incidental and not purposefully created for remembrance purposes. In daily life, these recordings are used primarily for leaving voicemails or for functional information purposes. Hearing these incidental voice recordings, or coming across left-behind digital assets, often made respondents pause. Voice recordings conjured up memories very strongly, and took participants by surprise with how powerfully they evoked memories of the deceased. Perhaps this is because the vocalization capacity of the body ends permanently with death, while the visual representation of the body persists.

“My husband (it was his father that died) kept his father’s voice on his voice mail for a long time...we kept his answering machine message until it got too creepy.” – P9

The role of the recorded human voice in this quote raises an important point. Currently, personal computer systems indicate people as permanent, structured, swappable data

structures (“users”). In our digital legacies, we are represented by static, formatted pieces of information: email addresses, snippets of voice mail, and text messages. Participants reacted emotionally to this kind of representation because it did not match with reality, where we are temporary beings using a machine for a small period of time. Participants were not always emotionally able to respond to technologies which, through their ability for action, breathed life into an otherwise dead persona.

“I got a call a couple of months from her office after she died, but it was her phone number, and I thought I was having some surreal poltergeist kind of moment...I recognized she passed away and thought ‘My mom’s calling me’ and I froze and freaked out there. I remember that terrified me, but how excited I was at the potential to talk to her.” – P21

Indeed, technologies codify and assert the life of their users. Just as texts give life to their authors, digital representations of people can animate the deceased [8]. To remove the digital representation, therefore, asserted the death of the individual in both the real and digital worlds.

“Removing his email address from my email really ‘finalizes’ it and we’re not ready to go there yet.” – P9

When designing technologies which model users, we rarely take into account that these people will one day die.

Afterlifelogging

Lifelogging technologies have been proposed to help an individual capture and reflect on his or her life experiences [7]. Whether this review process is intended to support memory, tell stories, or discern activity patterns [2], these databases can be useful resources for the bereaved by acting as an “afterlifelog.” In the absence of comprehensive lifelogging technologies, participants described their own efforts to preserve aspects of their dying loved ones.

“I will tell you, before my dad dies (he’s 90, by the way), we’re going to get him to tell some stories or jokes so we can have his voice recorded, and maybe we’ll video him...and put them with pictures on a DVD.” – P8

Some participants who were unable to capture this kind of media about their loved one regretted they did not.

“There are all sorts of things I wish we had done...I knew she was getting worse but I wasn’t accepting she was going to pass, and it wasn’t a conversation we ever had. One thing I encouraged her to do was to write us things, or because she was too weak, to [voice] record things...every time I suggested it, she was too tired, ‘wonderful idea, but not today...’ I don’t know if there were some sort of technology that could help, but she was saying no to getting the equipment, setting it up...” – P21

Lifelogs do not become obsolete upon the death of the subject; rather, these databases can become afterlifelogs and support reflection, mourning, and commemoration.

DISCUSSION: CHANGES IN BEHAVIOR AND ATTITUDES

A death in the family can change bereaved family member's behaviors and attitudes towards everyday activities, from cleaning to paying the bills [1]. For our respondents, computing was similarly considered among these everyday activities. In this section, we discuss how they changed their attitudes and behaviors with regards to their own technology use.

In our sample, a small number of respondents (13%) took action to ensure their digital assets were distributed according to their wishes upon their death. The plans for distribution ranged from including digital assets in a legal will (as with P7 below), to creating a backup where family members could access the data (as with P42).

"I saved everything to an external drive; not password protected; my intentions and directions for managing my personal technologies are mentioned in my will" – P7

"My photos are stored on a spare hard drive as well as DVDs - my children will share them as well as retain possession of my website." – P42

While it is unclear whether these actions were the result of pre-existing decisions, or attributable to enduring the process of sorting through the deceased's assets, these respondents clearly wanted to make it easy for their families to access their digital assets after death.

A comparatively small number of respondents (8%), however, took the opposite stance. They saw the end of their natural lives as the end of their capacity for action, and any subsequent affairs to be inconsequential. They were unconcerned about how their assets would be distributed, or if they could even be accessed by their family at all.

"I don't care what happens to my stuff after I die." – P32

"It is irrelevant to me what happens to possessions after I die." – P44

But for the majority of respondents (79%), the logistics of distributing digital assets after death was simply an issue that was either unconsidered or overlooked. As a result, their attitudes and behavior towards their technology use remained largely unchanged.

"I haven't thought about it at all. I think my sister would take [my computer], but I didn't make those plans..." – P26

One major reason for failing to consider this eventuality was that the respondent was simply not ready to prepare a will. Respondents who were young, single, and childless described this attitude most frequently. This is not to say that they did not value their data – they simply had not found suitable reason to make these kinds of plans yet. A second widespread attitude was that the respondent viewed their personal computer as a functional electronic asset (like a TV), more so than a data-storage device warranting special consideration. Several respondents had written their

computers into their wills, but did not make a special distinction between its physical form and the data it held. This lack of distinction is also evident in the way that passwords were shared.

"My husband and I share all our account passwords so I expect he can find anything he wants after I die." – P25

In general, the death of a family member did not change respondents' attitudes and behaviors with regards to their own technology use.

OPPORTUNITIES FOR DESIGN

Based on the results of the survey and interviews, we present a concise list of opportunities for thanatosensitive design – a process which explicitly acknowledges mortality, dying, and death in the design of a system [10]. We present these opportunities as a series of problems to be solved by the research and design communities, and in the same order as presented in the discussion section.

The Generational Problem: As generations age, more meaningful artifacts will be digital, but well-considered ways to inherit them do not exist. It will become critical to develop software and procedures for inheriting digital data.

The Claiming Problem: Digital devices need better affordances for inheriting – the digital equivalent of "claiming" or bequeathing items is an unsolved problem. We need to blend the benefits of digital devices with the physicality, accessibility, and meaningfulness of personal artifacts.

The Will-Drafting Problem: Digital assets are easily forgotten in the process of drawing up a will. Systems which make the distribution of assets simpler would help ensure that the wishes of the deceased are carried out.

The Domestic Data Problem: We must recognize that technologies frequently belong to a household more so than to a single person. When people in the household die, other household members logically inherit the devices, with the "gatekeeper" of the data distributing assets on an as-needed basis. When designing domestic technologies, we must remember that these home technologies will always have at least two users: the primary user, and the inheritor.

The Desirable-to-Inherit Problem: Some people consider digital devices to be less meaningful than other personal items like clothing or jewelry; for other people, these digital devices carry great emotional meaning. When designing technologies that are meant to be inherited, properties such as beauty, aesthetics, and prolonged functionality become more important than they are for disposable devices.

The Role Inheritance Problem: Whenever a person inherits data, they are also inheriting a set of social and practical role commitments associated with that data. Ensuring that these commitments can be met easily by inheritors is an unsolved design problem.

The Support Problem: Technologies specifically designed to provide social support following a death in the family have not yet been developed; these types of technologies could provide comfort and solace to bereaved families.

The Reconciliation Problem: Bereaved people have to face uncomfortable situations when they handle the digital legacies of those who die. When designing technologies which represent living people, we must consider how the technology will represent the person after they die, and if that representation will cause discomfort for the bereaved.

The Afterlifelog Problem: Existing lifelogging technology can be used and reviewed, with new meaning, by family members of the deceased. Reimagining the role of lifelogs for use after the death of their subject – “afterlifelogs” – could provide new, unique opportunities for bereaved family members to remember their loved ones, especially if they provide access to new types of media (e.g., voice). Determining how to find and present the important pieces from this large dataset is also a challenge.

The Attitude Spectrum Problem: People hold a variety of attitudes towards how their assets will be distributed, with the majority of them unaware that it will even be an issue. Personal technologies should support informed decision-making surrounding this issue, and provide options for a range of data distribution policies after death.

LIMITATIONS

Because a self-selected convenience sample was used for this survey, these results will differ from the general population of bereaved individuals. It is also likely this sample was more technologically comfortable than the general population because the survey was conducted via the internet. While ethnicity and religious affiliations were not solicited in the survey or interviews, post-hoc analysis of the responses suggests that participants were from predominantly Western Judeo-Christian cultures. Other religions and non-Western cultures were not mentioned, and may hold a different set of attitudes. Finally, the concerns expressed by the bereaved within 5 years of the death may differ from concerns after longer periods of time.

CONCLUSION

This study explores how bereaved individuals inherit, use, and reflect upon personal digital devices after a death in the family. The results of both the survey and interviews provide the HCI community with a foundation for structuring research, adapting existing systems, and envisioning future technologies. These insights may improve the design of personal technologies such that they remain useful tools for the bereaved, rather than sources of discomfort or confusion.

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