

Digital Systems and the Experience of Legacy

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ABSTRACT

As people generate large quantities of heterogeneous data across their lifetimes, there is an opportunity to consider how we might build digital systems that leverage this information to help people communicate aspects of their life for which they would like to be remembered without the need to directly assign or pass on this information to another person. We present a study that leverages existing research and the use of an online design probe to explore how people think about how they'll be remembered, and how digital systems and information might help shape how people look back on and interpret people's lives after they've passed away. Findings from this work articulate specific challenges and opportunities for building systems to support people's ability to engage with experiences and memories through their digital materials.

Author Keywords

Digital systems; legacy; memory; remembrance; family; design research; experience design; death and dying

ACM Classification Keywords

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

INTRODUCTION

When a person dies, they leave behind digital information and media generated over the course of their life. As with physical artifacts, these digital representations of a person's experiences exist as a way that people may interpret, reflect on, and communicate aspects of a person's life, even long after they have passed away. Though digital materials may not change the fundamental desire to be remembered in a particular way or have a particular impact on future generations, the affordances, capabilities, and limitations of digital materials do influence how and when people engage in legacy-oriented or commemorative practices.

Our work seeks to understand how digital information and

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digital systems can communicate the various things that make up a person's legacy or remembrance without requiring that people directly assign a recipient or steward for their digital information. This work builds on existing work in HCI that has focused on the specific mechanisms of owning, managing, and passing on digital materials. Systems like Facebook's Legacy Contact and Google's Inactive Account Manager serve a valuable purpose ways to pass on specific accounts and permissions, but there is a need to understand how systems can support the many informal and unstructured ways that people engage with legacy and remembrance through the broader collections of heterogeneous digital materials left behind by other people. As a part of this work, we draw from participant's descriptions of how they experience aspects of the lives and legacies of people who have passed away.

Building on literature from death and dying studies [21, 25, 30, 40], the first part of this work investigates the particulars of what people want to pass on to future generations, how they want to be remembered, and how they think about the legacy they'll leave behind after they pass away. The second part of this work bridges death and dying studies and human-computer interaction to investigate how digital systems might engage with information that hasn't been assigned to another person or directly passed down. To investigate these questions, we developed a multi-methods study that consisted of four open-ended interviews interspersed within a 9 week deployment of an experimental website developed as a design probe. The "Retrospect" website used data from participants' Facebook accounts to explore the content and form of an individual's digital legacy and was used as a starting point for discussions about diverse types of digital information people share online.

Findings from this work reveal insights into how to approach building of digital systems can make use of digital information of the deceased to shape how a person will be remembered and to provide other people with the ability to engage with the lives of people who have passed away.

PRIOR WORK

This research draws on prior work that describes goals and obstacles associated with the creation of a legacy, articulates the ways that people deal with death and its implications online, and argues for the potential benefits of creating systems that sensitively engage with lifetimes or generations of digital materials. We provide an overview of

that work below and where appropriate, in other sections of the paper. In doing so, we provide context for our work and identify areas where our research extends and contributes to existing knowledge. As our research work spans a number of genres, the content below is not exhaustive. Instead, this work was selected to highlight the ideas that influence and contextualize the work in this paper.

Before the review of prior work we feel that it's important to acknowledge that, in this paper, discussions about death, dying, legacy, and remembrance are most deeply influenced by Western perspectives and writings on those topics.

Legacy and life stories

This work is grounded, in part, in an understanding of the steps people take to shape how (and by whom) they'll be remembered. As people age, they are often motivated to consider and shape the impact their life has on the lives of others [40]. This process can have many parts, all of which contribute to the larger goal of leaving behind an impactful or enduring legacy [21, 36, 40]. For some people, the process of establishing a legacy involves passing on one's values to their children, friends, and communities [11]. For others, there is a desire to increase the longevity, size, or reach of one's impact on the world. To do so, people take steps to highlight meaningful aspects of their life and experiences through activities such as telling stories, accumulating objects, making donations to cultural or educational institutions, and by giving away symbolic objects to other people [25, 40].

However, the desire to be remembered or to have a particular impact on the world after one's death is not an entirely straightforward process. A legacy, like the performance of identity during a lifetime, is interpreted by the people to whom it is communicated. When a person passes away, people who mourn their death may integrate aspects of their life into their own [42]. A person's hopes for how they'll be remembered, however, may not align with how other people interpret or look back on their life. Instead, each person is influenced by their own values, memories, and perceptions of the deceased.

Dealing with death online

Though our work is focused on a multigenerational timeframe, it is also influenced by work from a variety of disciplines that examines the role that digital systems play directly before and after a person's death.

Before death, digital systems are sometimes used to help the dying find support and to share information about their experiences with death and terminal illness [39, 43]. Going beyond finding support and information, some digital systems also offer people the ability to record their wishes for post-mortem concerns, such as end-of-life care or funeral arrangements [13]. Caregivers also use online resources, like forums, to connect with people who can offer information and emotional support [45]. These

services can be a valuable resource for the dying and their caregivers, family, and friends.

Post-mortem, digital platforms like social networks offer a space where people can share details about a person's life, grieve, and seek support from others [4, 23, 28]. Research in this area has demonstrated how online platforms have extended the groups of people who can participate in mourning a person's death and has made elements of this experience more public. The bereaved also use digital spaces to memorialize the dead [13, 32]. Doing so provides them with a way to connect with other people, share information about the deceased, create a space for people to grieve, and create an enduring reflection of a person's life.

After a person passes away they leave behind a vast assortment of digital materials [27, 34]. These materials differ for each person, but often include social media accounts, photographs, financial information, and emails, and may be spread across a variety of different accounts, websites, and devices. Digital resources are also used to help people gather materials, like photographs and quotes, that can be used as a part of a funeral service [31].

Multigenerational systems

Looking beyond the period of time directly before or after a person's death, researchers have discussed the potential significance of intentionally creating systems designed to span generations. This work does not often focus directly on the subject of legacy or experience, but describes systems that serve similar purposes using similar types of digital materials.

This research on multigenerational systems suggests that such systems would make use of information created in the near and distant past for a variety of purposes: helping people unpack and address complex issues like war and genocide, helping people better understand their own lives, and mediating more meaningful interactions with digital materials and the physical world [2, 13]. Research in this area also raises concerns regarding the design of such systems, particularly the difficulty of finding meaningful content in larger archives, questions regarding the ownership of these digital materials beyond a person's lifetime, and the difficulty of engaging with large collections of digital materials [7, 12, 26]. These concerns are significant and reflect how the standard, well-understood challenges of managing personal digital information are further complicated by death and dying.

A synthesis of this literature reveals that there is an opportunity to design systems that have functionality to support death-related practices and needs. Much of the current research in this space has focused on system services like Facebook's Legacy Contact [11] that support the direct transmission of specific accounts or pieces of digital media from one person to another [5]. This work is significant (and likely meaningful for the many families who make use of those features). However, as we argue in

this paper, it is important to consider how future systems might make sense of digital materials that are not managed in this way. Systems like Legacy Contact [11], Google's Inactive Account Manager [16], or beneficiary systems used by financial institutions will help people make plans for particularly meaningful accounts, but after that there is a need for a different kind of system – one that can help people engage with the broader landscape of digital materials that people leave behind when they pass away.

One potential avenue for this work is the development of automated or assistive systems that curate large collections of digital information [16]. Such systems, the algorithmic precursors of which already influence the content people see online [10, 37], might someday be employed to help convey meaningful representations of another person's life and experiences, even after their death. In this paper, we explore how emerging computational capabilities of digital systems can help communicate legacy oriented ideas and materials. We also discuss ethical implications stemming from the development of such systems.

METHOD

We used a multi-methods approach for this research. Participants were asked to use Retrospect, a design probe we developed and populated with their data, for nine weeks and to participate in four interviews over that time period. Prior to developing Retrospect and collecting data from participants, we spent several months designing the system and corresponding interview protocols to ensure that each piece would help elicit information relevant to the goals of our work. In the sections below, we first describe the design and development process for Retrospect and the tasks that participants completed using that system. Our desire to describe the process of designing and developing Retrospect was influenced by work by Boehner et al. [3] that noted that this work is not often shared in research papers. We hope that this information will be useful for people interested in similar design research methods. After discussing Retrospect, we then describe the interview protocols and the information we set out to collect from participants through those interviews.

RETROSPECT SYSTEM DESIGN

After identifying that we were interested in learning about how people engage with the lives of people who have passed away and about their own understanding of how future generations of people will interpret what they leave behind, we began to design a probe that could use a person's digital information to facilitate and support conversations about the information that is captured and made visible by digital systems. In addition to addressing our research questions, we had several high-level goals for this system. First, we wanted the system to provide an engaging experience for participants to support their continued participation in this nine-week study. Second, it was important that the website be robust and able to handle potential issues with gathering and presenting user data

over the duration of the study since participants would be using the system unsupervised at home.

Designs went through a number of iterations, but started with an analysis of the probes we'd developed as a part of prior research projects [17, 18]. This review highlighted the ongoing need for research that investigates how people and digital systems can collaboratively communicate important aspects of a person's life in the context of death and legacy. In addition, our design process for Retrospect was inspired, at a high level, by Wallace et al.'s work on personalized probes [41] and by Khovanskaya's work on probes using digital traces [22]. A critical decision we made at this stage was to create a digital probe that lived on the internet. There were a number of factors behind this decision: we wanted to create a system that could easily and flexibly make use of a participant's digital materials and we wanted to create a system that participants could use on their own outside of interview sessions.

We then set out to identify what information the probe would use. We explored the types of data that could be collected from the APIs provided by different websites including the US Census, social media sites like Facebook and Twitter, and location-based services like Google Maps and Yelp. Figure 1 and Figure 2 depict some early designs that we developed during this phase of the project.

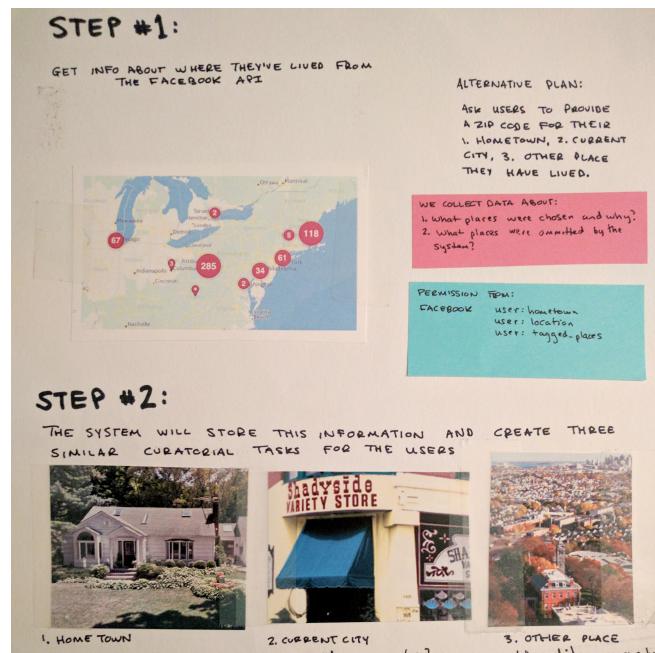


Figure 1: An early design sketch for one potential version of Retrospect. In this sketch, the different data sources we considered can be seen along with notes about how design decisions would allow us to ask particular research questions.

After reviewing our preliminary design work and the available data sources, we decided to build the probe using Facebook's API. We chose to use Facebook data for a number of reasons. Their API is well documented and there was a large group of developers using the API (which

turned out to be immensely helpful when we ran into issues developing the probe). In addition, the popularity of Facebook allowed us to recruit from a larger, more diverse pool of potential participants than if we'd used services with fewer users or that were primarily used by tech savvy people. Finally, Facebook captures a wide range of information about different aspects of people's lives and we felt as though it would be a good way to foster conversations about people's digital information in general.

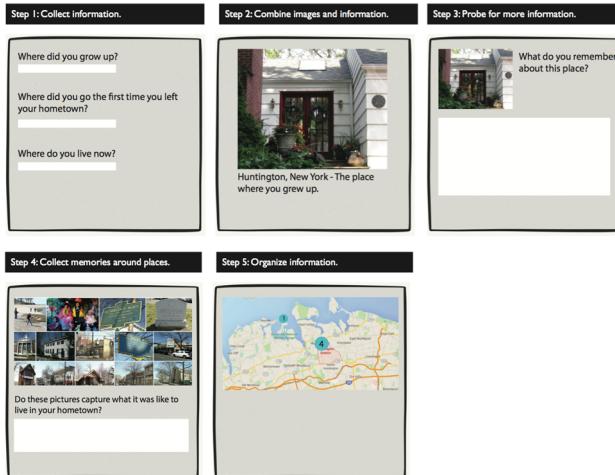


Figure 2: Another potential design for Retrospect. This design combined information from several data sources to help people curate information about places from their past.

After choosing to focus on information available through Facebook's API, we took the many designs we'd developed and experimented with ways that we could adapt some of these designs to make use of information available through the API while still addressing the larger goals of the study. Our work was also influenced by institutional guidelines that governed what information could be displayed, solicited, and captured about third parties, which limited our ability to ask participants detailed information about other people or to display materials that might inadvertently solicit this type of information.

Our probe, Retrospect (Figure 3), was a product of this

iterative, exploratory process. At each stage in the design process we assessed how changes to our design might help us elicit more useful information both from and for our participants. At the end of this process, we produced a probe that gathered information from a participant's Facebook account and then used that information to prompt them to reflect on different aspects and stages of their life using their profile pictures, information about places they'd been, and information about different personal milestones with work, education, and relationships.

This information was used as the basis for nine tasks in three different categories: *place*, *milestone*, and *gallery* tasks. Participants were asked to complete three of each of these types of tasks (for a total of nine). For the place task, participants were asked to reflect on (1) what it was like to live in their hometown, (2) what motivated their decision to come to their current city, and (3) a place they'd been in the past that had been significant to them in some way. For the milestone task, participants were asked to reflect on what it was like to (1) attend and graduate or leave a school they'd attended, (2) work at some job they'd had, and (3) be a part of a relationship with another person. For the gallery tasks, participants were shown two profile pictures from different times and were asked to write about how their life had changed between the times when the photographs were taken. Participants had the option to refresh the page to get two new photos if they weren't interested in the photos that were being displayed.

As an important note, although Retrospect asked participants to reflect on aspects of their life, we were not formally interested in making any primary contributions to research on reflection [1, 38] and reminiscence [8]. Instead, in Retrospect we used reflection to help participants consider what information is available about them online, and how that accessible data aligns with their understanding of important aspects of their life and experiences.

Retrospect was developed using the Python programming language and was translated to the web using Flask, a framework for building and deploying websites using Python and a host of related services including SQLite3, a

Figure 3: The Retrospect homepage. New tasks were shown on the left and completed tasks were available for review on the right.

data management tool. The website was hosted on the Python Anywhere platform which offered secure hosting and an appropriate level of functionality for a small website.

Each participant had a unique account on the Retrospect website that they set up during the first interview session by picking a username and password, and by authorizing Retrospect to access some of the information in their Facebook account. As a part of that authorization, Retrospect collected the following data from participants:

1. Their 50 most recent profile photos. For participants with less than 50 photos, the system simply collected however many they had.
2. Location information, including a person's hometown, current city, and any location they had tagged in a photograph or post.
3. Information about milestones or major events. This included a person's work history, education history, and relationship status.

Participants were not screened or excluded from the study based on the information they had in their Facebook profiles. As a result, the system did not always have all of the information that was used to build tasks for participants. When information was missing, participants were asked to supply that information. For example, if information was missing for a place or milestone task, participants were invited to choose a relevant milestone or location that had some significance to them and to answer the questions based on what they'd chosen. They also had the option to skip tasks for which they did not want to provide information.

All of the Facebook data used during the entire course of the study was stored in Retrospect's database as it was collected from the Facebook API during setup, which meant that the system did not have any information that was shared to a person's Facebook account after the start of the study. As a result, participants were welcome to rescind their Facebook authorization for Retrospect after this setup process had been completed. This helped streamline the process of using the Retrospect website, avoiding repeated user re-authorizations and reducing potential errors connecting to Facebook during the 9-week deployment. The Retrospect website also contained standard functionality to assist with common issues experienced using websites over time, including the ability for users to reset their passwords, send messages to the researchers from within the website, and access information about the study and the researchers (including a copy of the consent form). The Retrospect website was extensively tested before the main participant study through a series of pilot studies aimed at screening for possible errors and potential security issues.

INTERVIEWS

In addition to being asked to use Retrospect to complete a reflective task each week on their own time, participants

participated in four interviews over the course of the nine week study.

First Session

The first session with each participant marked the start of nine weeks participating in the study. During the first interview session, we talked with participants about the goals and components of the project. After confirming that they still wanted to participate, we helped each participant set up their account on the Retrospect website, answered any questions they had about authorizing the website to access their Facebook data, and explained our institution's policy on participant data management and security. We then showed them the different types of tasks they'd be asked to do over the course of the study and showed them how to access parts of the website they could use to report errors, reset their password, and send us a message.

We also explained our use of Retrospect as a design probe. That is, we did not build Retrospect as a prototype, nor did we intend to use it outside of the study itself. Instead, we built it to better understand the aspects of a person's past that are shared online, to investigate how people perceive the value and impact of that information, and to ground, prompt, and guide discussions during the interview sessions.

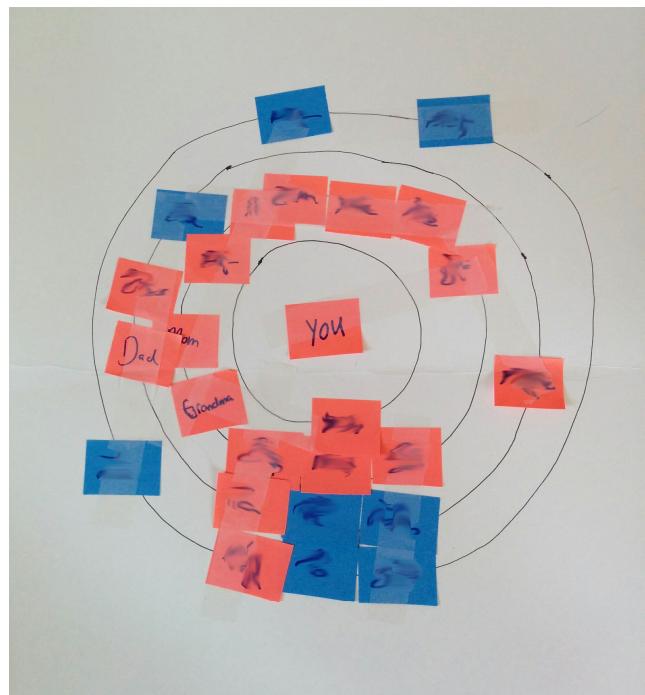


Figure 4: A participant's participant-aided sociogram. The names have been blurred to protect participant privacy.

We then conducted a short interview, lasting between 15 to 30 minutes, in which we asked each participant to give a brief overview of their life, to talk about the different websites they visit online, to talk about their experience using websites to revisit older content, and to describe their interest in reflecting on their own life. We also had

participants complete a participant-aided sociogram [1], which are simple graphical representations useful for displaying, reflecting on, and interpreting social relationships. Following [1], participants wrote out the names of all of the people with whom they had ‘very close’ and ‘somewhat close’ relationships and then arranged them on concentric circles, positioning people relative to themselves and to each other. After the participant completed their sociogram, we asked them to describe their relationships with the people they’d included. Figure 4 shows a sociogram created by one of the participants.

Second Session

We scheduled a second interview with participants 2-3 weeks after the first interview. In this interview, we talked to participants about their experience using Retrospect and we then asked them to answer questions about their experiences making end of life plans (such as creating a will), their experiences talking to their parents or relatives about their deaths, their experience inheriting things from people who have passed away, and any recent or significant experience they’d had with the death of someone who was close to them. These interviews lasted about an hour.

Third Session

The third interview was scheduled for week 6 or 7 of the study, depending on the participant’s schedule. During this interview, we asked participants to talk about how they define legacy and how they had been impacted by the legacy or memory of other people. We also talked about their sense of how their life and legacy had changed over time. On average, these interviews lasted about an hour.



Figure 5: For each participant, we created a booklet that contained excerpts of the information they shared with Retrospect. We gave these booklets to participants in the fourth interview session.

Fourth Session

We scheduled a final interview with each participant after 9 weeks. During this interview, we asked them to talk about the experience of using Retrospect. As a memory aid, we gave each participant a custom booklet containing excerpts of the responses they’d contributed to Retrospect so far. This booklet, an example of which is shown in Figure 5, reflected our interest in exploring how we might give participants access to the information they provided to the design probe. In the interview session, the physical format of the booklet provided an easy way for the researchers and the participants to review the information that a participant had contributed. Prior to creating and then looking through the booklet with each participant, we did not review the information they had contributed to the system. Because we did not intend to analyze the information participants wrote using Retrospect, we made the decision to give the participants the opportunity to share this information as it pertained to the interviews.

We also asked the participants to talk about their experiences researching their family history. Finally, we interviewed them about the different ways in which they document their life online and offline. These interviews lasted about an hour.

PARTICIPANTS

We recruited 10 adults to participate in the study through a local email list. Participants were selected that were diverse in age, stage of life, technological proficiency, family size and situation, gender, and socioeconomic status. To participate in this study, participants had to be at least 18 years old, have a tablet, laptop, or desktop computer in their home that could access the internet, and have a Facebook account. They also had to be comfortable with sharing their Facebook data with the Retrospect system, with participating in in-home interview sessions, and with joining a study that was designed to take place over nine weeks. Because we were collecting personal information from people’s Facebook accounts, we provided potential participants with detailed information about these aspects of the study so that they could make an informed decision about whether or not they’d like to participate.

Of the 10 participants, 5 were men and 5 were women. The age of participants ranged from 23 years old to 52 years old, with an average age of 33.8 years old. 7 of the participants were married and 5 of the participants had children. Participants had a wide range of occupations, including a small business owner, a professor, and a nurse. In addition, participants varied with regards to their interest in and proficiency with computers, though all had some means of connecting to the internet, a presence on Facebook, and an email account. Participants also had a wide range of life experiences. For example, nine of the ten participants were not originally from the local area but had moved there at different stages of their life for work, to go to school, or to move closer to friends and loved ones. They also had

varying experiences thinking about death, legacy, and end-of-life care. Several had recently experienced the death of a family member, friend, or classmate.

Interviews took place primarily in participants' homes, but also took place in an office at Carnegie Mellon when that was more convenient for a participant. Participants were paid a total of \$80 for their involvement in the entire study. They were paid \$20 after the first interview, \$10 for the second interview, \$15 for the third interview, and \$35 for completing the fourth and last interview. All of the participants completed all four interviews and did at least one task for each of the three task types. Six participants did all nine tasks; participants completed an average of 8.2 tasks.

DATA ANALYSIS

For each participant, we had three recorded interviews (the first interview was mostly a preliminary session and was not recorded) in addition to many pages of notes and documents created and collected by the researchers. Each of these three interviews was transcribed directly after the interview session.

After the study was complete and all of the recordings were transcribed, we analyzed the data using an iterative, open coding process drawn from the methods used in grounded theory [6]. We began by reading through each of the interviews to get a better sense of the connections between the information provided by each of the participants. From there, we created a collection of codes that described the data and that connected the information we'd collected with the larger goals of the study. The codes changed as we continued to review the transcripts. After several revisions, this coding scheme contained 80 codes distributed among 10 higher-level categories. Once a final set of codes was developed, we re-coded each interview and began to formally identify meaningful findings from the study data.

It is important to note here that the information contributed by participants to Retrospect via their task activities was not included in our analysis. Within our research, Retrospect was used to accomplish several clear and related goals: 1) to get a better sense of the aspects of a person's past that are shared as information online, 2) to draw out examples of how people use digital systems, like social networks, in ways that might not be apparent to curatorial systems, and 3) to scaffold conversations with participants about how their shared online information might shape how they're viewed after their death. The information collected and then surfaced in Retrospect helped us explore these ideas with participants and elicited a rich set of examples drawn directly from participants' experiences using and thinking about the Retrospect website.

FINDINGS

Below, we present a collection of findings, which describe 1) the need for systems that engage with materials that are and will be left behind (and not directly passed down), 2)

comparisons between how a person wants to be remembered and the digital materials they think they'll leave behind, and 3) the potential for systems to support the ability for people to engage with the experience of legacy. Afterwards, we discuss these findings and examine how designers and developers could build systems that engage with the large, heterogeneous collections of digital materials that people leave behind when they pass away.

Systems for passing down and leaving behind

A key aspect of this work was to better understand the role that different types of systems can play in how people engage with a person's digital materials over time and across generations. Prior research in this area [5, 35] has described considerations for systems that allow for the assignment or stewardship of particular accounts or pieces of digital information (*i.e. things that are passed down*). Though that work has elicited valuable contributions, the findings from our work focus on a distinct, but related vein of inquiry: how people engage with information that is not directly or deliberately handled using such features (*i.e. things that are left behind*). Our findings build on this work and describe how digital systems can represent and adapt to the ways in which a person's legacy may change over time and the ways in which a person's interest in another person's life may change over time.

While features like Facebook's Legacy Contact and Google's Inactive Account Manager are valuable, none of the participants in our study had used post-mortem account management features. Furthermore, only about half of the participants had a will (though many noted the value of creating such documents). This situation highlights the opportunity to learn from how people handle the many physical or financial things that people leave behind, but do not formally pass on, when they die. That is, although a significant percentage of the population of US adults do not have a will [14], the bereaved are often still able to make decisions about what should happen to possessions that are left behind after that person has passed away. This is based, in part, on their understanding of a person's life and on existing norms and practices. This finding articulates the importance of two complementary aims: 1) encouraging companies to develop services that facilitate passing on particularly important aspects of a person's digital materials, and 2) creating systems that help survivors and future generations of people engage with the rest of a person's digital materials without their direct instruction, assignment, or stewardship.

Participants expressed mixed feelings about using features like Facebook's Legacy Contact. Some were open to using these features if it would have value to their partners or relatives, saying things like "*I don't really care what happens to my Facebook page after - if they want to keep it up and running or not, same idea*" (P4). Others expressed questions and concerns about using those features, such as "*What happens? I guess it just stays, does it ever go away,*

after several years of inactivity?" (P1) and "I'm not personally a fan of that. I would rather just have it shut down and I think if people need to say something they can just send a prayer or call my parents or something, there's other avenues for showing support other than writing on the wall of someone who's never going to read it." (P7). This evidence serves as another reason to consider the development of systems that manage legacy information without direct instruction or assignment. In keeping with existing research [23, 33], participants did, of course, name digital materials that they hoped would endure, including photos of significant events, like weddings and trips, and photos that depicted significant family members and friends. However, participants also questioned 1) the value of maintaining a digital presence after their death, 2) whether digital information would have value many years in the future, and 3) the effort that would be required from the person assigned to manage some account or information.

Despite this uncertainty, participants in the study also identified a number of potential benefits of systems that would help people engage with their digital materials (whether passed down or left behind). Of the ten participants, five (P2, P3, P7, P8, P9) felt as though their children might find value in the digital information they'd leave behind both because of what is captured in that information and because of what it conveys about a person's life and values. P9, talking about a picture of his daughter he'd recently shared on Facebook through the Facebook 'On This Day' feature said '*Yesterday there was like the, you know, [Facebook] memories. So yesterday there were a whole bunch [of photos]—I changed my profile picture to my daughter when she was two weeks old and I was like 'oh that's really cool'... She could potentially see that kind of thing in the future and my son could potentially see that kind of thing in the future. Oh, look at what I looked like or look at what I did. So I think that's really cool."*

Conveying important aspects of one's life

During conversations with participants we discussed the different ways that aspects of participants' lives could be passed down or left behind after their deaths. In line with existing literature [29, 21], participants described that they wanted to 1) pass on their values to future generations, 2) have a positive impact on future generations, and 3) ensure the continuation of particular traits, values, and traditions. Given that focus, we asked participants to consider the extent to which information about those things could be found in, or understood through, their digital materials.

Retrospect played a large role in this line of inquiry – the website asked people to reflect on pieces of their digital information as a part of every task on the site. In the second, third, and fourth interview sessions we used Retrospect tasks as a jumping off point for conversations about the different types of digital materials participants

generate and how that relates to important aspects of their life. Participants did not always feel a strong connection to the people, places, and things that populate their digital accounts. For example, nearly all of the participants had their hometown listed on their Facebook account but several participants were not interested in reflecting on it as a part of the place task, or in talking about it as one of the important parts of their life. Providing information about one's hometown, high school, or college serves a logistical function within systems as a way for people to identify and connect with other users. While this information describes some aspect of a person's life, it may not be as meaningful to a person as other information that is not documented in the same way.

Discussions with participants about the different ways they use system functionality to accomplish their own goals also highlighted opportunities for systems to capture potentially meaningful aspects of a person's life. For example, P3 talked about changing her profile picture to a photo of the deceased actor Philip Seymour Hoffman when he died, saying "*I wrote a tiny bit about Phillip Seymour Hoffman, because that was one of the photos that came up today. It was that and this other one... [I thought] wow I posted this picture on the day that he died, in my favorite role of his.*" Many people choose profile pictures that feature a place, object, or different person as a way for people to demonstrate their connection to that thing and to foster conversations about it. Similarly, several participants described occasions in which they updated their profile picture to be an old photo of themselves, such as a photo of when they were a child. In these cases, it is clear to see how the metadata about those photos (such as the date they were posted relative to a person's age) could help surface or convey some meaningful or interesting content from a person's life.

There is a great variety in how people perceive the value (in both the short term and long term) of the information they share online. Though it is easier to prioritize or privilege structured data, it is important to consider the implications for doing so and to look for opportunities to find and highlight other, meaningful aspects of a person's life.

Experiencing legacy

Interviews with participants elicited information about how they engage with legacies and memories that other people have left behind. Seven of the participants reported that they'd inherited things from people who had passed away; five had inherited money, one had inherited jewelry, and one had inherited a treasured possession from her grandfather. Participants also described objects that they had been given or had claimed after the death of a loved one. These objects weren't inherited directly from the person who had passed away, but were instead given to the participant by an intermediary (such as a parent) or were taken as a part of organizing and giving away a person's possessions as they reached the end of their life (as has

been described in research work such as [25]). This included a set of gloves and a brooch from a participant's great-aunt and a jacket a participant's grandparent had worn. Though the participants appreciated the money they'd inherited, people seemed to be more deeply impacted by objects that reminded them of people who had passed away.

Participants also engaged with memories of other people through their everyday experiences. These experiences, which rarely involved any valuable, old, or rare objects, instead focused on specific memories people had about people who'd passed away. P1 illustrated this idea by describing one of the ways in which she is reminded of her grandmother "*Every time I see a red cardinal we always say 'That's grandma!' because she loved red cardinals. We have so many cardinals in my backyard, we say 'Hi Grandma!!' So things in that way I think is kind of a legacy because the red cardinal was insignificant until grandma made it something. That's something, like, our whole family does now. I guess that's kind of a legacy, it's just a bit of her that we remember even though she's been gone for several years now.*" Nearly all of the participants were able to provide an example of this type of remembrance. P6, for example, also shared a way he is reminded of his deceased grandfather: "*[My grandfather] really enjoyed walking. A lot. He used to – whenever we'd visit, or whenever he visited here when we first moved out to America, he would... leave the house and then just go start walking and then he'd be back like 5 hours later. We'd be like where'd you go? and he'd be like I just walked until it ended. Anytime I go on like long walks or hikes I guess it's a little bit [like] mini reminders [of him].*" As with these two examples, many of these remembrances were connected to nature in some way.

It's unlikely that digital information would form the basis for this type of remembrance; many of these examples resulted from a person internalizing some memory about a loved one. There is, however, the potential that digital information could be used to trigger the process of remembering and experiencing some aspect of a person's legacy in a similar way. Just as seeing a red cardinal evokes memories of P1's grandmother, there is an opportunity to build systems that foster mundane or everyday reminiscence about people who have passed away. Though these systems would need to be sensitive to potential harm that could result from reminding a person about a deceased loved one, such systems could also provide people with a new way to connect with treasured memories and experiences.

Another important consideration for how people experience and engage with other people's legacies is the idea that a person's understanding of another's person's life will change over time. In one of our interview sessions, P5 discussed how raising a child had changed how she understood her mother's life and her mother's interest in

elementary education, saying "*I think all of her mothering went into her students, pupils - into the kids. But she would talk to me sometimes about what happened at school and I took on certain attitudes about early childhood through her that have served me very well as a mother.*" Several participants described family traditions, traits, and memories they hoped to instill in the next generation of their family. Creating a legacy is a process that is undertaken, in part, because a person wants to establish some form of enduring remembrance of their life. Digital systems operating in this space should account for the ways in which a legacy can change over time as it is interpreted and reinterpreted by new generations. For example, a system might allow a person to select and integrate particular aspects of another person's digital information into their existing accounts or profiles.

DISCUSSION

In this section we describe several potential avenues for system development, including the opportunity to leverage information about a person's life to identify aspects of that life that might be worth reflecting on or sharing post-mortem, the opportunity to guide people through the process of learning more about their ancestors, and the opportunity to help people better understand information created in the past by placing that information into context.

Opportunities for analytical systems

As illustrated by this work and other related research [18, 27, 31], there is an opportunity to understand how we can use digital information, and the digital systems that capture and hold that information, to help people communicate important aspects of their life post-mortem. One way of doing this is to develop systems (or features for existing systems) that facilitate this process by leveraging what systems know about a person's preferences, hobbies, and personality to organize content around those topics in formats that can be easily shared with other people. Most social networks have an internal assessment of a user's personality, hobbies, and interests, and this information can help systems identify meaningful representations of a person's life in their digital materials. For example, if a system observes that a person has an interest in travel, they might generate a slideshow of travel-related content that they can reflect on and share. Creating an assessment of one's life relative to one's broader digital materials may not be entirely feasible at this point in time, but the ability for systems to analyze and make judgments about digital content continues to develop.

A concern here is the degree to which such systems might influence a person's understanding of their own life or the lives of others. Though prior research indicates that people are interested in this type of system [18], work by Warshaw et al. emphasizes that people felt uncomfortable making corrections to a system's analysis of their personality traits [44]. Systems that curate and synthesize found digital information need to be cognizant of how their rendering of

a person's life and experiences may impact how they are remembered.

Finding experience in large archives

If people are interested in engaging with information about a person's life, systems can help with this process in much the same ways that they help people make sense of their own digital information. One way to do so is for systems to offer people the ability to get a quick sense of a large amount of information. For example, a system might analyze the content from an old online diary and present the viewer with a mediated summary of the contents. This information could include topics covered in the posts, the names that are mentioned, any photographs that were posted, or the dates when the service was used. This information could then help a person decide whether they'd like to explore that account more deeply. The ability to provide this type of information might be coupled with broader analytical capabilities. Prior work has illustrated the value of this technique [9], and there is an opportunity to understand how we might apply it to lifetimes of digital information.

Another way to address this issue would be to develop systems that search directly for content relevant to particular supported queries. Participants in this study who had conducted family history research described being particularly interested in a small set of questions such as what was a person's life like, or how did a particular person make important decisions? Finding content related to specific questions could help people initially approach or become interested in researching their family history using digital information (which might otherwise be a daunting task). There is a great opportunity for future work to leverage the ways that people investigate their family history to inform the design of future systems that engage with information left behind when people pass away.

Communicating context

If future generations of people are interested in digging deeper into a person's digital materials, a major challenge to a person's ability to understand that information is that the norms and practices that influence the use of digital systems will likely have changed over time. This has happened many times already with online social networks (including once prominent sites like Friendster, Orkut, and MySpace which no longer operate in the same contexts). Norms for the content and format of what people share has also changed on websites that are currently popular. Similarly, changes to people's understanding of audience have shaped how individuals engage in identity presentation and management on these websites. The potential difficulty of understanding the context of some piece of digital information and media is not unique to digital things, but the scale and format of digital things exacerbates this issue.

As a result, there is an opportunity to build system features that allow people to explore how websites were used in the

past. One could imagine, for example, a feature that allows a person to roll back their own Facebook or Twitter feed to see what the experience of using the site was like a decade ago. This feature could be built into existing functionality, such as Facebook's security-based 'View As' feature, which allows people to see what their profile looks like from the perspective of other people.

Advancing the probes method

Finally, there is an opportunity to extend the use of design probes in HCI research, and to better understand how we might engage in participatory work with probes. A number of papers have outlined how researchers build and utilize probes, and how the results of that process might (or might not) be analyzed [3, 15]. Building on that work, we believe that there is a need to understand how probes like Retrospect can demonstrate that the contributions made by participants are valued and allow those participants to lead discussions about what they've shared.

In this study, we assembled each participant's data into booklet and gave it to the participant in the final interview. Prior to that interview, we did not review the information participants had written in Retrospect. By allowing participants to control the process by which we looked through and learned about the information they provided, we hoped to communicate our respect for their experiences and their contributions to our work. This procedure was also a way for us to allow participants to decide what to share with us, and how and when to share that information. This is only one of many different potential options for expressing these ideas, and we look forward to future variations on utilizing probes to collect sensitive or personal information from participants.

CONCLUSION

This study explored how people might communicate aspects of their life, relative to the stores of digital information that they have collected, once they pass away. We presented a mixed-methods study that involved an online design probe which investigated how digital systems and information might help shape how people look back on and interpret people's lives after they've passed away. We hope that findings from this work will guide the design and development of systems that work with large found and unassigned archives of digital information to surface meaningful aspects of a person's life and legacy after they've passed away.

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REFERENCES

1. Eric P.S. Baumer, Vera Khovanskaya, Mark Matthews, Lindsay Reynolds, Victoria Schwana Sosik, and Geri Gay. 2014. Reviewing reflection: on the use of reflection in interactive system design. *DIS 2014*, 93 – 102.
2. Gordon Bell and Jim Gemmell. 2007. A digital life. *Scientific American*.
3. Kristen Boehner, Janet Vertesi, Phoebe Singers, and Paul Dourish. 2007. How HCI interprets the probes. *CHI 2007*, 1077 – 1086.
4. Jed R. Brubaker and Gillian R. Hayes. 2011. “We will never forget you [online]”: An empirical investigation of post-mortem Myspace comments. *CSCW 2011*, 123 – 132.
5. Jed R. Brubaker and Vanessa Callison-Burch. 2016. Legacy contact: Designing and implementing post-mortem stewardship at Facebook. *CHI 2016*, 2908 – 2919.
6. Kathy Charmaz. 2006. Constructing grounded theory. SAGE Publications.
7. Mary Czerwinski, Douglas W. Gage, Jim Gemmell, Catherine C. Marshall, Manuel A. Pérez-quiñones, Meredith M. Skeels, and Tiziana Catarci. 2006. Digital memories in an era of ubiquitous computing and abundant storage. *Communications of the ACM* 49, 1: 45 – 50.
8. Dan Cosley, Victoria Schwanda Sosik, Johnathon Schultz, S. Tejaswi Peesapati, and Soyoung Lee. 2012. Experiences with designing tools for everyday reminiscing. *Journal of Human-Computer Interaction* 27, 1-2: 175 – 198.
9. Daragh Byrne, Aisling Kelliher, and Gareth J.F. Jones. 2011. Life editing: third-party perspectives on lifelog content. *CHI 2011*, 1501 – 1510.
10. Motahhare Eslami, Aimee Rickman, Kristen Vaccaro, Amirhossein Aleyasen, Andy Vuong, Karrie Karahalios, Kevin Hamilton, and Christian Sanvig. 2015. “I always assumed that I wasn’t really that close to [her]”: Reasoning about invisible algorithms in news feeds. *CHI 2015*, 153 – 162.
11. Facebook Legacy Contact. Retrieved from: <https://www.facebook.com/help/1568013990080948>
12. Andrew Fitzgibbon and Ehud Reiter. 2003. Memories for life: Managing information over a human lifetime.
13. Batya Friedman and Lisa Nathan. 2010. Multi-lifespan information system design: A research initiative for the HCI community. *CHI 2010*, 2243 – 2246.
14. Gallup Poll – Last Wishes: Half of Americans Have Written Wills. 2005. Retrieved from: <http://www.gallup.com/poll/16660/last-wishes-half-americans-written-wills.aspx>
15. William Gaver. 2012. What should we expect from research through design? *CHI 2012*, 937 – 946.
16. Google’s Inactive Account Manager. Retrieved from: <https://support.google.com/accounts/answer/3036546?hl=en>
17. Rebecca Gulotta, William Odom, Jodi Forlizzi, and Haakon Faste. 2013. Digital artifacts as legacy: Exploring the lifespan and value of digital data. *CHI 2013*, 1813 – 1822.
18. Rebecca Gulotta, Alex Sciuto, Aisling Kelliher, and Jodi Forlizzi. 2015. Curatorial agents: How systems shape our understanding of personal and familial digital information. *CHI 2015*, 3453 – 3462.
19. Rebecca Gulotta, David B. Gerritsen, Aisling Kelliher, and Jodi Forlizzi. 2016. Engaging with death online: An analysis of systems that support legacy-making, bereavement, and remembrance. *DIS 2016*, 736 – 748.
20. Bernie Hogan, Juan Antonio Carrasco, and Barry Wellman. 2007. Visualizing personal networks: Working with participant-aided sociograms. *Field Methods* 19, 2: 116 – 144.
21. Elizabeth G. Hunter and Graham D. Rowles. 2005. Leaving a legacy: Toward a typology. *Journal of Aging Studies* 19, 3: 327 – 347.
22. Vera Khovanskaya, Eric P.S. Baumer, Dan Cosley, Stephen Voda, and Geri Gay. 2013. “Everybody knows what you’re doing”: A critical design approach to personal informatics. *CHI 2013*, 3403 – 3412.
23. David S. Kirk and Abigail Sellen. 2010. On human remains: Values and practice in the home archiving of cherished objects. *TOCHI* 17, 3.
24. Jessa Lingel. 2013. The digital remains: Social media and practices of online grief. *The Information Society* 29, 3.
25. Jean-Sébastien Marcoux. 2001. The ‘casser maison’ ritual: Constructing the self by emptying the home. *Journal of Material Culture* 6, 2: 213 – 235.
26. Catherine C. Marshall, Sara Bly, and Francoise Brun-Cottan. 2006. The long-term fate of our personal digital belongings: Toward a service model for personal archives. *Archiving Conference*.
27. Michael Massimi and Andrea Charise. 2009. Dying, death, and mortality: Towards thanatosensitivity in HCI. *Proceedings of CHI 2009 Extended Abstracts*.
28. Michael Massimi and Ronald M. Baecker. 2011. Dealing with death in design: Developing systems for the bereaved. *Proceedings of CHI 2011*, 1001 – 1010.
29. Dan P. McAdams, Ed de St. Aubin, Regina L. Logan. 1993. Generativity among young adults, midlife, and older adults. *Psychology and Aging* 8, 2: 221 – 230.
30. Dan P. McAdams. 2001. The psychology of life stories. *Review of General Psychology* 5, 2: 100 – 122.

31. Wendy Moncur, Jan Bikker, Elaine Kasket, and John Troyer. 2012. From death to final disposition: Roles of technology in the post-mortem interval. *CHI 2012*, 531 – 540.
32. Wendy Moncur. 2014. An emergent framework for digital memorials. *DIS 2014*, 965 – 974.
33. William Odom, James Pierce, Erik Stolterman, and Eli Blevis. 2009. Understanding why we preserve some things and discard others in the context of interaction design. *CHI 2009*, 1053 – 1062.
34. William Odom, Richard Banks, Richard Harper, David Kirk, Siân Lindley, and Abigail Sellen. 2012. Technology heirlooms? Considerations for passing down and inheriting digital materials. *Proceedings of CHI 2012*, 337 – 346.
35. Raquel O. Prates, Mary Beth Rosson, Clarisse S. de Souza. 2015. Making decisions about digital legacy with Google’s Inactive Account Manager. *INTERACT 2015*, 201 – 209.
36. Linda L. Price, Eric J. Arnould, and Carolyn Folkman Curasi. 2000. Older consumers’ disposition of special possessions. *Journal of Consumer Research* 27, 2: 179 – 201.
37. Emilee Rader and Rebecca Gray. 2015. Understanding user beliefs about algorithmic curation in the Facebook news feed. *CHI 2015*, 173 – 182.
38. Corina Sas and Alan Dix. 2009. Designing for reflection on experience. *Proceedings of CHI Extended Abstracts*, 4741 – 4744.
39. Barbara F. Sharf. 1997. Communicating breast cancer on-line: Support and empowerment on the internet. *Women and Health*, 26, 1.
40. David R. Unruh. 1983. Death and personal history: Strategies of identity preservation. *Social Problems* 30, 3: 340 – 351.
41. Jayne Wallace, John McCarthy, Peter C. Wright, and Patrick Olivier. 2013. Making design probes work. *CHI 2013*, 3441 – 3450.
42. Tony Walter. 1996. A new model of grief: Bereavement and biology. *Mortality* 1, 1: 7 – 25.
43. Tony Walter, Rachel Hourizi, Wendy Moncur, and Stacey Pitsillides. 2012. Does the internet change how we die and mourn? Overview and analysis. *Omega* 64, 4: 275 – 302.
44. Jeffrey Warshaw, Tara Matthews, Steve Whittaker, Chris Kau, Mateo Bengualid, Barton A. Smith. 2015. Can algorithms know the ‘real you’? Understanding people’s reactions to hyper-personal analytics systems. *CHI 2015*, 797 – 806.
45. Lia Willis, George Demiris, and Debra Parker Oliver. 2007. Internet use by hospice families and providers: A review. *Journal of Medical Systems*, 31, 2: 97 – 101.