Digital Legacy: A Systematic Literature Review

DYLAN THOMAS DOYLE, Information Science, University of Colorado Boulder, United States
JED R. BRUBAKER, Information Science, University of Colorado Boulder, United States

To better support the dying and bereaved in end-of-life contexts, over the past two decades HCI and social computing scholars have sought to understand digital legacy. In this paper, we argue that it is time to take stock of digital legacy scholarship, examining what we know, what gaps remain, and what areas are imperative for future work. Through a Grounded Theory Literature Review (GTLR), we identify four foci in digital legacy research to date: how identity is navigated in the passing of digital legacy, how digital legacies are engaged with, how digital legacies are put to rest, and how technology interfaces with offline legacy technologies. Based on our analysis, we present a model depicting how digital legacy research examines a lifecycle of data as it is passed down. This model identifies that digital legacy data moves through three stages: encoding, accessing, and dispossessing. The model illustrates gaps in current research and charts possible inflection points for future social computing research. Specifically, we highlight the importance of multi-user and multi-generational networks of people in end-of-life scenarios. Additionally, the model exhibits emerging theoretical findings and major concepts in the nascent field of digital legacy research.

CCS Concepts: • **Human-centered computing → HCI theory, concepts and models**; **Collaborative and social computing theory, concepts and paradigms**; • **Information systems → Collaborative and social computing systems and tools**.

Additional Key Words and Phrases: digital legacy, end of life, inheritance, stewardship, memorial, memory, death, identity, legacy, heirlooms, literature review

ACM Reference Format:
Dylan Thomas Doyle and Jed R. Brubaker. 2023. Digital Legacy: A Systematic Literature Review. *Proc. ACM Hum.-Comput. Interact.* 7, CSCW2, Article 268 (October 2023), 26 pages. https://doi.org/10.1145/3610059

INTRODUCTION

Moments surrounding the death of a loved one can be, and often are, fraught with emotional, spiritual, and logistical dilemmas that are destabilizing and painful. The toll the death of a loved one can take is exacerbated by questions about what gets passed down by the deceased and where or to whom it goes next. Legacy materials that get passed down can include values, wishes, identities, objects, digital content, heirlooms, or many other meaningful items. Both the tangible items like heirloom objects and more amorphous things like values form a legacy that is passed down [27], often to a recipient such as a bereaved loved one. When taken as a whole, digital legacy materials such as data and accounts form a digital legacy that is passed down between individuals. Similar to other legacy materials (e.g., physical heirlooms), digital legacy materials (e.g., social media accounts, collections of passwords, or digital archives of files or media) can carry values and meaning that are passed down.

Authors' addresses: Dylan Thomas Doyle, Information Science, University of Colorado Boulder, INFO 129, 1045 18th St., Boulder, Colorado, 80309, United States, dylan.doyle@colorado.edu; Jed R. Brubaker, Information Science, University of Colorado Boulder, INFO 129, 1045 18th St., Boulder, Colorado, 80309, United States, jed.brubaker@colorado.edu.

2573-0142/2023/10-ART268
https://doi.org/10.1145/3610059

As technology – especially digital accounts and data – make up a greater percentage of what is passed on by those who die, it is increasingly important for designers to consider the potential role their systems may play in the passing down of digital legacy [36].

Designing for the passing of digital legacy runs into challenges due to it being a process that occurs over time and between people across a diverse set of familial connections, social systems, geographies, and cultures. Technologies must consider not only what digital legacy materials (systems, accounts, and data) are included in an individual's digital legacy, but also how an individual's digital legacy is shared and received across multiple generations of other individuals within complex social environments.

By designing more apt technologies to serve the social complexities of digital legacy, burdens can be lessened for those who are dying and their loved ones. To aid in the design of more effective technologies, over the last two decades HCI and social computing scholars have published important research on digital legacy.

However, the scholarship examining digital legacy has been varied in how it has empirically attended to the social complexities of passing digital legacy. Digital legacy research has focused on divergent populations, topics, and considerations of the transmission of data and accounts. For example, while some papers researching digital legacy discuss how people can more effectively decide what accounts and data are meaningful for them to preserve [11, 16, 22, 40], other papers discuss attitudes of bereaved individuals towards the memorialization of their loved ones on social media [7, 8]. Though each of these papers may focus on digital legacy broadly, they enter the conversation from different perspectives and focus on diverse elements of digital legacy. With a large variety of perspectives and empirical foci, it is difficult to look at this literature and determine its scope, interests, and future research directions.

With a diverse critical mass of scholarship now published about digital legacy, it is time to take stock of this area as a whole, examining what we know, what gaps remain, and what areas are imperative for future work. As a community grounded in examining and addressing complex social-technical gaps [2], social computing is especially well positioned to add perspectives that help digital legacy scholarship contextualize its work in complex end-of-life social systems. CSCW has a rich history of researching related areas of study such as lifespan technology development [35] and data management during life transitions [37] and is well situated to contribute to digital legacy challenges. However, though CSCW is well situated to contribute to digital legacy research, to date it is minimally represented in the literature. By mapping where digital legacy research interests converge in HCI literature more generally, social computing research can more comprehensively identify suitable inflection points for its future research and contributions.

To this end, we present the results of a Grounded Theory Systematic Literature Review (GTLR) [51] of digital legacy scholarship to date. Via an inductive thematic coding and analysis process (per GTLR methods), we found CSCW and the broader HCI community focuses on four key areas: how identity is navigated in the passing of digital legacy, how digital legacies are engaged with, how digital legacies are put to rest, and how technology interfaces with offline legacy technologies (e.g., virtual gravestones). GTLR is used in newer research spaces to summarize existing work in the field and to enumerate key concepts that have emerged across disparate empirical foci, as is the case with digital legacy scholarship.

By looking at the papers beyond their specific topics and in relationship to one another, we find that digital legacy literature is interested in a broader lifecycle of data (e.g., digital legacy materials). We find that in this lifecycle data moves through three interdependent stages on its way to final deletion: encoding, accessing, and dispossessing.

Interpreting the data cycle we identify through our literature, we present a *digital legacy data lifecycle model* depicting how digital legacy data is passed down across generations (e.g., the dying

individual and a receiver is a single generation of passing down, while that receiver passing down that data to a second receiver is a second generation of passing down, and so on). The data lifecycle model highlights that digital legacy material is acquired and re-acquired across multiple end-of-life stages and across multiple generations of individuals. The model seeks to illustrate and interpret how digital legacy literature depicts the path of data as it is passed down, the technical challenges in designing for the path of data depicted, and research gaps that should be addressed in future research.

This paper contributes to the CSCW community by presenting a synthesis of HCI digital legacy literature; literature that often examines the social complexities of data management as data passes from the dead to the living, and between the living. By presenting this synthesis through a model we seek to help CSCW researchers and designers identify the most pressing inflection points through which social computing research can contribute. We argue that there is ripe potential for CSCW perspectives to be applied to future research to more effectively address the socio-technical gaps examined in the literature.

METHODS

We followed the Grounded Theory Literature Review (GTLR) method [51] across two rounds of selection and analysis. As a method, GTLR uses a grounded theory approach [17] to inductively generate insights from the papers as if they were empirical material that is thematically coded. We chose to use the GTLR method as it provides established and repeatable mechanisms for searching, selecting, and analyzing the studies in our review, while still providing a level of analytic flexibility we found necessary for this still-developing research area. Additionally, GLTR has precedent in HCI research as ideally suited for mapping out an emerging area of study, as seen in Nunes et al.'s GLTR surveying HCI literature studying self-care technologies in HCI [39] and Rapp et al.'s GLTR surveying HCI literature studying human-chatbot interaction [43].

The GTLR method involves five iterative stages for describing article selection and findings. These stages are: (1) defining the scope of the review (setting inclusion and exclusion of fields and sources, setting search terms), (2) searching for the papers, (3) selecting the final set of papers for the review (filtering of the corpus based on title and abstract), (4) analyzing the papers using thematic analysis, and (5) presenting emerging thematic categories.

In this section, we detail the first four stages, followed by a presentation of our thematic categories in the findings and an interpretation of those categories in our discussion.

	First Round of Search	Second Round of Search
Date of Query	November 1, 2021	November 2, 2022
Publications Queried	SIGCHI - ACM Digital Library	Top 20 HCI Venues
Final Corpus	24	31 (7 added)

Paper Search Methods Summary

Scope, Search, and Selection

Our review intentionally focused on surveying HCI literature that discusses digital legacy technologies in an end-of-life context. While related fields such as Archival Studies or Communications may contain relevant literature that could further inform findings of this review, our goal was to summarize digital legacy research in HCI venues and to situate CSCW literature within the wider HCI digital legacy research umbrella. Our HCI focus allowed us to conduct an in-depth analysis on human-centered scholarship related to end-of-life digital legacy concerns.

Our search for papers consisted of two rounds: one focused on the ACM Digital Library, and one focused on the top 20 HCI venues. We describe our methods for each round below.

Search (Round One): ACM Digital Library. The papers collected via the first search were queried on November 1, 2021, entirely from the ACM Digital Library (ACM DL). Within the ACM DL, we further filtered our search to publications in SIGCHI Proceedings. We chose to limit our search to SIGCHI Proceedings due to their significant coverage of HCI publications exploring the human-centered technology needs of individuals and communities, including needs at the end of life.

We did not restrict the search to a specific time frame and collected all relevant papers included in the ACM DL at the time of our search.

To identify relevant papers, we first created a dictionary of terms to guide our search. We started by conducting a preliminary search for "digital legacy" within the titles of publications. Of these, we organized the query based on the number of citations and sampled the top five publications, ensuring that all five were relevant to our research topic. We then collected the five most frequent keywords from these five papers to conduct our search. These keywords were: digital legacy, memorial, heirloom, inheritance, and stewardship. In the instances of memorial and inheritance, which often show up in multiple forms (memory, inherit, etc), we conducted follow-up searches using the root, designating it with a * (e.g., memor* and inherit*). This was to ensure we captured as many relevant publications as possible.

Our initial search terms and parameters were the following:

```
Title:("DIGITAL LEGACY") OR
Title:(inherit*) OR
Title:(memor*) OR
Title:(stewardship) OR
Title:(heirloom)
```

After inspecting our initial search results, we noted that a number of relevant papers were not included. As "digital legacy" is an emergent term in the field, we discovered that a number of relevant papers did not use it in their titles. Therefore, in order to make sure our review captured relevant papers we adjusted our search parameters to search abstract text in addition to titles.

```
Title:("DIGITAL LEGACY") OR
Title:(inherit*) OR
Title:(memor*) OR
Title:(stewardship) OR
Title:(heirloom) OR
Abstract:("DIGITAL LEGACY") OR
Abstract:(inherit*) OR
Abstract:(memor*) OR
Abstract:(stewardship) OR
Abstract:(heirloom)
```

Our search of titles and abstracts resulted in 3367 publications, which we then imported into a spreadsheet for further selection and analysis.

Selection (Round One): ACM Digital Library. Each entry in the spreadsheet included the title, abstract, DOI or URL, publication year, publication venue, and keywords. By filtering through the spreadsheet according to inclusion criteria the authors selected the papers to be considered for the review.

We then cleaned the data set, removing duplicates, as well as removing workshop proposals, panels, and talk abstracts. Peer-reviewed papers submitted to conference workshops were included. Additionally, given the languages known and skill-set of our research team, we filtered our corpus

to include only papers written in English. Collectively, this cleaning reduced the corpus from 3367 to 1832 unique paper entries.

Throughout our cleaning process, we were surprised at the large number of papers in our search results that were not relevant to end-of-life digital legacy. While it was our intention to find articles related to "legacy" – especially given the nascent use of this term – we ran into significant challenges with how this term is used elsewhere in computing (detailed below).

After cleaning the dataset and identifying 1832 entries, the authors manually reviewed each of the 1832 publications to determine which articles should be included in the final corpus. Multiple researchers reviewed each possible publication independently, with authors reaching consensus about inclusion. Authors evaluated each entry based on the following two prompts:

(1) Is this paper about end-of-life digital legacy?
(2) Is this paper studying a technology for end-of-life digital legacy?

Each paper was annotated by the authors with a reason to include or exclude. Through multiple meetings the authors determined which papers would be included in the final corpus.

Many of the papers focused on legacy systems and data management systems. For example, these included papers about effectively transferring data while shutting down servers, how designers can more efficiently update aging or archaic systems, and optimizing algorithms for the maintenance of archives. Other papers focused on different uses of the term memory (search term 'mem*'). Memory papers included articles on technical memory such as RAM, increasing human memory through technology aids, and wearable technology related to tracking human memory capacity. We excluded these papers that explored memory as a technical or biological process because of their lack of a connection to end-of-life concerns.

A further point of cleavage was a large subset of papers focused on inheritance and heirlooms that did not include end-of-life concerns. These papers often included the preservation of data (most often media) over time and as it is transferred between technical systems. For example, multiple papers discussed how the improvements in smartphone technology increased the need for personal computers to adjust how photos are transferred in order to maintain resolution. While some of these papers did focus on data or accounts being transferred between people, and even the logistical and emotional impact of this transfer during times of life transition, these papers did not focus on end-of-life concerns and so were not included in the corpus.

Finally, there were a small number of papers that examined end-of-life concerns but did not engage with digital legacy. For example, papers that focused on the role of technology in clinical care giving such as hospice were excluded. Papers were excluded that dealt with virtual death, such as an avatar's death in a video game. Papers were also excluded that engaged with metaphorical questions of resurrection or what technology means to our social understanding of death. Although tangentially related in topic, these papers were excluded due to their lack of specific focus on digital legacy.

Following our manual review, which included many conversations by the research team to reach consensus about inclusion and exclusion, the final review list consisted of 24 papers that fit the selection criteria. Although the research team had anticipated a higher yield of relevant papers, the team concluded that these papers would allow for an effective qualitative analysis.

Search (Round Two): Top HCI Venues. To ensure that we fully represented HCI, including venues that are not part of the ACM DL, we conducted a more expansive second search. Following the methods of other SLRs (e.g., [25]), we used the top 20 HCI venues based on h5-index as reported by Google Scholar [1]. This list included all venues from our Round One search, and as a result, papers published in those venues since the first search were also added to our results. The second search was conducted November 3, 2022.

In our second search, articles were included and excluded based on the same process, inclusion criteria, and exclusion criteria as the first search. Each venue in the second search was searched independently by going to the search page for the venue and querying for matches to our search term in the abstracts and titles of papers. Although there were many more total papers that emerged in the search through the 20 HCI venues than in the original ACM DL search (mostly, again, through the mem* keyword), retrieved papers followed the same trends as in our first search (e.g., papers were predominantly non-human centered or did not explicitly engage with end-of-life or digital legacy) and were systematically excluded.

Selection (Round Two): Top HCI Venues. We retrieved 7 new relevant papers from the second search. Surprisingly, no new papers from CSCW had been published in the year since our first search, signifying that digital legacy remains an understudied area in social computing research.

Our final dataset for analysis consisted of 24 papers from our first search, and 7 papers from our second search, for a total of 31.

Qualitative Analysis

We conducted two rounds of inductive analysis; one round following the first search (the original 24 papers), and a second round following the second search (the subsequent 7 papers). We analyzed each of the two groups of papers independently, seeking to avoid biasing our analysis of the 7 new papers by analyzing them alongside the original 24. It was only after completing the independent analysis of the second group of papers that we combined our findings, amending findings from our analysis of the first set of papers.

In both analyses we followed stringent GLTR analysis methods [51], which consist of three coding stages: open coding, axial coding, and selective coding. Open coding identifies concepts and associated insights abstracted from the literature; a set of categories or a bird's eye view of the studies' foci or findings. Axial coding identifies categories, subcategories, and thematic interrelations between them. Selective coding integrates and refines the higher level categories that were determined in axial coding.

All papers in each of the two analysis processes were read in full at each stage of coding (open, axial, and selective) with every paper being read by at least two members of the research team. Following GLTR best practices, at each coding stage the research team randomized the papers, individually read the papers, and highlighted any findings and insights in the texts that seem relevant to the review's scope and the goals of that stage in the coding process. Throughout the entire coding process, we synthesized our findings through memos and ongoing conversations among the research team.

Our open coding passes were driven by the question of "what is this corpus of literature interested in?" Both analyses determined that the literature was interested in how data and accounts are passed down around the time of death.

Axial coding iteratively followed from the broad interest we identified in our open coding and determined high level categories about what the literature was interested in. Our first analysis revealed the following high level categories: digital legacies as identity, how people create digital legacies, what people do to get rid of digital legacies, and how offline legacy building is being impacted by digital tools. Our second analysis revealed the following high level categories: the limits of technologies to enshrine the identity of the deceased, how people interact with digital legacies, how people get rid of digital legacy data, and how digital tools impact offline mourning practices.

Selective coding sought to provide insight into themes of how the high level categories related to one another. In our first analysis this led to us determining that the challenges and technological

affordances related to the movement of data between people was the unifying interest of the literature. Interpreting the high level categories that identified ways in which data moves between many different people and places, we synthesized the way that data moves by plotting a data lifecycle. A primary contribution of this plotted lifecycle is explicating the interconnections of emerging concepts in digital legacy research, a sought-after outcome of GTLR methodologies [51].

In our second analysis we reached the same conclusion; that the literature is most interested in how data moves between people and places.

Upon finishing our second analysis, we then compared the categories and insights between both analyses. Through comparison, we determined final themes that we detail below in our findings.

The addition of the analysis of 7 new papers from the second search allowed for the research team the opportunity to both: (1) validate our previous findings that a *digital legacy data lifecycle* is a reasonable model to interpret the interests of digital legacy literature, and (2) make appropriate elaborations to our lifecycle model.

Importantly, to avoid confirmation bias on our findings, during the analysis of our second corpus of papers, we followed an identical iterative coding process as our first round of analysis. A primary intention in the analysis of our second corpus of 7 papers was to pay special attention to avoid immediate comparison to our first set of findings until all three coding passes were complete. Though we attempted to treat the analysis of our second corpus as an iterative addition to our first round of analysis as would be done in any constant comparative approach, the possibility of confirmation bias is a limitation of this study.

Though our first round and second round analysis led to the same broad insights in the first and second passes of coding, there was a distinction insofar as the second round of coding included a higher ratio of papers in the corpus examining integrating technologies into offline legacy practices. The increased ratio of papers examining integrating technologies into offline legacy practices in the second round led us to more intentionally consider the importance of technology integration into the data lifecycle model that emerged in our first round of analysis.

FINDINGS

Our literature review finds that, although there is no agreed upon definition for digital legacy, there are common areas of interest. Broadly, digital legacy literature is interested in how data and accounts are passed down between people and communities around the time of death. More specifically, we summarize the common high level categories of interest as follows: (1) digital legacies as manifestations of identity, (2) ways in which people engage digital legacies, (3) practices for and implications of putting digital legacies to rest, and (4) integrating technology into offline legacy practices. These high level categories depict a wide range of scenarios in which data moves between people, cycling through generations of individuals until it is 'put to rest.' Our findings examine the high level categories our coding process identified. Our discussion then presents an interpretation of the lifecycle of data as the literature depicts it cycling through generations.

Characterizing Definitions of Digital Legacy

A concise definition of "digital legacy" across much of the literature is surprisingly elusive as most scholars have left the definition implicit. When defining the concept of legacy, scholars focus on two themes: (1) conceptual practices around identity and remembrance, and (2) the material realities through which the passing down and remembrance occur. Focusing on the remembrance, [21] explains that "the creation of a personal legacy is a process through which information, values, and memories are passed down to future generations." Thomas and Briggs present a similar definition, stating that digital legacy is a valued collection of digital information that may be difficult to control or disseminate after death [45]. Others, like Pfister [41], focus on the material, explaining that

Theme	Definition	Scholarship
Digital Legacies as Identity	Scholarship focused on what elements of a person persist in digital legacies after death and the motivations and considerations that drive a person crafting a digital legacy	
Identity Persistence	Challenges caused by the persistence of data that represents its owner after death	[8, 15, 16, 19, 21, 22, 26, 29, 32, 36, 38, 41, 44, 45]
Crafting a Legacy	The motivations and challenges during the intentional crafting of a legacy	[11, 15, 16, 19, 20, 20–22, 26, 28, 41, 45]
Engaging with Digital Legacies	Scholarship focused on how people experience, relate to, and care for the digital legacies of others	
Ambiguity of Use, Care, and Understanding	The impact of the uncertainty of how to use, care for, and think about the digital legacies of others	[15, 16, 21, 29, 38, 40, 41, 45]
Audience & Access	Considerations of who has access to digital legacies	[3, 21, 26, 32, 36, 38]
Respecting the Memory of the Deceased	Challenges for managing data based on the perceived values of the deceased when there is no specified plan in place	[8, 11, 16, 21, 45]
Barriers to Respecting the Wishes of the Deceased	Challenges to fulfilling the plans and wishes of the deceased	[3, 7, 11, 15, 16, 40, 41, 45]
Putting to Rest	Scholarship focused on what happens to technology after someone dies.	
Re-examining Putting to Rest Practices	Re-examination of digital systems and services that facilitate putting to rest practices	[3, 16, 19, 22, 32, 36, 38, 40, 41, 44]
Preservation & Deletion	Tensions between decisions of when data is preserved, how it is preserved, and if it is preserved at all	[4, 16, 19, 21, 22, 29, 30, 38, 40]
Symbolic Legacies	Challenges to put to rest a person's digital legacy relative to a person's social life, relationships, and experiences	[7–9, 15, 19, 28, 34]
Integrating Technology into Legacy Practices	Impacts on the bereaved of technology used to adapt in-person legacy practices	[24, 40, 46–50]

Table 1. Overview of themes and their constituent categories, including definitions and links to articles in our corpus that were coded as belonging to each category.

digital legacies are collections of the data and accounts we accrue during our life that "impacts others as the recipients of digital remains in the form of a digital legacy or digital estate."

The lack of explicit definitions for digital legacy in much of the scholarship, and the diversity of definitions present even when definitions are provided, underline the diverse topics and perspectives present in the research. Although there are common themes, topics, and interests across the research, as the remainder of this paper examines, the lack of an agreed upon definition is telling as to the breadth and nativity of this area of study.

Digital Legacies as Identity

In this section we report on the theme of digital identity; that is, the literature is interested in the ways through which the attributes of a dying or deceased person that are embedded in their digital legacy materials.

Identity persistence. The most prevalent focus throughout our corpus was the persistence of data that represents its owner after death [8, 15, 29, 32, 36, 38, 44]. In many instances, it is the persistence of this data that gives rise to digital legacies in the first place, such as in the case of social media profiles that become memorials [8, 15, 16]. The persistence of accounts and data prompt many of the opportunities and challenges that scholars have considered.

The form of digital legacy materials scholars discuss range from uncurated repositories that loved ones might inherit (akin to a storage room or attic) [29] to intentionally curated representations that may resemble public memorials [38]. Gulotta et al., for example, discusses the ambiguities around burner accounts that circumstantially were never deleted [19]. She et al., meanwhile, describe the benefits of private archives created to facilitate individual mourning practices[44]. In most instances, the literature focuses on the digital traces people leave behind through online accounts and data, and the resultant legacy crafting and memorialization opportunities the persistence of those digital traces provides (intentional and otherwise).

Identity persists in intentionally curated forms, such as memorial pages on social media [8, 15], as well as private archives created to facilitate individual mourning practices [44]. However, scholarship in our corpus also contends that identity persists in forms that were not created for post-mortem memorial or mourning purposes, such as burner accounts or social media profiles that were never deleted [19].

The persistence of these identities has notable benefits, especially for the bereaved. The identities in digital legacies can facilitate healthy grieving practices [44], enable learning about the life of a loved one [45], and help maintain a connection to the deceased after death [21, 44]. However, the persistence of online identities presents challenges. For example, in many instances persistence is the default [41], resulting in a potentially overwhelming amount of uncurated information about a person's identity online [26].

An additional challenge is that, though information persistence is often the default, people typically are uncertain about how to think about the longevity of their data [22] and how to ensure a desired representation of their identity after they die [19]. For example, whereas abandoned accounts may not represent the identity that the deceased wanted to persist [19], the uncensored picture of the deceased that they provide the bereaved may be a window into a much more honest and full picture of who they really were [22]. The social dimension of online accounts, especially on social media, present an additional layer of challenges: because online accounts are experienced by audiences, including audiences they were not originally meant for, those audiences can interpret identity in ways the original poster did not intend [38].

Due to the above challenges, although persistence of accounts can have immense benefits for the recipient's relationship with the deceased, in some cases it is important for the accounts that persist

to be deprovisioned. Deprovisioning is especially important if the account is actively harmful to the bereaved for an online account to exist [21]. Accounts are often private for a reason; for that account to persist may be emotionally or otherwise damaging for loved ones who remain. Therefore, while persistence exists and in some cases is beneficial, there are other cases in which data and accounts should not exist, due to their propensity to cause harm.

Some scholarship responds to problems of persistence, privacy [32] and identity theft [45] for example, by calling for greater restriction. To address these types of concerns, Locasto et al. [32] suggest a set of strategies for decommissioning online accounts more effectively, while others have argued for increased control over what data and accounts persist in the first place [38, 45].

Crafting a legacy. While many digital legacies are the byproduct of the data accumulated throughout one's lives, a thread of scholarship has identified motivations around the intentional crafting of a legacy. People are motivated to document their life story [45], major life events [28], and pass on their values to future generations [20]. People are also more open to legacy crafting after experiences with death [26, 41] and the more proximate they are to the end of life [11], but this comes with a possible trade-off: Thomas & Briggs' study of older adults found significant concerns that they might be excluded from digital legacy creation on account of technology access, literacy, and adoption [45].

Despite potentially clear motivations, people often find it difficult to conceptualize how their digital information will be used, and of what value it might be to those who survive them [16] and future generations [22]. However, several studies of memorialized social media profiles found that people with prior experience with memorials more readily saw the value in them [7, 15], suggesting that as digital legacies become more common, understanding of their use and value may increase.

A number of studies by Gulotta and colleagues found that people often conceptualize their digital legacy in relationship to its value and impact on future generations. Most pertinent here is a study in which they used a design probe to ask people how they wanted to be remembered [20]. Extending prior work [19, 21], they found that people wanted to pass on their values to and have a positive impact on future generations, as well as ensure the continuation of particular traits, values, and traditions [20]. Ideally, documenting a person's life would also provide a valuable resource for future generations [19].

Maintaining control over one's identity and legacy is also important to people when crafting a digital legacy – however, how "control" is conceptualized differently across studies. For example, through user studies with design concepts, Chen et al. [11] found that participants had a preference to control their self-representation even after death, but also acknowledge that any control is dependent on knowing the extent of one's data. Managing the outcomes of a digital legacy is another form of control. Trolling, identity theft, and information loss are concerns resulting from information being online [45], however, people also share concerns that meaningful aspects of their lives might not be captured in their legacy [19] or that the digital legacy might not adequately capture the social and cultural context of the individual's life [21].

Engaging with Digital Legacies

In this section, we describe key themes from the literature about how people experience, relate to, and care for the digital legacies of others. While the scholarship here has significant overlaps with other themes, for the sake of clarity, we emphasize the perspective of those who receive the legacies of the deceased (who we call 'receivers') — including the bereaved, survivors, next of kin, and the public more broadly.

It is worth starting this section by acknowledging that there are potentially infinite types of digital legacies generated by the management and movement of digital legacy materials. Indeed,

scholars often consider any digital traces as having legacy potential [e.g., 26, 41], and thus the conditions under which one might engage these traces are at least as diverse as the circumstances and intentions that led to their creation. In practice, the bulk of scholarship discussing experiences with digital legacies focuses on (1) public or semi-public digital memorials and (2) logistics around accessing private online accounts (e.g., email). For this reason, we focus on these two areas of scholarship while reflecting on the theme of engaging digital legacies.

Ambiguity of use, care, and understanding. Common throughout the literature are examples of the uncertainty people feel about how to use, care for, and think about the digital legacies of others. This is because there is no existing social script to discuss digital legacy [41]. Whereas there are medical, legal, and cultural practices and norms that exist in more traditional legacy practices (e.g., graveside memorial services), there are not yet practices and norms enculturated for digital legacy.

When faced with ambiguity, people turn to physical analogs to orient themselves; however, these analogs are often insufficient. While it is common for people to draw comparisons between physical heirlooms and specific media like pictures [4, 40], it is more difficult for people to create analogs for the scale and online networked format that data and accounts provide.

Unlike more familiar forms of legacy (e.g., physical heirlooms[4, 40]), we are less likely to have prior experience or cultural norms that provide guidance when engaging in online memorials, receiving digital heirlooms [4, 30, 40], or navigating a loved one's myriad online accounts [41]. Indeed, as Pfister explains, it is often unclear what content and accounts should be considered part of a digital legacy.

In many cases, ambiguity is the result of collections of data that were only ever created as personal archives [29] or with a specific pre-mortem purpose (such as interpersonal communication) [15, 16, 21, 29, 38, 45]. As Kaye et al. explain, personal archives invariably are expressions of the author's identity, but people's primary motivations are to archive materials so that they can easily find and access them later[29]. As a result, unless an individual specifically organizes their data with another audience in mind (as in the "Crafting a Legacy" section above), there will be significant challenges around how to map pre-mortem data to post-mortem purposes.

Audience & access. A central issue when considering experiences with digital legacies is one of audience and access. As Moncur describes in her model guiding the design of digital memorials, any memorial that is created is also 'consumed' by an audience [38]. Audiences can be large or small and more or less private or public. In online memorials, choices about which audiences have access to memorials (and which audiences do not) are critical levers that shape the purpose of, and ultimately who experiences, a digital legacy.

Moncur highlights how a public online memorial for the Rwandan genocide might be more public and permanent than a private online memorial for a deceased individual due to the disparate needs of the intended audiences [38]. While some memorials have been designed as such, the vast majority have not. They are most often the online accounts and data that remain after someone dies. As such, scholars have asked who should have access to memorials, and at what level.

Most systems presume that an account will only ever be used by one person. However, in end of life contexts accounts are used by multiple people by definition (before death by one person and after death by a different user)[3, 32, 36]. The single-user assumption leads to difficulties in login and management of digital legacies for the bereaved. To address this issue, scholarship proposes using new categories of shared identity for systems to consider [3] and implementing new types of platforms (e.g., cloud computing).

In our corpus, a key consideration about access is the privacy of the deceased. For instance, Gulotta and colleagues ask in what ways enabling people who are not designated pre-mortem to access digital records is a possible violation of privacy [21]. Holt et al. complicate notions of privacy

considerations by noting that one's privacy choices in life may no longer be a true reflection of their continuing privacy preferences after the point of death [26]. Reflections on legal protections for the digital privacy of the deceased reflect on them being inconsistent and underdeveloped, at best [32].

Respecting the memory of the deceased. In instances where no plan is in place people managing the digital legacy of the deceased value respecting their memory vis-a-vis how the digital legacy is managed. Respecting the memory of the deceased largely includes making educated guesses about how the deceased would have liked their legacy managed and perceived values of the deceased [8, 11, 45].

A key consideration of respecting the memory of the deceased is whether to make changes to the data or account of the deceased in the first place. As Brubaker and colleagues found in a study exploring stewardship of memorialized profiles, people were generally uncomfortable altering account settings or existing content unless explicitly directed to do so [8]. When changes were made, it was in order to create a more accurate or appropriate representation of the deceased [8].

There are times when the person managing the digital legacy has to sift through competing options and competing ways to respect the memory of the deceased. Brubaker et al. found that when people seek to resolve conflicting needs, they prioritize explicit requests from the deceased, followed by the needs of survivors, and finally perceived wishes that were not explicitly requested [8]. Furthermore, even when specific needs are known, there can be a tension between what the bereaved believes best honors the memory of the deceased and what the deceased has stated they would like.

Surviving loved ones are entrusted with mediating the expectations of the deceased and the lived reality of managing digital legacy plans; a mediation that can be complicated by interpersonal relationship and communication practices between them. For example, Gach & Brubaker describe that trust is a mediating factor between the dying creating a plan and the bereaved executing a plan [16]. Beyond trust, there are instances in which the deceased and receiver have entirely different expectations about the appropriate form a digital legacy should take, leading to the risk that the receiver's management of the legacy will value their wishes over the wishes of the deceased [21].

Barriers to respecting the wishes of the deceased. Fulfilling wishes and caring for the memory of the deceased requires that people are empowered socially and technologically. Collectively, our corpus notes that challenges to this empowerment include having to navigate impersonal systems [16], being able to access systems in the first place [45], and the lack of capacity for systems to be able to facilitate multi-user logins [3, 26, 32]. These challenges can impede the ability for people to make the wishes of the deceased a reality, even when those wishes are explicit.

A key concern of our corpus is the gap between the expectations of people managing digital legacies and the technical systems they are navigating [3, 8, 41]. For example, while someone managing a digital legacy might assume that they will be able to access an account to make changes, there is often a lack of a sanctioned way within platforms to designate someone as able to have access [7]. Even when access is provided – say through Facebook's Legacy Contact or Google's IAM features – those entrusted to care for or take action on behalf of the deceased may find that they do not have the technical ability to do what has been requested of them [15]. This barrier can lead to emotional distress and large amounts of logistical overhead for the bereaved to find a workaround [11].

A problem that people engaging digital legacies run into is a lack of ability to conceptualize digital legacies in the first place [45]. Whereas people often make analogs between the legacy of physical heirlooms and the digital legacy of specific media like pictures [40], it is more difficult for people to create analogs for the scale and online networked format that data and accounts provide.

Putting to Rest

In this section, we examine themes from the scholarship focused on what happens to technology after someone dies. In contrast to our 'Engaging Digital Legacies' theme, where we focus on the experiences people have with digital legacies, in this section we focus more on the pragmatics around ownership, inheritance, and stewardship of digital legacy accounts, data, and systems. Collectively, we refer to these post-mortem logistics as 'putting to rest.' In our context, we also use the term to refer to instances where technology is abandoned as a result of a death, and thus is effectively put to rest.

Re-examining putting to rest practices. Collectively, scholarship calls for the reexamination of digital systems and services that facilitate putting to rest practices. Specifically, scholarship calls for a reexamination of inheritance policies, platform functionality relative to inheritance practices, and how the nature of technology serves as a barrier to meeting inheritance needs.

The policies that digital systems abide by determine the boundaries of what inheritance processes are possible in the first place [3, 22]. In response, the literature invites a reexamination of the technical policies that influence workflows [32, 36] and legal policies that may serve as a barrier to inheritance needs [3, 41]. Work like that of Adams and Williams further explores policy barriers to inheritance through exploring legal policies like jurisdiction (including which country's inheritance laws take effect), and the property status of data (e.g., emails) and online accounts [3]. Scholarship examining platform functionality is interested in examining the degree to which platforms support inheritance practices. Few digital systems provide functionality that supports the ability to give access to your digital information to another person [19], in part due to digital systems' designing inheritance capabilities based on assumptions about people, their data, and their relationships [16]. Factors identified in the literature that currently do not take into account are the grieving processes of the inheritor [19, 44] and/or the relationship between the system and the inheritor [16, 44].

Beyond specific platform functionality, scholarship in our corpus invites a reexamination of the nature of digital systems themselves. Oftentimes, systems make assumptions that the capabilities of the living user (alive and able to take action) are the same as what the reality of the user is (generally a bereaved individual acting on behalf of the original user who is deceased)[38]. Assumptions such as these ignore nuanced concerns such as the lack of existing practices around digital inheritance [40] and transcending status quo relationships between the executor of a digital legacy and technological systems writ large. To this end, scholarship suggests that there may be an opportunity to reflect on redesigning the nature of digital systems themselves to better support complex digital legacy needs.

Preservation & deletion. When disposing of a digital legacy, the bereaved must consider where the data will be stored and in what ways it will be preserved. The answers to these questions are informed by what information is being managed, how should that information be curated, and what the intention is behind the storage or preservation of the data [38]. As exemplified by Kaye et al.'s research on why archives matter, the storage of data and curation of accounts is seen in our corpus as more than simply logistical; rather it is seen as driven by deeper values [29].

A key decision point for the bereaved in determining where and how data is stored is determining the intentionality of how the stored data will be used. For example, as Moncur and Kirk explore using the example of online memorial pages, the form of a memorial will greatly depend on what message the memorial is intended to convey ('message' in this case is quite broad, signaling values relative to cultural, personal, sacred, and secular perspectives)[38]. Further factors that determine where and how the data is stored are who the author is of the archive or account [38] and to what degree multiple users will be involved in its ongoing preservation [40].

In some instances, inheritance and management is not desired and those managing the digital legacy opt for deletion. Deletion may occur in instances where there is sensitive data [22] or to simplify the process of 'putting affairs in order' [19]. Bereaved users seeking to delete data run into barriers relative to lack of platform guidance and platform functionality [16]. Even when functionality exists for deletion pre-mortem or post-mortem it is not always apparent to users that this functionality exists or how a user is supposed to access it [21].

Symbolic legacies. Though the majority of literature reflects on inheritance practices of how data and accounts are transferred from one person to another, some scholarship in our corpus challenges this focus by centering the dispossession of symbolic legacies embedded in data and accounts.

The social impacts of inheritance practices may necessitate new ways of thinking about the ways HCI scholarship and designers think about ownership and inheritance practices in the first place. In the context of social media, for instance, Brubaker et al. found that ownership does not resonate with the would-be inheritors of accounts [8]. Instead, participants focused less on ownership of the data, and instead on the duties and potential conflicts associated with maintaining an account post-mortem [7]. This leads the authors to argue that in a social context, inheritance and ownership are not necessarily helpful models to serve the needs of the people inheriting the data and accounts that are dispossessed. To this end, Brubaker & Callison-Burch argue that "[i]n contrast to heirlooms and possessions that are amenable to ownership, symbolic legacies more commonly necessitate stewardship – someone to manage and maintain the marker on behalf of the deceased" [7].

A thread of scholarship in our corpus additionally highlights that to better understand the passing of symbolic legacies it is important to ask what the social experience of managing digital legacies is in the first place [9, 15, 28, 44]. Work by Jamison-Powell and colleagues comment explicitly on this sentiment, arguing that inheritance is not simply transactional and is instead bound up with grief and mourning, which needs to be considered with designing digital legacy management tools [28]. Further work by Gach and Brubaker illuminate the downstream impacts created when the social experience of managing digital legacies is not fully integrated into systems, including anxieties created when managing postmortem profiles involves carrying out unspecified responsibilities that may not be permitted [15].

Integrating Technology into Offline Legacy Practices

Finally, there is a subset of work in the corpus that is focused on the use of technology to adapt offline legacy practices, largely emerging from the research of Uriu et al. [46–50]. In our analysis, these pieces stood apart due to their exploration of the role technology can play in traditionally non-digital funerary rituals and objects.

This scholarship takes a design orientation; prototyping, validating and evaluating novel prototypes and systems. Examples include the webcasting of funerals [50], Japanese floral rituals [46], tangible interactive heirlooms [40], and gravestones with interactive displays [24]. By embedding digital elements into traditionally non-digital funerary rituals and objects, this scholarship probes the intersection of material ritual practices and digital affordances.

A key tension that this subset of scholarship explores is between the traditional materiality of mourning rituals and the potential of digital affordances. For example, Häkkilä et al., in their study exploring the emotional response to an interactive gravestone with a digital display, found that the digital elements of their prototype was positively received as a memorial provided it reflected the dignity of the context [24].

Of note in Uriu and colleagues' research is that it is intentionally grounded in a non-western context, in this case Japan. Whereas much of the qualitative research in our corpus has featured

participants from North America and Europe, Uriu et al.'s work show a promising path for future research to expand geographical foci. Scholarship exploring how traditional practices can incorporate technology presents an opportunity to consider culturally-diverse digital legacy practices.

DISCUSSION

Digital legacy literature is interested in the movement of data in complex end-of-life social contexts in which data is passed down. When reading individual papers it may appear that digital legacy literature is entirely interested in the passing down of data from a dying individual to a bereaved loved one. The passing down of data from a dying individual to a bereaved loved one is certainly a part of the interest of the literature. However, the themes we identified during our analysis demonstrate that the scholarship is not limited by the one-to-one relationship between two users or a single moment of the passing of digital legacy materials (e.g., an account) from one person to another.

Instead, digital legacy research examines how digital legacy materials move across a range of stages making up a lifecycle, from the encoding of digital materials to their access to their dispossession. We additionally find that, on the whole, digital legacy research is interested in how data may move through this lifecycle multiple times, often consisting of multiple generations of individuals sharing and receiving it.

In summary, digital legacy scholarship is interested in the passing down of data between people; both the movement of data between the dead and the living, and the passing down of data between the living. Digital legacy literature examines the movement of digital legacy materials between individuals until it is eventually put to rest; a cycle of sharing and receiving that includes much more than a single act of transmission between a single person dying and a single loved one. We find that digital legacy scholarship is describing a cohesive cycle of data movement, which we call a *digital legacy data lifecycle*. In the following section we present a model of this lifecycle, depicting how the literature on the whole conceives of the stages that digital legacy data transitions through as it is passed down.

We first introduce the *digital legacy data lifecycle* at a high level, noting the stages of the lifecycle and connecting the lifecycle to other information lifecycle models. We then describe each of the *digital legacy data lifecycle* stages and the interdependencies between them, referencing the thematic findings of our review. We go on to delineate two core categories of technical challenges that the data lifecycle presents to technology design: multi-user challenges and multi-generational challenges. Extrapolating from multi-user challenges and multi-generational challenges, we conclude by identifying future research opportunities in digital legacy research and examine ways through which social computing perspectives can help digital legacy research more effectively address those challenges moving forward.

Digital Legacy Lifecycle

When considering the relationships between our themes during our analysis, we were struck by how each theme spoke to ways through which data was being passed between individuals. As we moved through our selective coding process we noted the literature's depiction of data being passed down as similar to the stages of data described in information lifecycles. For example, we noted during our coding that research by Odom et al. examines attitudes of participants towards the dispossession of their data as it moves from one person to another through a digital heirloom [40]. Meanwhile, we also noted that research by Moncur et al. examines how a person's identity might be encoded into the data of digital memorials [38]. As we continued to code the data, patterns emerged in what data stages the literature covered. Our coding led us to map three stages of a data lifecycle that the literature was interested in: encoding, accessing, and dispossessing.

Information lifecycles are often used to highlight relationships between stages of data, often as data moves from creation to disposition. Information lifecycles can trace their roots to libraries, archives, and information management systems, an exemplar of these systems being the National Archives of the UK, institutionalized in the early 1900s [10]. Lifecycles focus on the management of information and data, which is conceptualized as moving through multiple phases over a lifespan.

In social computing, one application of information lifecycles that is especially pertinent to our current work is Pierce and Paulos's article on the acquisition of previously possessed technology [42]. While not focused on mortality, Piece and Paulo describe a technology lifecycle that involves acquisition, possession, dispossession, and reacquisition.

In the selective coding portion of our analysis, while examining ways the literature describes stages of data interacting with one another, we noticed that individual papers depicted ways in which digital legacy data was acquired, possessed, dispossessed, and reacquired (similar to Pierce and Paulos [42]). For example, research by Jamison-Powell et al. considers the attitudes of participants towards how their legacy data was first created, how the data was used and possessed by themselves during their life, and how the data would be reacquired as it will be passed down to loved ones [28]. As we analyzed additional papers we saw similar examples of acquisition, possession, dispossession, and reacquisition across multiple papers.

However, in a departure from Pierce and Paulos, our coding led us approach acquisition and reacquisition as a single stage: 'encoding.' We additionally found that digital legacy literature is better represented by concerns around 'accessing' rather than possession.

Engaging our thematic categories with an information lifecycle in mind, we interpret the broad interests of digital legacy scholarship around three stages of a data lifecycle: encoding, accessing, and dispossessing data (See Fig. 1). The presentation of this lifecycle model, and our descriptions of the stages therein, seeks to provide an entrance point for social computing researchers to determine gaps in current research and help identify helpful inflection points to direct future work.

Encoding

Encoding refers to the capturing of information, experiences, and values by systems, accounts, and data. In digital legacy scholarship, this stage includes concerns about the creation of legacy data (e.g., themes of encoding identity into data and crafting a legacy) and the acquisition of legacy data (e.g., themes of symbolic legacy, identity persistence, preservation). Encoding can occur multiple times for the same data and across multiple users or multiple generations of receivers. In our view, any time that data is passed down (i.e., not deleted or erased) a phase of encoding occurs.

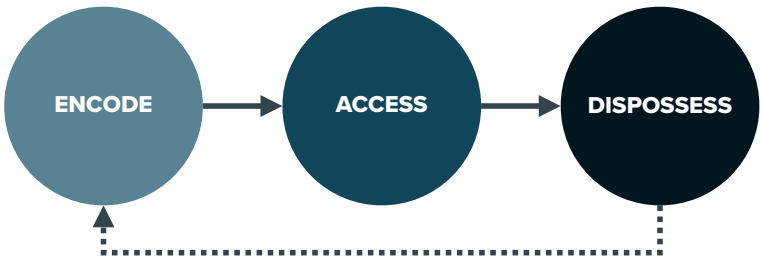

Fig. 1. Digital legacies move through a three stage lifecycle that includes *encoding* the legacy content into a digital form, *accessing* that content, and the *dispossession* of that legacy to another individual or through deletion.

For example, consider the case of an individual downloading the Instagram photos of a deceased loved one to an external hard drive and then deleting the Instagram account. In this instance, the data has been literally encoded to a different location and potentially into a different technical format. The data is transformed (encoded) by virtue of it being acquired by a new individual as it moves to a new location, is stored in new files, or is associated with a different user account.

Integrating technology into offline legacy practices presents another example of encoding legacy data in a new form. In Uriu et al.'s work on digital tombstones, for example, there is an encoding of the identity of the deceased into a physical object that has technology embedded within it. Contrasted with the previous example of the acquisition of online photos, the persistence of the identity of the deceased is now tethered to a physical object displayed in a public space that is capable of decay. Uriu et al.'s research, along with Odom et al.'s research on heirlooms, demonstrates that encoding can occur across multiple mediums and in both private and public spaces, leading to several additional open design questions. In the encoding phase, the primary challenges synthesized from the literature are open questions of how to adequately encode individual and socially networked values, wishes, practices, and identities into data so that it will effectively persist as a holistic representation of the deceased. Although, in many cases, values and identities might overlap, the communal and familial aspect of death invites further discussion of collective and relational digital legacy realities in addition to individual needs.

Access

Access encapsulates the myriad practices and needs for the digital legacy materials encoded into a system. In digital legacy literature, access specifically corresponds to concerns about who can access what data and when (e.g., themes of audience and access, respecting the memory of the deceased, barriers to respecting the wishes of the deceased, and preservation). The literature raises open questions about how to and who should gain access to digital legacy data, as well as explorations around how to, given access, respect the wishes of the deceased.

In the access phase the primary challenges are how to research and design for multi-user access of archives and accounts. Addressing these challenges is imperative due to current barriers in the technical capacities of the majority of platforms to smoothly transition access from the dying user to the bereaved user, especially when multiple individuals who have acquired the same data or account. Scholarship in our corpus points to a gap between technical capacity for access and the expectations of dying and bereaved users.

Dispossession

Dispossession focuses on the moment that data is passed from one individual to another, or when the data is deleted or erased (put to rest). Of the themes found in our analysis, dispossession includes considerations of re-examining putting to rest practices, preservation & deletion, and identity persistence. What is encoded and what the exact considerations of access will be, are in part determined by the practices through which the data was passed down, what data was passed down, and if the data was even passed down at all. These factors can be determined by the social context of the individual(s) in charge of managing the data; their relationship with the deceased, their relationship with the previous administrators of the data, and their relationship with the data itself.

Central questions about dispossession invited by our corpus include what should be preserved in a digital legacy and, by extension, what should be disposed of. Scholars in our review have rightly pointed out the limited support for actually engaging in dispossession practices.

In the dispossession phase the primary challenges are challenges related to adequately understanding a massively diverse, and sometimes conflicting, set of user needs around dispossession.

That is, there are many situations in which questions of access do not account for the fullness of needs for the inheritance of data. Indeed, sometimes there are no clear inheritors of the data. Other times, even if an inheritor is identified, wishes are unknown. These cases are complicated by a lack of socialized cultural scripts to orient the dying and bereaved around the questions of digital legacy inheritance in the first place. At the end of life, decisions often must be made quickly and decisively.

Interdependencies Between Phases

As digital legacy materials move between stages in the lifecycle they require additional considerations that illuminate technical shortcomings. For instance, as data moves from the encoding phase to the access phase, the choices that were made about what was encoded and where it was encoded to can impact who can access the data, where they can access it, and how. These choices are determined largely by how the information was encoded in the first place and whether the technology in question allows for the access that is required. Likewise, many dispossession practices are predicated on specific types of access determined by technical affordances and barriers. For example, if a loved one of the deceased does not have access to an account, they will not be able to make choices about what should be preserved or deleted.

As mentioned above, dispossession does not necessarily mean the deletion or de-provisioning of information or accounts in digital legacy scenarios. Instead, we see options and choices at the dispossession stage impacting how the cycle repeats. In order to take possession of an online scrapbook, for example, the recipient may transfer ownership to their own account, download the images, re-upload them into their preferred service, and export the scrapbook to a PDF. In each case, people are constrained by the types of dispossession practices that are technologically supported. We see the practices determining the change of possession as re-encodings of the digital legacy that may then have implications for subsequent access, dispossession, and so on.

Multi-User Considerations

If information lifecycles have a shortcoming, it is that they center the information over the people that make use of it. Examining the lifecycle, it may be easy to consider the stages from the perspective of a single user who creates an account, accesses data, and eventually deletes their data and account. However, as our review has demonstrated, digital legacies are a deeply multi-user affair.

Beyond familiar multi-user and collaboration scenarios (e.g., collaborative editing of a document), digital legacy scholarship clearly demonstrates that people are making choices with others front of mind. For example, in the case of the deceased choosing a Legacy Contact on Facebook, the Legacy Contact is chosen with a particular audience in mind. Similarly, users who have a social media account bequeathed to them will consider the deceased when making access and dispossession decisions [7, 8, 15]. Even after someone dies, the actions of the recipient are not divorced from the wishes and considerations of the deceased.

Beyond considering the needs of others, in digital legacy contexts, the primary actor is not necessarily (and in fact, rarely) consistent across the digital identity lifecycle. In the case of a private archive, the legacy moves from the deceased who creates the archive to the recipient. The recipient may then delete the archive, dispossess the archive to another actor or actors, or even combine the archive with new information about the deceased, re-encoding the data into a new form.

In the instance of a forgotten or abandoned account, it is still the case that the deceased created and used the account before it was forgotten or abandoned. As seen in literature reflecting on identity persistence, the identity information is still embedded on the forgotten account even if there is no user accessing or managing it. In these cases, after the death of the person who created a forgotten or abandoned account, an ad hoc dispossession occurs – based on the policies the service

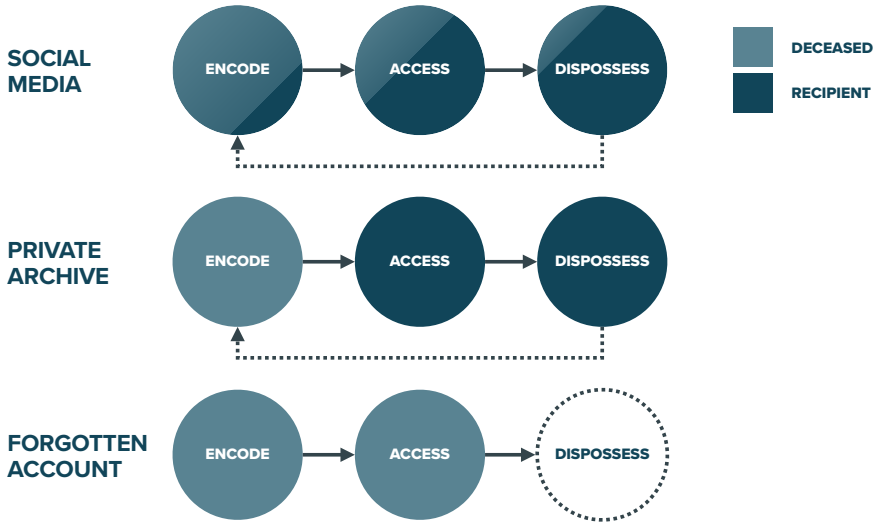

Fig. 2. Digital legacies move through multiple users throughout their lifecycle. Depending on the form the legacy takes (social media, private archive, or forgotten account) the relationship between the deceased and the recipient may appear different.

provider has for inactive accounts, if any. Importantly, dispossession occurs even when there is not an intentional hand-off between a deceased person and a receiver.

Future research would be prudent to focus on how user expectations for multi-user access at end of life can be more effectively supported.

Multi-Generational Considerations

Finally, the repeating nature of cycles reminds us that legacies may be dispossessed multiple times as they are repeatedly handed down. The caretaking required for technological heirlooms across multiple generations was a key insight from the work of Odom et al. [40]. However, multi-generational concerns and ways that those who inherit a digital legacy might one day bequeath it are largely cursory in the literature as a whole.

Perhaps scholarly attention has prioritized addressing issues in the first round of dispossession first before considering subsequent laps in the lifecycle. Additionally, studying real-world instances of dispossession of digital legacies is difficult.

However, scholarship following the multi-cycled lifespan of digital legacies is necessary if we are to entrust them with our identities, values, and heritage. A fertile place to start may be answering questions about how digital systems can ensure the preservation of a legacy across time. Although digital information may not decay in the same ways that physical artifacts might, the user experience of receiving digital legacy information through generations may very well be different than the previous times. The usability of digital legacy information also contends with the fact that platforms evolve over time, as does the regular use of those platforms (e.g., if legacy information is on Twitter, what happens if Twitter is no longer functional in fifty years?). We invite future research to explore how the temporal realities of evolving technologies may impact the receiving of digital legacy information as it endures multiple generations of the lifecycle.

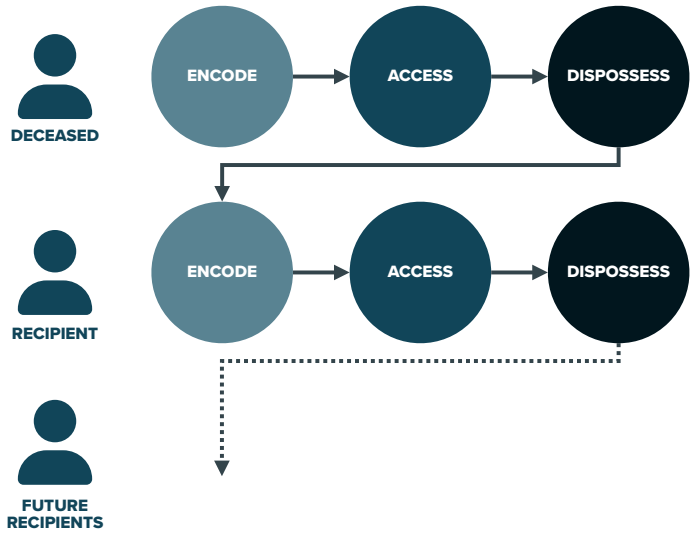

Fig. 3. Digital legacies may encounter multi-generational transitions throughout their lifecycle. The considerations of encoding, access, and dispossession change depending on who is receiving the legacy and what type of legacy they are receiving.

Challenges for Digital Legacy Research and Design

In this section, we use the *digital legacy data lifecycle* to identify inflection points where digital legacy research should be expanded, taking into consideration current gaps. We then examine the role that social computing perspectives might play in addressing current gaps.

Diverse circumstances of death. Looking at the considerations the literature has for the dispossession stage of the data lifecycle reveals that there is a gap in current literature insofar as it does not account for diverse circumstances of death.

The circumstances around death vary, but current literature does not account for the full breadth of these distinct circumstances. The scholarship to date is biased towards scenarios in which people have time and space to craft and manage legacies, or where people are the recipients of un-curated digital content. However, the literature does not speak to scenarios such as sudden death, the death of children, or other crises.

Specific types of deaths and end-of-life scenarios deserve discreet attention. In the near term, we imagine that scenarios such as "sudden death" may serve as "extreme users" [13, 14], helping identify assumptions we are making in our designs. However, in the long term, just as other medical, legal, and funerary services have specific practices for different end-of-life scenarios, we argue that technology should as well.

Abandonment. The stages of encoding and dispossession can only occur if there is data that is passed down. By looking at the *digital legacy data lifecycle* it quickly becomes apparent that research to date does not account for scenarios in which data is abandoned.

While at times people die with a clear inheritor for a digital legacy, and indeed this assumption frames the majority of current research, there are many other cases in which people die with data or accounts are abandoned. Situations through which data or accounts are abandoned vary; generally occurring either because the data or accounts are forgotten or intentionally not managed by the

deceased. Therefore, while scholarship discusses moments in which an inheritor is known, it is important to research scenarios in which there is no apparent inheritor of the account and the data or account is 'abandoned.' Based on the literature's focus on situations where digital legacy data is intentionally managed throughout the lifecycle, one area future scholarship should prioritize is what happens to data in situations where there is no intentional management, such as when an account has been abandoned during life and still persists after death.

Alternatives to "ownership" and "inheritance". The multi-user technical challenges seen at multiple stages in the lifecycle demonstrate a need for technologies to consider alternatives to user access, ownership, and inheritance. Encapsulating a person's life, relationships, and experiences are critical to crafting a digital legacy that honors the memory and wishes of the deceased. However, as Moncur and colleagues argue while discussing their framework for digital memorials, the social and relational components of a person's life are exceptionally difficult to encode into data and accounts due to their socially networked nature [38]. One way scholarship might address this gap is by exploring alternatives to inheritance perspectives. While inheriting digital legacy information is certainly an important lens to think through the passing down of ownership of accounts, it is not as helpful in situations where ownership is not the issue at hand. In our corpus, stewardship [7, 8] presents one alternative to inheritance. However, stewardship runs into similar problems as inheritance when pre-mortem planning has not occurred and there is no clear hand-off between the deceased and the recipient.

Here we take inspiration from Gulotta et al. [19], who question inheritance as a default for digital legacies:

> [I]t is not clear that we should model the processes of passing down and inheriting digital materials on those of physical artifacts. Instead, there may be an opportunity to completely rethink the role that digital information can play in how we make sense of a person's life, relationships, and experiences. [19]

While we support the development of digital legacy features, policy, and systems, work by Gulotta et al. serves as a reminder to not be limited by inheritance optimized for physical property, objects, and finances. Future research should invite alternatives that will be more effective at addressing scenarios where models based in 'ownership' are not sufficient. After all, if digital legacies centered around remembrance can be captured in digital content that can be duplicated at no cost [20], ownership may not be relevant.

Distinguishing crafted legacies from content with legacy potential. There is a division in the literature between digital legacies that are intentionally crafted (typically by the individual that legacy represents) and digital content that has legacy potential (that, for example, a loved one might find value in, but that was not created with legacy in mind). Over time the literature has shifted from focusing almost exclusively on content that has digital legacy potential and increasingly considers how one might intentionally craft and care for a digital legacy. However, these scenarios (and relevant findings and design recommendations) are often blurred, even within a single paper.

We feel it is important to start making a distinction between these two types of digital legacy content. If for no other reason, the sheer volume of data that people generate over their lifespan makes the thoughtful dispossession of any data that might have legacy potential untenable. Additionally, the act of crafting one's digital legacy does not somehow eliminate the legacy potential of other data. Fundamentally, our obligations to crafted legacies are different than accounts and data that might have legacy potential, and our scholarship should reflect this moving forward.

Real world implementation. Digital legacies are not created and deployed in a vacuum; they are created and experienced in complex socio-technical systems being lived out in everyday scenarios.

Due to the lived nature of digital legacy, there is a need for additional studies of real-world implementations. Yet, much of our scholarship consists of design explorations and studies exploring the hypothetical needs of users. For digital legacy technology to succeed in the real world, our research needs to engage the real world as well. Specifically, future research should build on existing literature through field deployments and the study of actual digital legacy experiences.

Accessibility. Building on our call for research on real-world systems, as the number of digital legacy systems increases, future work should not forget to examine for whom these systems are accessible. While Thomas and Briggs importantly note limitations for older adults [45], we are struck that papers noting these types of limitations are not more common. We imagine that traditional usability and accessibility work on digital legacy systems will be crucial – especially so given the sensitive contexts in which they are often used. Yet it is important to remember and account for people who never engage with these systems in the first place or who are unable to engage with these systems for any number of reasons.

Integration with existing cultural practices. As digital legacy practices increase, the contexts in which they are encoded, accessed, and dispossessed will only grow. The potential role of technology in cultural practices around death is underexplored [6], and while our current literature highlights specific cultural contexts, they are largely North American and European. Even this literature tends to be non-cultural and secular in its focus.

Scholarship by Uriu and colleagues exploring the role of technology in funerary practices [46, 50] serves as a reminder of the diverse legacy-related practices in which technology will play a part.

The Role of Social Computing in Addressing Future Challenges

Considering the above gaps in research, we are of the strong belief that social computing is uniquely positioned to push forward future research in addressing these challenges. The scant number of publications that turned up in our systematic literature from CSCW-specific venues was striking, considering the substantial amount of CSCW research on life transitions and social technologies [12, 23, 31, 33, 35]. The inability of HCI as a whole to adequately address the challenges we discussed in the previous section might be the result of HCI's focus on the single user. As Baumer Brubaker [5] argue, the user "constrains the types of human-computer interactions we can meaningfully account for in our research." To the extent that the user (and their account) exists as a container for interactions, access, and data, we feel that the user alone is inadequate when designing for the changing ecology of people – both across time and generations – that digital legacies should serve. Digital legacies are collaborative.

From its incarnation, CSCW had adopted a useful concession: people do more than interact with computers, they collaborate with one another through them. As a result, CSCW has a fundamental orientation towards the types of multi-user scenarios that are pervasive throughout digital legacy scholarship.

One only need revisit Grudin's classic list of CSCW challenges for groupware [18] – some of our earliest collaborative systems – to see their relevance when considering digital legacies as well. We see echos of Grudin's *adoption process* challenge, that successful groupware requires people to adopt a set of social practices in addition to a software system. There are similar challenges with digital legacy adoption as well. While in some cases there are technical features that can support digital legacy practices (e.g., backing up data from an online account), these general-purpose tools leave people without adequate guidance on how they might be used for the purposes of legacy crafting and maintenance. Introducing technical systems with more careful implementation, as Grudin suggests for groupware, may provide additional guidance on their use for the purposes of legacy crafting and maintenance. Adopting CSCW's multi-user (and, indeed, a multi-generational)

perspective highlights the importance of introducing digital legacy tools as socio-technical artifacts. Likewise, digital legacy embodies Grudin's challenge from the *disparity in work and benefits*, where he argues that groupware systems often require work from people who do not perceive the benefits of that work. While groupware and digital legacies are different contexts, the act of crafting legacies is often done by an individual who can only imagine the benefits for those one leaves behind.

As future scholarship attempts to more effectively understand the fluid social relationships between individuals as digital legacy data is passed down, CSCW's centering of social solutions to address socio-technical challenges can be a helpful foundation. In particular, we see CSCW providing a crucial perspective as we design beyond the single user and consider multi-user and multi-generational technical challenges.

LIMITATIONS

Our literature review was intentionally focused on HCI scholarship to summarize the current scholarship on user experiences and design considerations for digital legacy. Moving forward, there is relevant literature from other disciplines and venues that could be influential to digital legacy scholarship. For example, issues around legacy can be found in Media Studies journals (e.g., New Media Society, Social Media + Society), Archival Studies journals (e.g., The Journal of Academic Librarianship, Library Information Science Research), and Death Studies journals (e.g., Omega). Given our focus on HCI scholarship alone, we cannot capture the insights of those other fields. Future work would benefit from incorporating additional perspectives from adjacent literature.

An additional limitation of our study is that our insights are largely limited to a Western contexts — a byproduct of the Western focus of the available scholarship. We recognize that grief, mourning, and legacy have a diversity of expressions and realities that vary across geographies, cultures, and religions. Our hope is that by shining a light on the current overrepresentation of Western perspectives on grief in the literature, future research can begin to address this gap.

CONCLUSION

Through this Grounded Theory Literature Review (GTLR), we have compiled an archive of digital legacy research in HCI and social computing literature. We determine that the conversation about digital legacy in CSCW and broader HCI community is about how identity is navigated in the passing of digital legacy, how digital legacies are engaged with, how digital legacies are put to rest, and how technology interfaces with offline legacy technologies. We find that individual papers on these topics empirically examine specific moments in data management. However, by looking at the papers in relationship to one another, we find that digital legacy literature is interested in how digital legacy materials (data and accounts) cycle through multi-user and multi-generational networks of people.

Interpreting the data cycles we identify in the literature, we have presented a *digital legacy data lifecycle* model depicting how digital legacy research examines a lifecycle of data as it is passed down. We have used this model to help illustrate gaps in current research and chart pertinent inflection points for future social computing research. Additionally, this model has illustrated emerging theoretical findings and major concepts in the nascent field of digital legacy research.

ACKNOWLEDGMENTS

We thank our reviewers and the members of the CU Boulder Identity Lab for their thoughts, suggestions, and revisions on this paper throughout the writing and submission process. We would especially like to thank: Jessica L. Feuston, Michael Ann DeVito, Casey Paul, Casey Fiesler, and Bryan Semaan. This research was supported by NSF CAREER Award #2048244.

REFERENCES

[1] 2022. Google Scholar: Top Publishers in HCI. Queried 11/15/22. https://scholar.google.com/citations?view_op=top_venues&hl=de&vq=eng_humancomputerinteraction

[2] Mark S. Ackerman. 2000. The Intellectual Challenge of CSCW: The Gap Between Social Requirements and Technical Feasibility. *Human–Computer Interaction* 15, 2-3 (Sept. 2000), 179–203. https://doi.org/10.1207/S15327051HCI1523_5

[3] A. A. Adams and S. A. Williams. 2014. What's Yours Is Mine and What's Mine's My Own: Joint Accounts and Digital Identity. *ACM SIGCAS Computers and Society* 44, 1 (April 2014), 15–26. https://doi.org/10.1145/2602147.2602150

[4] Richard Banks, David Kirk, and Abigail Sellen. 2012. A design perspective on three technology heirlooms. *Human–Computer Interaction* 27, 1-2 (2012), 63–91. https://doi.org/10.1080%2F07370024.2012.656042

[5] Eric P. S. Baumer and Jed R. Brubaker. 2017. Post-Userism. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*. ACM, Denver Colorado USA, 6291–6303. https://doi.org/10.1145/3025453.3025740

[6] Genevieve Bell. 2006. No More SMS from Jesus: Ubicomp, Religion and Techno-spiritual Practices. In *UbiComp 2006: Ubiquitous Computing*, David Hutchison, Takeo Kanade, Josef Kittler, Jon M. Kleinberg, Friedemann Mattern, John C. Mitchell, Moni Naor, Oscar Nierstrasz, C. Pandu Rangan, Bernhard Steffen, Madhu Sudan, Demetri Terzopoulos, Dough Tygar, Moshe Y. Vardi, Gerhard Weikum, Paul Dourish, and Adrian Friday (Eds.). Vol. 4206. Springer Berlin Heidelberg, Berlin, Heidelberg, 141–158. https://doi.org/10.1007/11853565_9

[7] Jed R. Brubaker and Vanessa Callison-Burch. 2016. Legacy Contact: Designing and Implementing Post-mortem Stewardship at Facebook. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. ACM, San Jose California USA, 2908–2919. https://doi.org/10.1145/2858036.2858254

[8] Jed R. Brubaker, Lynn S. Dombrowski, Anita M. Gilbert, Nafiri Kusumakaulika, and Gillian R. Hayes. 2014. Stewarding a Legacy: Responsibilities and Relationships in the Management of Post-Mortem Data. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, Toronto Ontario Canada, 4157–4166. https://doi.org/10.1145/2556288.2557059

[9] Jed R. Brubaker, Gillian R. Hayes, and Melissa Mazmanian. 2019. Orienting to Networked Grief: Situated Perspectives of Communal Mourning on Facebook. *Proceedings of the ACM on Human-Computer Interaction* 3, CSCW (Nov. 2019), 1–19. https://doi.org/10.1145/3359129

[10] Natalie Ceeney. 2008. The Role of a 21st-Century National Archive—The Relevance of the Jenkinsonian Tradition, and a Redefinition for the Information Society. *Journal of the Society of Archivists* 29, 1 (April 2008), 57–71. https://doi.org/10.1080/00379810802499868

[11] Janet X. Chen, Francesco Vitale, and Joanna McGrenere. 2021. What Happens After Death? Using a Design Workbook to Understand User Expectations for Preparing Their Data. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*. ACM, Yokohama Japan, 1–13. https://doi.org/10.1145/3411764.3445359

[12] Munmun De Choudhury, Scott Counts, and Eric Horvitz. 2013. Major Life Changes and Behavioral Markers in Social Media: Case of Childbirth. In *Proceedings of the 2013 Conference on Computer Supported Cooperative Work*. ACM, San Antonio Texas USA, 1431–1442. https://doi.org/10.1145/2441776.2441937

[13] KL Denny Ho, Yanki Lee, and Julia Cassim. 2009. What if… users do not know how to be inclusive through design. In *Proceedings of the 5th International Conference on Inclusive Design*.

[14] J. P. Djajadiningrat, W. W. Gaver, and J. W. Fres. 2000. Interaction Relabelling and Extreme Characters: Methods for Exploring Aesthetic Interactions. In *Proceedings of the 3rd Conference on Designing Interactive Systems: Processes, Practices, Methods, and Techniques*. ACM, New York City New York USA, 66–71. https://doi.org/10.1145/347642.347664

[15] Katie Z. Gach and Jed R. Brubaker. 2020. Experiences of Trust in Postmortem Profile Management. *ACM Transactions on Social Computing* 3, 1 (March 2020), 1–26. https://doi.org/10.1145/3365525

[16] Katie Z. Gach and Jed R. Brubaker. 2021. Getting Your Facebook Affairs in Order: User Expectations in Post-mortem Profile Management. *Proceedings of the ACM on Human-Computer Interaction* 5, CSCW1 (April 2021), 1–29. https://doi.org/10.1145/3449248

[17] Barney Glaser and Anselm Strauss. 1967. Grounded theory: The discovery of grounded theory. *Sociology the journal of the British sociological association* 12, 1 (1967), 27–49.

[18] Jonathan Grudin. 1994. Groupware and Social Dynamics: Eight Challenges for Developers. *Commun. ACM* 37, 1 (Jan. 1994), 92–105. https://doi.org/10.1145/175222.175230

[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. In *Proceedings of the 2016 ACM Conference on Designing Interactive Systems*. ACM, Brisbane QLD Australia, 736–748. https://doi.org/10.1145/2901790.2901802

[20] Rebecca Gulotta, Aisling Kelliher, and Jodi Forlizzi. 2017. Digital Systems and the Experience of Legacy. In *Proceedings of the 2017 Conference on Designing Interactive Systems*. ACM, Edinburgh United Kingdom, 663–674. https://doi.

org/10.1145/3064663.3064731

[21] Rebecca Gulotta, William Odom, Haakon Faste, and Jodi Forlizzi. 2014. Legacy in the Age of the Internet: Reflections on How Interactive Systems Shape How We Are Remembered. In *Proceedings of the 2014 Conference on Designing Interactive Systems*. ACM, Vancouver BC Canada, 975–984. https://doi.org/10.1145/2598510.2598579

[22] Rebecca Gulotta, William Odom, Jodi Forlizzi, and Haakon Faste. 2013. Digital Artifacts as Legacy: Exploring the Lifespan and Value of Digital Data. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, Paris France, 1813–1822. https://doi.org/10.1145/2470654.2466240

[23] Oliver L. Haimson, Bryan Semaan, Brianna Dym, Joey Chiao-Yin Hsiao, Daniel Herron, and Wendy Moncur. 2019. Life Transitions and Social Technologies: Research and Design for Times of Life Change. In *Conference Companion Publication of the 2019 on Computer Supported Cooperative Work and Social Computing*. ACM, Austin TX USA, 480–486. https://doi.org/10.1145/3311957.3359431

[24] Jonna Häkkilä, Ashley Colley, and Matilda Kalving. 2019. Designing an Interactive Gravestone Display. In *Proceedings of the 8th ACM International Symposium on Pervasive Displays*. ACM, Palermo Italy, 1–7. https://doi.org/10.1145/3321335.3324952

[25] Feng Han, Yifei Cheng, Megan Strachan, and Xiaojuan Ma. 2021. Hybrid Paper-Digital Interfaces: A Systematic Literature Review. In *Designing Interactive Systems Conference 2021*. ACM, Virtual Event USA, 1087–1100. https://doi.org/10.1145/3461778.3462059

[26] Jack Holt, James Nicholson, and Jan David Smeddinck. 2021. From Personal Data to Digital Legacy: Exploring Conflicts in the Sharing, Security and Privacy of Post-mortem Data. In *Proceedings of the Web Conference 2021*. ACM, Ljubljana Slovenia, 2745–2756. https://doi.org/10.1145/3442381.3450030

[27] Elizabeth G. Hunter. 2008. Beyond Death: Inheriting the Past and Giving to the Future, Transmitting the Legacy of One's Self. *OMEGA - Journal of Death and Dying* 56, 4 (June 2008), 313–329. https://doi.org/10.2190/OM.56.4.a

[28] Sue Jamison-Powell, Pam Briggs, Shaun Lawson, Conor Linehan, Karen Windle, and Harriet Gross. 2016. "PS. I Love You": Understanding the Impact of Posthumous Digital Messages. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. ACM, San Jose California USA, 2920–2932. https://doi.org/10.1145/2858036.2858504

[29] Joseph 'Jofish' Kaye, Janet Vertesi, Shari Avery, Allan Dafoe, Shay David, Lisa Onaga, Ivan Rosero, and Trevor Pinch. 2006. To Have and to Hold: Exploring the Personal Archive. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, Montréal Québec Canada, 275–284. https://doi.org/10.1145/1124772.1124814

[30] David S. Kirk and Abigail Sellen. 2010. On Human Remains: Values and Practice in the Home Archiving of Cherished Objects. *ACM Transactions on Computer-Human Interaction* 17, 3 (July 2010), 1–43. https://doi.org/10.1145/1806923.1806924

[31] Tianxiao Liu, Jasmine Glover, and Oliver L. Haimson. 2020. Reasons for Sharing With Separate Social Media Audiences During Life Transitions. In *Conference Companion Publication of the 2020 on Computer Supported Cooperative Work and Social Computing*. ACM, Virtual Event USA, 329–334. https://doi.org/10.1145/3406865.3418306

[32] Michael E. Locasto, Michael Massimi, and Peter J. DePasquale. 2011. Security and Privacy Considerations in Digital Death. In *Proceedings of the 2011 New Security Paradigms Workshop*. ACM, Marin County California USA, 1–10. https://doi.org/10.1145/2073276.2073278

[33] Rachel M. Magee, Denise E. Agosto, and Andrea Forte. 2017. Four Factors That Regulate Teen Technology Use in Everyday Life. In *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing*. ACM, Portland Oregon USA, 511–522. https://doi.org/10.1145/2998181.2998310

[34] Michael Massimi and Ronald M. Baecker. 2010. A Death in the Family: Opportunities for Designing Technologies for the Bereaved. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, Atlanta Georgia USA, 1821–1830. https://doi.org/10.1145/1753326.1753600

[35] Michael Massimi, Jackie L. Bender, Holly O. Witteman, and Osman H. Ahmed. 2014. Life Transitions and Online Health Communities: Reflecting on Adoption, Use, and Disengagement. In *Proceedings of the 17th ACM Conference on Computer Supported Cooperative Work & Social Computing*. ACM, Baltimore Maryland USA, 1491–1501. https://doi.org/10.1145/2531602.2531622

[36] Michael Massimi, William Odom, Richard Banks, and David Kirk. 2011. Matters of Life and Death: Locating the End of Life in Lifespan-Oriented Hci Research. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, Vancouver BC Canada, 987–996. https://doi.org/10.1145/1978942.1979090

[37] Wendy Moncur, Lorna Gibson, and Daniel Herron. 2016. The Role of Digital Technologies During Relationship Breakdowns. In *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing*. ACM, San Francisco California USA, 371–382. https://doi.org/10.1145/2818048.2819925

[38] Wendy Moncur and David Kirk. 2014. An Emergent Framework for Digital Memorials. In *Proceedings of the 2014 Conference on Designing Interactive Systems*. ACM, Vancouver BC Canada, 965–974. https://doi.org/10.1145/2598510.2598516

[39] Francisco Nunes, Nervo Verdezoto, Geraldine Fitzpatrick, Morten Kyng, Erik Grönvall, and Cristiano Storni. 2015. Self-Care Technologies in HCI: Trends, Tensions, and Opportunities. *ACM Transactions on Computer-Human Interaction* 22, 6 (Dec. 2015), 1–45. https://doi.org/10.1145/2803173

[40] William Odom, Richard Banks, David Kirk, Richard Harper, Siân Lindley, and Abigail Sellen. 2012. Technology Heirlooms?: Considerations for Passing down and Inheriting Digital Materials. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, Austin Texas USA, 337–346. https://doi.org/10.1145/2207676.2207723

[41] Joachim Pfister. 2017. "This Will Cause a Lot of Work.": Coping with Transferring Files and Passwords as Part of a Personal Digital Legacy. In *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing*. ACM, Portland Oregon USA, 1123–1138. https://doi.org/10.1145/2998181.2998262

[42] James Pierce and Eric Paulos. 2011. Second-Hand Interactions: Investigating Reacquisition and Dispossession Practices around Domestic Objects. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, Vancouver BC Canada, 2385–2394. https://doi.org/10.1145/1978942.1979291

[43] Amon Rapp, Lorenzo Curti, and Arianna Boldi. 2021. The Human Side of Human-Chatbot Interaction: A Systematic Literature Review of Ten Years of Research on Text-Based Chatbots. *International Journal of Human-Computer Studies* 151 (July 2021), 102630. https://doi.org/10.1016/j.ijhcs.2021.102630

[44] Wan-Jou She, Panote Siriaraya, Chee Siang Ang, and Holly Gwen Prigerson. 2021. Living Memory Home: Understanding Continuing Bond in the Digital Age through Backstage Grieving. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*. ACM, Yokohama Japan, 1–14. https://doi.org/10.1145/3411764.3445336

[45] Lisa Thomas and Pam Briggs. 2014. An Older Adult Perspective on Digital Legacy. In *Proceedings of the 8th Nordic Conference on Human-Computer Interaction: Fun, Fast, Foundational*. ACM, Helsinki Finland, 237–246. https://doi.org/10.1145/2639189.2639485

[46] Daisuke Uriu, Noriyasu Obushi, Zendai Kashino, Atsushi Hiyama, and Masahiko Inami. 2021. Floral Tribute Ritual in Virtual Reality: Design and Validation of SenseVase with Virtual Memorial. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*. ACM, Yokohama Japan, 1–15. https://doi.org/10.1145/3411764.3445216

[47] Daisuke Uriu and William Odom. 2016. Designing for Domestic Memorialization and Remembrance: A Field Study of Fenestra in Japan. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. ACM, San Jose California USA, 5945–5957. https://doi.org/10.1145/2858036.2858069

[48] Daisuke Uriu, William Odom, and Hannah Gould. 2018. Understanding Automatic Conveyor-belt Columbaria: Emerging Sites of Interactive Memorialization in Japan. In *Proceedings of the 2018 Designing Interactive Systems Conference*. ACM, Hong Kong China, 747–752. https://doi.org/10.1145/3196709.3196801

[49] Daisuke Uriu, William Odom, Mei-Kei Lai, Sai Taoka, and Masahiko Inami. 2018. SenseCenser: An Interactive Device for Sensing Incense Smoke & Supporting Memorialization Rituals in Japan. In *Proceedings of the 2018 ACM Conference Companion Publication on Designing Interactive Systems*. ACM, Hong Kong China, 315–318. https://doi.org/10.1145/3197391.3205394

[50] Daisuke Uriu, Kenta Toshima, Minori Manabe, Takeru Yazaki, Takeshi Funatsu, Atsushi Izumihara, Zendai Kashino, Atsushi Hiyama, and Masahiko Inami. 2021. Generating the Presence of Remote Mourners: A Case Study of Funeral Webcasting in Japan. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*. ACM, Yokohama Japan, 1–14. https://doi.org/10.1145/3411764.3445617

[51] Joost F Wolfswinkel, Elfi Furtmueller, and Celeste P M Wilderom. 2013. Using Grounded Theory as a Method for Rigorously Reviewing Literature. *European Journal of Information Systems* 22, 1 (Jan. 2013), 45–55. https://doi.org/10.1057/ejis.2011.51

Received July 2022; revised January 2023; accepted March 2023