Placelessness, Spacelessness, and Formlessness: Experiential Qualities of Virtual Possessions

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ABSTRACT

People worldwide are increasingly acquiring *virtual possessions*. While virtual possessions have become ubiquitous, little work exists on how people value them, and how their experiences of them differ from material possessions. In this paper, we reflect on and synthesize findings from five studies we conducted over the past five years that investigated people's perceptions of and practices with virtual possessions. Through the higher-level perspective we adopt, we propose three thematic qualities that help characterize people's experiences with virtual possessions, as compared to their material things: *placelessness*, *spacelessness*, and *formlessness*. We draw on these proposed qualities as lenses to help frame future research and practice opportunities for better supporting value construction activities with virtual possessions.

Author Keywords

Virtual Possessions; Interactive Systems Design; Interaction Design; Digital Archives; Theory

ACM Classification Keywords

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

INTRODUCTION

People collect and cherish a curated set of material possessions that provide a sense of who they were, who they are, and who they wish to become. For example, many parents cherish a small selection of books they read to their children, keeping these books long after their children have left home. Researchers from a range of disciplines have investigated these practices, developing theories that help understand how people use their things to construct their identity through acts of self-presentation and self-reflection.

As interactive technologies continue to become woven into the fabric of everyday life, people's practices have transformed, due in part to their growing and diverse collections of *virtual possessions* [22]. These include material possessions that have become immaterial (e.g., books, music, photos, and tickets); things that never had a lasting material form (e.g., electronic message archives,

social networking profiles, game avatars, and social networking badges); and also metadata from logs of digital devices and services that capture people's actions (e.g., photo location information, automatic and manual photo tags, music play histories, and credit card purchase histories). The convergence of social, mobile, and cloud computing services has created a world in which people can access, create, display and curate their collections of virtual possessions nearly everywhere and at any time.

In the past several years, HCI and design researchers have begun to explore people's practices with their digital content and collections [e.g., 3, 7, 14, 15, 25, 27]. This growing body of work has focused on both understanding and building tools to support people's values and practices surrounding specific types of virtual possessions (e.g., photos, video, music) and virtual archives as a whole. However, to date *virtual possessions* remain difficult to characterize. Part of this complexity owes to the fact that the experience of virtual possessions can exhibit key differences compared to material things, which affect the quality of people's experiences with their virtual archives. For example, virtual possessions are *placeless*; they can be accessed nearly anywhere, allowing them to be present in multiple locations simultaneously. They are *spaceless*; they largely do not intrude into people's physical space, making it difficult to understand the size and scale of a collection. They are *formless*; they can be easily reproduced, making it difficult to differentiate a copy from 'the original', and they can be re-formed to fit many different kinds of devices and re-mixed with various kinds of digital content. These differences can make the experience of virtual possessions quite unlike material things, and, understandably, theories of material possession attachment do not fully support understanding what virtual possessions are, and what they could be in the future. To date, research on virtual possessions offers little in the way of guidelines that can help designers to conceive of better virtual things.

In this paper we synthesize and reflect on findings from five studies we conducted over the past five years that, in different ways, investigated people's perceptions of and practices with their virtual possessions. Across these studies, in-home interviews were conducted with a total of 152 participants at sites spanning the United States, United Kingdom, Spain, and South Korea. The higher-level perspective we adopt in this paper enables us to surface key thematic qualities that help characterize how people

experience virtual possessions, and to relate these themes to existing research in the HCI and DIS communities. We see this as another step toward developing an understanding of factors shaping the experience of virtual possession. This can help provide a better grasp on what virtual possessions are as a class of artifacts, and to identify and structure rich opportunities for future research and practice initiatives.

This paper makes two contributions. First, based on synthesis of fieldwork projects conducted over the past five years, it proposes three qualities that help characterize experiences with virtual possessions as compared to material things. Second, it draws on the proposed qualities as lenses to help frame design opportunities to better support value construction activities with virtual possession. Our overarching goal is to nurture the community's interest in virtual possessions as a research topic, and to take a step toward advancing it beyond a nascent level of understanding.

BACKGROUND AND RELATED WORK

Over one hundred years ago William James described how people consider their possessions to be part of the self [13]. Since then, researchers from a variety of disciplines have characterized the connection between the self and material things in various ways. Goffman noted that people use their things as props in ongoing presentation and management of self to others [9]. Csikszentmihalyi and Rochberg-Halton describe how people invest psychic energy into the objects they associate with their life goals and achievements [4].

Consumer behavior research has extensively investigated material possession attachment. Synthesizing many perspectives in the social sciences, Belk describes a framework detailing how people extend their sense of self through their things [1]. He unpacks how people possess things to engage in and perform activities. Through both the internal conversations people have with themselves (self-reflection) and through the social experience of seeing how people react to their use of a thing (self-presentation), people develop a sense of value for a possession. Consumer behavior researchers have also turned to McAdams' concept of identity construction as the development of a coherent *life story*—a synthesis of stories uniting events from the past and present interwoven with aspirations for the future [17]. In the performance of their life, people draw on possessions as they develop a sense of who they are and who they wish to be seen as. They value possessions that point back to their past, that capture current practices and sense of self, and that project the future they desire.

Relatively little is known about how theories related to material possessions and attachment can be applied to people's rapidly growing collections of virtual possessions. Recently, researchers in the HCI community have begun to explore implications surrounding the increasing virtualization of material things, looking at specific topics such as photos [e.g., 25], music [e.g., 3], and currency [18].

HCI researchers have also begun to investigate digital artifacts with sentimental value. One strand of this research employs values-oriented perspectives when designing tools that better support the archiving of cherished digital objects [e.g., 15, 25]. Other work describes how archives function as rich resources for identity construction [e.g., 14]. New opportunities have also emerged for people to move virtual possessions to online places. Recent studies have illustrated how the presentation of digital content in online environments can support identity and relationship-building practices [e.g., 27]. Others have begun to explore how the Cloud muddles the notion of 'owning' personal or shared digital content [e.g., 16].

Several investigations have found that in peculiar ways virtual things are often not experienced as being as valuable as material things. For example, Brown and Sellen [3] showed how the transition to digital music diminished people's ability to easily present and display their collection. Other research [e.g., 25] has described how people digitizing artifacts like photos, cards and maps can diminish their value as people become less likely to re-visit them. More recent work has uncovered a more complex set of issues in terms of authenticity and tradition that can complicate the value of virtual things [26]. These issues present complex challenges and the topic of how to approach designing digital artifacts largely characterized by immaterial qualities remains an ongoing area of interest in the DIS and HCI communities [e.g., 6, 11].

In this paper, we aim to bring these different strands of research together. We want to synthesize findings across our work over the past several years to surface a broader set of thematic qualities that can help better understand people's experiences with their virtual possessions. Importantly, we do not claim that these thematic qualities are the only ones that exist. Nonetheless, they do provide a starting point for transitioning beyond study-specific findings, to a broader set of notions about factors shaping experiences with virtual possessions, and the interactive products and systems that manifest them. In this way, this paper contributes a modest step toward advancing knowledge about virtual possessions beyond a nascent level of understanding in the research community.[1]

SUMMARY OF FIELD STUDIES

In this section, we give a brief overview of our prior studies, all previously published at DIS or CHI. We describe them in support of our efforts to synthesize a broader set of qualities that help characterize people's experiences with their virtual possessions.

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[1] See Edmonson and MacManus' discussion of how knowledge within academic communities begins to transition beyond *nascent* as important relationships among phenomena are developed, confirmed, and critically reflected on, strengthening the topical foundation from which new research and theory emerges [5, p. 1158].

Bereavement Study: Understanding Bereavement in the context of Interactive Technologies. Initially, the first author, with colleagues Harper, Sellen, Kirk and Banks at Microsoft Research Cambridge, conducted in depth in-home interviews with 11 bereaved participants across the United Kingdom in 2009 [20]. The aim was to understand how emerging technological trends are requiring people to confront a range of new issues, such as dealing with locally stored or online digital data inherited from departed loved ones. We anticipated many of these concerns owe to there being few mechanisms in place that help people deal with the proliferation of their virtual archives on larger time scales, in and beyond their own life span.

Divorce Study: Divorced Families and Interactive Systems. We conducted in depth in-home observations and interviews with 13 divorced families during 2009-2010 in a large Midwestern city in the United States [21]. A total of 13 parents and 46 children (aged 10-17) were interviewed. One strand we focused on was teens' experiences of transitioning between two domestic environments that were often very different on social and material levels. We paid particular attention to the possessions teens drew on as coping mechanisms in these circumstances.

Teen Study: Teenagers and Their Virtual Possessions. Motivated by rich findings with teens in the Divorce Study, we conducted an expanded study of teens in cohesive homes to explore perceptions, uses, workarounds and breakdowns with their virtual possessions. We interviewed 21 teenagers (aged 13-17) in their bedrooms during 2010 in a large Midwestern city in the United States [22]. This study revealed a wide of range insights into teens' value construction activities with virtual possessions, especially in terms of how they supported practices of self-reflection and self-presentation in novel and meaningful ways.

Cloud Study: Understanding the Possession of Digital Things in the Cloud. The Divorce and Teen studies revealed a variety of ways Cloud computing was intersecting with virtual possessions. To dig in deeper on this growing area, the first author, with colleagues Sellen, Harper and Thereska at Microsoft Research Cambridge, conducted interviews with 13 participants from across occupations and life stages (e.g., teens, mid-20s, mid-30s, mid-40s, mid-50s, mid-60s). This field research was conducted in the UK in 2011 [23]. We focused specifically on people's experiences of using Cloud computing services to store, access, and share their virtual possessions. This study revealed several ways Cloud environments complicated, quite fundamentally, people's experiences and perceptions of 'possessing' their virtual things and archives.

Global Study: Understanding Perceptions of Virtual Possession among Young Adults in South Korea, Spain and the United States. Our prior studies helped identify early emerging issues related to people's practices with virtual possessions, but remained relatively small in scope. In collaboration with collegues at KAIST University,

University of Granada, and Vodafone, in this study we expanded the scope in terms of participants and geographic locations, conducting in depth in-home interviews with 48 young adults across sites in South Korea, Spain and the United States (8 male and 8 female per country) in 2011 and 2012 [24]. We wanted to advance a more cross-cultural understanding of people's value construction activities with their virtual possessions. We selected these sites as they represent three large regions (Southeast Asia, Southern Europe, North America), they have distinctly different cultures, and they have similarities in terms of technology infrastructure. It was in this work that themes started to surface across studies, which catalyzed our interest in exploring what might be a higher-level set of experiential qualities of virtual possessions.

EXPERIENTIAL QUALITIES OF VIRTUAL POSSESSIONS
We propose three thematic qualities to help characterize aspects of people's experiences with their virtual possessions. These qualities emerged from ongoing reflection and meta-analysis on findings across all five studies. As a part of this process, we reviewed prior transcribed data, photographs, field notes and textual documents coded with themes specific to individual studies. We also created new textual documents coded with overarching themes, and conceptual models and affinity diagrams to help structure emerging themes and connections. This paper provides a space to conceptually consider findings across our five studies from a higher-level perspective. For each quality, we offer a brief description, a 'prototypical' example, and a discussion of the benefits and shortcomings in terms of value-construction activities. Importantly, these are not rigid qualities and many aspects and observations weave together. However, they offer distinct and constructive lenses for designers to work with when conceiving of new kinds of virtual possessions.

Placelessness
With material possessions, most people have some sense of what they own and where these things can be found. People organize possessions in containers and put them in special places. Homes, workplaces, and even vehicles act as physical boundaries around material possessions, and within these boundaries, people create special places to further contain and organize them.

With virtual possessions, especially those stored online, people experience no equivalent sense of place. They have a quality of *placelessness*. They can be accessed and made present in and across multiple locations simultaneously. This quality provides flexible and extensible interactions not possible with material things. At the same time, it complicates the feeling of being in possession of a thing, and this may alter how people view an item as valuable.

Digital photos provide a prototypical example of placelessness. A photo gets taken on a smart phone, texted to a friend, copied to iPhoto on a laptop, and copied to the

Cloud via Dropbox. Next, it might be uploaded to social networking services like Facebook or Flickr where it can be viewed and commented on by others. The photo on Facebook or Flickr can continue to have social and machine-constructed metadata growing around it, while the others exist in parallel on various 'on body' devices, in-home hard drives and servers elsewhere in the world. This photo can be made present across many devices and services at the same time; however, it lacks the enduring, anchored presence of a singular, material photograph. This lack of a singular place makes it difficult to know where 'this' photo is, who may have it, and if it has been deleted.

Placelessness has emerged due to two interrelated technologies. First, mobile technologies (e.g., tablets, smartphones, music players) enable people to keep and carry entire collections everywhere they go, increasing accessibility but decreasing a sense of fixed place. Second, Cloud computing amplifies mobility. As people move their virtual archives from local to online storage, they gain access to larger and more diverse archives of virtual possessions. More and more Cloud-storage services continue to emerge to better support this trend.

Placelessness and value-construction activities
Across our studies, we observed people taking actions to make their virtual possessions more placeless. These behaviors were often motivated by desires to increase access. One of the most common practices was emailing files to oneself. For example, participants in the Teen Study frequently self-emailed their in-progress homework as they moved among school, friends' homes and their own home. This trend was also common among some of our oldest participants in the Cloud Study, where self-emailing was used to ensure future access of cherished photos and even financial and legal documents.

Mobile devices played a central role in making things more placeless. Teens in the Divorce Study commonly carried large collections of digital photos and music, helping them construct a more singular bedroom as they transitioned between their parents' homes. They drew on social networking services to create placeless proxies of cherished material possessions. For example, a female participant described a cherished pillowcase that had been signed by her friends and was on display in her bedroom at her Mom's house. Motivated by the desire to feel like it was with her despite the home she was living in, she posted a photo of it on her Facebook account. In this way, she leveraged placelessness to draw on a representation of it in environments outside her Mom's house. While subtle, she leveraged placelessness in a highly valued way that enabled her to gain a little more control over her things and the domestic environments she routinely transitioned between and outside of. This practice also led to new value emerging around the virtual proxy in unexpected ways (an example we will return to later in the formlessness section).

Collectively, these practices parallel observations from prior work illustrating how the ability to fluidly make virtual archives placeless provided *a sense of place* for people in transition without a home [29]. Interestingly, in the Divorce and Teen Studies the trend of creating placelessness through mobilizing and carrying large virtual archives, and through use of the Cloud illustrates that this quality is important to populations beyond the dislocated.

Placelessness can aid self-presentation and reflection. In contrast to the relatively slow rate of change in display of material possessions, virtual possessions populating backgrounds changed frequently. Teen participants described augmenting the background images of their devices from weekly to several times a day. In some cases this was motivated by a desire to cater to social audiences that might visit their room. For example, one teen described curating a Halo video-game theme across his computer, mobile phone, tablet, and video game console when particular friends visited. When alone, device backgrounds were changed to a curated selection of images associated with the university he planned to attend next year.

In the Global study, young adults, whom often had few material possessions in their homes, frequently augmented device displays with photos of people or significant material things they were separated from, and of images depicting their future aspirations (often in term of career, romantic relationships or personal hobbies). Here too, coordinated curated sets of virtual possessions were frequently changed to emphasize different life goals or interests depending on the social audience; young adults also highlighted the importance of being able to draw on these inspirational virtual things across environments, 'anywhere they go.'

Complications and workarounds triggered by placelessness
While placelessness increased access to collections, it also caused complications. Participants in the Cloud and Global studies voiced concerns about their use of the Cloud to create a sense of placelessness. They were uncomfortable with placing their personal and precious things in the hands of a largely unseen and unknown third party service. In the physical world, a benefit of knowing where your things live is that you can have quick access to them. The Cloud clearly improved this; however, participants commonly described feeling like they had no discernable control over the services that host the places where their digital stuff "lives", and that they might temporarily or even permanently lose access to them. When reflecting on their online accounts (e.g., Facebook, Dropbox), older adults, young adults and even teenagers described fears of "being at the mercy of someone else" or having their virtual possessions "disappear suddenly one day." These discussions made clear that participants were skeptical of the persistence and reliability of online places, and the uneasiness they felt over ceding accountability for significant virtual possessions to third party services.

Participants experienced problems when their digital devices and services failed to fully deliver of the promise of placelessness, for example, when virtual possessions became trapped on old devices. In the Bereavement, Teens, and Global studies, participants described holding onto no longer used (or non-functioning) digital devices tucked away in drawers and closets with the hopes that one day they would be able to resurrect their virtual archives stored within. These included old gaming systems (Xbox and Playstation) containing play histories and achievements, digital cameras now inaccessible that still have significant photos stored in their internal memory, and, most commonly, old mobile phones with cherished communication records and other digital content trapped inside. These situations could prompt extreme behaviors. For example, a Spanish participant in the Global Study described hand-writing an archive of SMS messages that detailed the progression of her current romantic relationship. These messages, which had become trapped on an old phone, filled four A5 journals.

Participants adopted many strategies to work around these limitations. In some cases, they printed out physical copies of their online possessions to 'have' an artifact that felt more persistent. These things included bound booklets of email correspondence and significant status updates or photo comments on social networking services. However, in all cases these practices were at some point considered futile and abandoned. In more extreme cases, we observed participants creating redundant copies of archives across a set of networked computers located in the homes of family or friends. While rare, these instances highlighted the significance of the social context surrounding where remote storage drives were located. Similar to their treasured material things, participants desired their virtual archives to be kept in socially appropriate settings. In this way, participants were able to re-construct a higher level of awareness and control over their virtual archives, while also retaining some of the intrinsic benefits of placelessness.

Another major complication placelessness introduced owed to its fragmenting affect on people's virtual possessions. Participants (particularly in the Cloud and Global Studies) commonly reported having a variety of valued virtual possessions split across many different services online. These things included digital photos on social networking services, collections of inspirational images (e.g., Pinterest.com), wish lists on shopping websites (e.g., Amazon.com), archives of personal photos, video and documents, and information related to personal achievements in online games (e.g. World of Warcraft). While these things were broad, they were highly valued as elements helping participants construct their evolving life story. Similar to the workaround mentioned above, here too the most common approach we observed was participants' attempts to create material copies of online virtual possessions to regain a higher level of control over them to create more holistic collections (e.g., printing a Facebook

photo along with the comments attached to it in order to place it in a memory box with other mementos). However, people commonly expressed dissatisfaction with this approach due to its cumbersome nature and that it complicated the authenticity of a virtual possession itself once removed from the online system.

Collectively, these findings help illustrate the paradoxical nature of placelessness. It compresses distance and makes people' collections instantly available everywhere. This supports them in more fluidly engaging these collections to self-reflect and self-present. At the same time, placelessness causes people to experience loss of awareness of what they have and where it might be. It also creates loss of control over things as people increasingly become dependent on their digital devices and third-party services to become their permanent archive of cherished digital things.

Spacelessness
Material possessions remain present in the world, taking up physical space in the various environments and places they inhabit. As new material possessions are acquired, people must continually reassess what to keep and what to dispossess. It is in part this process that motivates people to engage in an ongoing critical reflection on and organization of their collections. As a result, the artifacts that remain present in the world become curated assemblies put on display in and outside of the home to support self-reflection and self-presentation. However, tension arises when people are forced to dispossess objects they cherish, such as when an elder couple moves from the home where they raised their children to a smaller home.

Virtual possessions have a valued experiential quality of *spacelessness*. They largely do not intrude into people's physical space and can thus grow invisibly. People can consume more and more virtual possessions without having to critically consider letting any go, creating massive archives that would largely be impossible if they were material. This quality makes it difficult to understand the size, scale and even contents of a personal collection. In addition, it does not force curation, leaving people with collections that may not represent who they are, and that are often full of things they do not value.

People's digital media collections provide a prototypical example of spacelessness. A person can keep every book, song, ringtone, TV show, and movie they ever purchase. Their archive can grow as their taste changes and at anytime they can revisit anything from their history. However, the presence of material media is largely lost, which has for many years allowed people to display a constructed self to others who visit their homes. People can also become increasingly unaware of the collection's scale as they move through and dwell in their domestic space. At the same time, when they purchase new media, the tension of where it will go and how it will shape the organization of

other domestic artifacts is no longer a concern; it easily fades into the largely immaterial virtual archive.

The emergence of spacelessness can be linked to the abundance of affordable storage drives and appliances offering massive amounts of space. We see the point at which storage space superseded the size of one's virtual archive as significant in terms of when the experience of spacelessness began to more prominently shape people's practices with and perceptions of their virtual possessions.

Experiencing spaceless virtual archives and possessions
Across many studies we observed that people valued the quality of spacelessness because it made consumption easier. People could acquire new things as part of their identity construction process with no worries that these things might not fit, or would force them to dispossess other things. Across the Divorce, Teen, and Global studies, people especially valued how this enabled them to have a virtual archive that captured years of life experiences while being encapsulated within a single point of storage. It was common for participants to describe massive collections containing digital photos, music, videos, personal documents, artworks, etc., which had been acquired over several years, in some cases over a decade. The majority of participants in these studies regarded their archives to be among their most significant things, virtual or physical, often equating them to containing their 'whole life.'

Whether preparing to complete high school or to begin one's first job, many of our participants were in transitional situations and connected the value of spacelessnes to how it enabled them to move their archives with them across different physical environments. Here, the experience of spacelessness enabled the potential to mobilize one's life and emerging legacy in ways that would have been impossible with material things. This appeared to provide a valued sense of security for these participants; they could accrue a huge archive of possessions that could support reflection on the past and present, despite the uncertainty that characterized their future material conditions.

Emergent tensions and complications with spacelessness
While the experience of spacelessness was perceived as valuable in enabling people to own, archive and move massive collections of virtual possessions, this same quality could fundamentally complicate the value it opened up. As personal archives grew larger, they increasingly became invisible, lacking the material presence that might enable people to grasp just how big they are. This made participants across studies far less inclined to curate their collections, often leading to a proliferation of unorganized and unstructured masses of virtual possessions.

While this accelerating unstructuredness produced struggles for people on an everyday basis, the Bereavement study highlighted its longer-term consequences. Several bereaved participants described the heavy burden of inheriting large

unstructured virtual archives from departed loved ones. They often characterized these experiences as amplified versions of being left with a houseful of material possessions. In particular, unsettling experiences emerged as the bereaved meticulously combed through hard drives they had inherited, struggling to separate significant virtual possessions from masses of trivial things, at times encountering troubling material they were not intended to see. In other instances, participants were too overwhelmed to come to terms with their departed love one's unfiltered virtual archive. The machines these archives were stored on tended to still be in people's possession and occupied uneasy places in their lives.

A second issue, centered on how the experience of spacelessness revealed that few tools exist to support the effortful curation of virtual possessions. Across the Teen, Cloud and Global studies, we observed that as archives grew too large, participants drew on existing mechanisms native to their operating system in attempts to curate their virtual possessions in some way. These largely centered on use of automated features, such as sorting and organizing their things by the date and time they were created or by their alphabetic order based on their title. These practices were nearly always deemed unsuccessful, particularly as participants sought to create and classify collections based on years worth of life experiences, stories and relationships captured by various kinds of virtual possessions.

Like placelessness, spacelessness has a paradoxical nature. On the one hand, it enables people to create massive archives of virtual possessions that are representative of many life experiences and stages on a scale and specificity that material possessions often cannot achieve. On the other hand, this virtue lead to an inability to conceive of what exactly is in an archive and how to meaningfully experience and curate its elements. In this way, spacelessness can lead to a loss of awareness and, consequently, a loss of control over how archives can be curated and interacted with.

Formlessness
Another characteristic of material possessions is that they have a concrete physical form that can accrue meaning over time. For example, the dog-eared pages, smudged fingerprints and handwritten notes of a cookbook handed down from mother to daughter help capture implicit and explicit material records of its past and current owner(s) through use. Over time, as the material qualities of a possession change, they become increasingly singular, unique and distinct, a notion parallel to Nelson and Stolterman's concept of an *ultimate particular* [19, p. 34].

When it comes to a virtual possession, there is no clear sense of how it can become a distinct, inimitable thing. Virtual possessions have a quality of *formlessness* in the sense that they can be easily reproduced, making it difficult to differentiate 'the original' from a copy. In addition, virtual possessions can be re-formed to fit many different

kinds of devices and re-mixed with various kinds of digital content. These qualities enable virtual possessions to be integrated into meaningful assemblies, and to grow and evolve over time without destroying or fundamentally altering the initial thing. At the same time, these aspects of formlessness can complicate value construction activities in that they can cause people to lose all sense of provenance attributed to a virtual possession.

A material recipe passed down from a loved one offers a counter example. The material recipe is the actual thing, it has been used and touched. Its creases and stains give evidence that it has been witness to the experience of many cooking episodes. In contrast, a digital recipe that has been passed down holds the recipe content but offers no evidence of having been touched or altered over time. Depending on the device used for display and the service used to host the recipe, these contents are reformatted, making it easier to read, but lessening the sense of it as a singular thing. Displayed on a tablet in the kitchen, even the rotation of the device will provide a new layout for the fixed content. Over time, the idea of the 'original' digital recipe fades away as it is manifested in various locations and, through various devices, potentially with new or different kinds of information attached to it each time.

The quality of formlessness is tied to several emerging technology trends. First, the increasing proliferation of personal devices used to interact with virtual possessions is driving a need for their form to flexibly conform and reform to the various dimensions of these output mechanisms. Second, the ability to apply different kinds of human-produced (e.g., 'likes' or 'comments' attributed to a Facebook photo) and machine-constructed (e.g., frequency of times an iTunes song was listened to) metadata to virtual possessions offers increasing opportunities to manipulate and generate new forms. The emergence and popularity of end-user API toolkits further enables people to create mashups and re-mixes of virtual possessions with a huge variety of digital information and other virtual things.

Formlessness and value construction activities
Across several of our studies, the metadata that could be applied to a virtual possession surfaced as a resource for people to manipulate and personalize their virtual possessions. In the Teen study, we encountered instances where teens gave and received musical playlists as gifts, several of which were modified metadata as a part of the gifting practice. For example, one participant replaced album art images with photos from events he attended with his girlfriend. Other teens used this practice to feature images of their friends from road trips and other social events in place of the album art of songs in their collections. In other cases, teens edited the metadata of songs to include personal notes in playlists in efforts to record memories associated the music. These instances highlighted novel ways that formlessness was leveraged to make particular

virtual possessions stand out among an ever-increasing collection of similar things. It also illustrated how virtual possessions, like the songs in music playlists, could be re-formed to be more unique and particular to the receivers.

As noted earlier in the placelessness section, we encountered a range of instances in which participants created virtual copies of cherished material possessions that were typically constrained to particular physical locations. What we want to draw attention to here is how, when uploaded to social networking services, these virtual representations accrued new value through socially constructed narratives. An exemplary case of this emerged in our Teen study in which one participant uploaded digital copies of several hand drawings he had made of his Halo avatars. These images were inscribed with a range of comments recorded by many of the people that viewed these images. Similarly, in the Divorce study, the emergence of the pillowcase online prompted many friends of our teen participant that had originally signed it, to post comments related to it. Over time, these comments became indivisible from the pillowcase itself, enhancing the value and meaning of both the material possession and its virtual proxy. In both of these cases, such manipulations to the virtual possession ultimately shaped how the material possessions themselves were perceived.

Complications and the experience of formlessness
The dimensions of reproducibility and manipulability emerging from the experience of formlessness could also complicate value construction activities. First, as noted above, participants in several cases were able to draw on formlessness to personalize their virtual possessions, and, in some cases, directly augment one virtual possession with another to mark a particular experience. However, participants often experienced frustrations over their inability to apply this kind of practice on a broader level across their larger collection of virtual possessions. For example, in our Teen and Global studies, participants struggled to create more holistic archives of their virtual possessions organized in terms of their evolving life story and experiences. In some cases, participants attempted to reorganize their virtual archives by creating digital folders in which different kinds of virtual possessions thematically related to particular experiences were kept together. While this workaround enabled participants to bring a more specific order to their virtual possessions, the applications used to generate their respective forms and make them available for interaction (e.g., iTunes, iPhoto, Microsoft Word) still operated independently. This negated any successful attempts to combine virtual possessions into new, worthwhile forms and assemblies.

In other instances, the reproducible nature of virtual possessions contributed to the perception that they were less 'real' compared to material possessions. Participants' reflections typically centered on two key issues. First, the fact that a near infinite amount of exact copies of a virtual

possession can be generated complicated its authenticity. In these cases, participants often described frustrations owing to having many similar versions of the 'same' virtual possession fragmented across different devices and services. Comparable to their cherished physical things, participants desired to have a singular form that could be available in many places. It was commonly perceived that this could have two main benefits. First, this could track and record the history of a virtual possession, for example who has augmented, used or interacted with it over time and when and where. This would help create a more unique and particular representation of a virtual possession. Second, this could reinforce higher levels of awareness and control over where their virtual things were and who might knowingly or unknowingly also have copies of them.

These examples help illustrate the paradoxical nature of formlessness. On the one hand, it enables people to manipulate, personalize and re-shape virtual possessions in ways that make them more reflective of their social interactions and experiences. Formlessness can also enable entirely new and meaningful experiences of the contents of a virtual archive, potentially providing meaningful insights into different dimensions of the life experiences and social relationships captured in it. On the other hand, these aspects of formlessness are often not well leveraged within current systems, leading to potentially negative experiences around creating rich new forms of virtual possessions. Additionally, the inherent reproducibility that formlessness introduces can complicate the perceived authenticity of a virtual possession compared to material things, and lead to perceived losses in awareness and control.

DISCUSSION AND DESIGN OPPORTUNITIES

Virtual possessions, like material things, play significant roles in people's lives. People use them in support of the value construction activities of self-reflection and self-presentation. However, the ways in which people experience virtual possessions can differ substantially from their experiences with material possessions. We proposed *placelessness*, *spacelessness*, and *formlessness* as thematic qualities affecting people's experiences with their virtual possessions. Each is paradoxical in that the uniquely virtual aspects both increase value and complicate value. In this, we see these qualities as similar to the paradox designers commonly face when creating new things. On the one hand, people desire new possessions as a way of incorporating new experiences into their everyday lives. On the other hand, people love "typical" things, finding their familiarity comforting. The challenge for a designer is to seek harmony in a specific situation and make a thing that is both novel and familiar [12]. An open design question is how to balance the novelty and familiarity with virtual possessions.

Metadata—human or machine constructed traces of digital information that implicitly and explicitly document people's interactions with virtual possessions—offers largely unexplored opportunities to better support people's value construction activities with their virtual possessions. Through our work, we identified future research and design opportunities investigating how metadata might positively address some of the shortcomings that people experienced with placelessness, spacelessness and formlessness.

Placelessness—Across studies, people's experiences of placelessness supported value construction activities, particularly in terms of enabling them to draw on their virtual archives across geographic locations, and through supporting self-presentation to multiple social groups. Placelessness complicated value construction by fragmenting virtual possessions across many different locations, making it difficult to know where they 'are', and subjecting them to being suddenly lost or meddled with by unknown entities. In reaction, people adopted different strategies to enact higher degrees of 'placefulness'; however, all of these workarounds diminished the value and benefits of placelessness to various degrees.

One approach to better supporting experiences of placelessness could center on creating a bounded, defined digital place that people consolidate their cherished virtual possessions, even if kept across many different servers, applications and hard drives. Here, metadata could be used as a binding element to keep track of location and status, and to interact with and apply changes directly to them. For example, this approach could include an inventory list, map, or even a zoomable lens and toolkit that document the specific location of every individual virtual thing within one's networked web of places. This approach would enable virtual possessions to continue accrual of valued social metadata, while providing people with a higher level of control and awareness over their things.

Building on the workarounds we encountered in our Cloud and Global studies, another approach could be to more deeply investigate the design of services that use metadata to mirror and link virtual possessions across folders on trusted remote devices. This could, in a sense, create a more anchored version of placelessness, enabling people to draw on their virtual archives across geographic locations, while tying the storage and safekeeping of them to known and trusted material environments.

Both of these design directions offer potential to help preserve the beneficial aspects of placelessness, while reinstating a deeper sense of awareness of one's distributed collections and a higher degree of control over locating and drawing on them. These directions open up questions for interaction designers in terms of how different forms and presentations of one's virtual archive could shape interactions, and how it might be embodied and made present both digitally and materially.

Spacelessness—Spacelessness emerged as a highly valued experiential quality, particularly in terms of how it enabled people to possess and mobilize archives documenting years' worth of experiences. This benefit also caused

archives to become increasingly unfiltered as they invisibly grew larger, hindering people's ability to curate them over time. In contrast to Belk's discussion of material collections as being characterized by their ability to become finite and complete [2], virtual archives seemed boundless, producing often-unresolved immediate and long-term consequences.

These issues echo broader concerns that critically question a 'total capture' lifelogging perspective [e.g., 25, 28], and demonstrate clear need for designers to develop new opportunities to support the curation of virtual archives. In many cases, we saw that people used largely ineffective approaches for sorting their virtual possessions, such as by their file type or timestamps. This suggests a large opportunity to support more effortful curation practices through the design of new interactive applications that incorporate richer, user-generated forms of metadata to classify, sort, organize and represent the contents of an archive. For example, applications could prompt people to rate or speculate on the perceived value of new virtual possessions as they enter the archive. Older virtual possessions that have not been viewed in months could be automatically resurfaced in ways that invite people to encode them with improved organizational metadata, simply reflect on them, or even dispossess them if desired. In this way, metadata could be created that captures perceived value in use and, more broadly, to help move the agency and meaning making implicated in curatorial experience back to people [7]. As we look toward longer-term implications of multi-generational interactions with virtual archives [8], this offers one strategy that could implore people to re-evaluate the value of the virtual possessions in their archive in meaningful ways.

In a contrasting approach, we see opportunities to explore designing new interactive systems that might rigidly embrace storage space limitations to force curation, or to at least prevent the invisible accrual of large uncurated collections of things. The social sharing service Snapchat (www.snapchat.com) offers one view of applications taking this stance. While focused more on privacy and unwanted self-disclosure, the result of using such a service is a curbing of the invisible growth of archives. In addition, work by Gulotta et al. [10] suggesting digital photos that decay over time provides a radically different way of achieving this same outcome. These research opportunities provide an interesting approach to explore especially when considering designing for young (or unborn) generations that have yet to acquire large virtual collections. However, they offer little help for the problem of existing large archives and could compromise the inherent value of spacelessness that people have grown accustomed to.

Formlessness—People's experiences of formlessness also highlighted paradoxical situations, especially when they compared their virtual possessions to cherished material things which did a much better job of holding on to unique histories. The manipulability that formlessness affords could support the creation of highly personalized virtual possessions. These could use descriptive metadata to provide richer perspectives on people's life stories and how their collections support both self-reflection and self-presentation in conjunction with these stories. However, the inherent reproducibility that formlessness also introduces could lead people to experience virtual possessions as quickly losing any sense of provenance and authenticity.

Despite the opportunities that formlessness presented, people struggled to create more unique virtual possessions reflective of their life experiences. This suggests an opportunity for moving away from the current system structures that largely do not enable people to re-form their cherished virtual possessions easily. One strategy centers on using metadata to enable people to collate virtual possessions based on experience-oriented or social relationship-based metrics. This kind of metadata could help people more easily bring various kinds of virtual possessions together in more holistic forms. For example, a photo taken at a soccer match could be combined along with social media comments, video, that day's weather report and ticket purchase information. New interactive applications and toolkits could be developed to support the construction of experience-oriented assemblies like this. Ultimately, this direction could help people retain more control over the process, while preserving the original content used to construct them. It also provides a secondary type of curation, as systems can monitor the artifacts that are never used or repeatedly used as being an indicator of the artifact's match to the person's sense of self

The experience of reproducibility bound to formlessness complicated the authenticity and uniqueness of virtual possessions, leading to perceptions that they were less 'real' than material things. This suggests an opportunity to use metadata to describe a virtual possession's use across people and contexts, in the service of making it more distinct. Returning to the cookbook example, as a person digitizes a family recipe and shares it online, uses of this recipe among family in different geographic locations could be collected. Over time a history of recipe's usage in relation to social gatherings, its continued modifications, and even cooking mishaps could cling together, providing a new kind of evidence for the lasting impact this artifact has across a family. This could create an entirely new form that continues to become unique, in effect separating the emerging social history from the constellation of devices in which the form is made present and interacted with. This design direction builds on Feinberg's [6] recent discussion of the 'intellectual work' as a framing mechanism for shifting emphasis away from value being characterized in different versions of digital objects themselves, toward the broader social or cultural expression of the thing.

CONCLUSION
We have reflected on and synthesized findings across five field studies investigating people's practices with and

perceptions of virtual possessions. A core goal of our paper is to take a step toward nurturing the research community's interest in virtual possessions as a research topic, and advance it beyond a nascent level of understanding. We proposed *placelessness*, *spacelessness* and *formlessness* as a set of interrelated and paradoxical qualities that shape people's experiences with their virtual possessions. This set of experiential qualities can be used to help critique and understand how current technologies and systems shape people's experiences with their virtual possessions, and to help frame future design explorations. Importantly, these are not the *only* experiential qualities of virtual possessions. Issues of timelessness and temporality, and even the extent to which a virtual thing can be made 'possessable' are important considerations for future work. As virtual possessions become more pervasive, and archives continue to grow ever larger, it is a crucial time to consider factors shaping people' experiences with them and how they can become more meaningful parts of our lives and our selves.

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