

Critically Exploring the Virtual Possession Design Space Through Fieldwork and Constructive Design Research

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Human-Computer Interaction, Interaction Design, Research through Design, Constructive Design Research, Virtual Possessions, Slow Technology, User Enactments

Abstract

Many disciplines have investigated how people modify and form attachments to their material possessions. Much of this work explores how material possessions play fundamental roles in supporting people's practices to construct a sense of who they were and who they want to become, as well as to give order to the intimate environments in which these experiences unfold. As interactive technologies continue to become woven into the fabric of everyday life, people's practices have expanded and today they are amassing ever-larger and more diverse collections of *virtual possessions*. Virtual possessions include former material things that are becoming immaterial (e.g., books, music, photos, tickets); things that never had a lasting material form (e.g., electronic message archives, social networking profiles); and also metadata traces that document people's interactions with digital devices and services (e.g., photo location information, music play histories, automatic and manual photo tags). The convergence of social, mobile and cloud computing services has created new opportunities for people to carry, access, create and curate their virtual possessions across environments throughout the world.

Over the past several years, the HCI community has begun to explore the intersection of virtual possessions with people's everyday lives. This nascent body of work has largely focused on understanding and building tools to support people's values and practices surrounding particular virtual things (e.g., photo collections, video, text messages). However, to date virtual possessions remain difficult to characterize, and little is known about what they are, and what they could—or *should*—be in the future.

This dissertation offers two core contributions to explore *virtual possessions* as a research topic for the HCI community. First, I propose virtual possessions as a class of artifacts for the HCI community to investigate. To do this, I draw on findings from qualitative field studies I have conducted with populations in several sites around the world that investigated people's perceptions of and relationships with their virtual possessions—how they become mundane parts of everyday life, how they are drawn on as resources for self-reflection and self-presentation, unexpected workarounds people devise to get a better 'grasp' on them, and, in some cases, how they become extraordinary. From this backdrop, In chapter 9 I synthesize and reflect on findings across these studies to take a step toward unpacking how virtual possessions differ from material things, and articulate key factors shaping how virtual possessions are experienced; namely, *placelessness*, *spacelessness*, and *formlessness*. Beyond solely articulating these qualities, this chapter frames and structures an agenda for future research and practice initiatives in the HCI and interaction design communities.

The second contribution of this thesis is knowledge on how virtual possessions can be represented in radically different and potentially more valuable forms. To do this,

I draw on several studies I conducted of design artifacts, environments and prototypes that, in different ways, explore new forms and behaviors of virtual possessions, and the potential technological futures they represent. This corpus of research illustrates how the HCI community can move beyond studies of people's current practices toward making radical conceptual leaps that provocatively engage users in dialogues about the largely uncharted and unstructured virtual possession design space. Building on findings from my earlier fieldwork and design-oriented studies, on chapter 8, I describe the design, implementation and long-term field study of the *Photobox*, a technology probe that in part aims to open up value construction activities with people's Flickr photo archives.

Collectively, these two contributions provide substantial new knowledge into understanding (i) what virtual possessions are as a class of artifacts and factors shaping people's experiences with them and (ii) how the form, presentation and behavior of virtual possessions can be radically transformed to open up new and potentially more meaningful interactions with them in the future.

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1 Introduction

Many disciplines have investigated how people modify and form attachments to their material possessions. Much of this work explores how material possessions play fundamental roles in supporting people's practices to construct a sense of who they were, are and want to become, as well as to give order to the intimate environments in which these experiences unfold. As interactive technologies continue to become woven into the fabric of everyday life, people's practices have expanded and today they are amassing ever-larger and diverse collections of virtual possessions. Virtual possessions include former material things that are becoming 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 traces that document people's interactions with digital devices and services (e.g., photo location information, music play histories, automatic and manual photo tags, and credit card purchase histories). The convergence of social, mobile and cloud computing services has created new opportunities for people to carry, access, create and curate their virtual possessions across environments throughout the world.

Over the past several years, the HCI community has begun to explore the intersection of virtual possessions with people's everyday lives. This nascent body of work has largely focused on understanding and building tools to support people's values and practices surrounding particular virtual things (e.g., photo collections, video, text messages). However, to date virtual possessions remain difficult to characterize. Part of this complexity owes to the fact they are *placeless*; they can be accessed anywhere, leaving them without a anchored physical location. They are *spaceless*; they do not take up physical space, making it difficult to get a grasp of the sheer size and scale of virtual archives. They are *formless*; they can easily be reproduced, often with no distinction between an original and a copy, and that they can be easily mashed up with other things to match specific devices or applications. These experiential qualities make virtual possessions seem less like material things, and make it difficult to obtain a sense for what they are and what they could, or should, be in the future.

This dissertation offers two core contributions to open up *virtual possessions* as a research topic for the HCI community. First, I propose virtual possessions as a class of artifacts for the HCI community to investigate. To do this, I draw on findings from qualitative field studies I have conducted with populations in several sites around the world that investigated people's perceptions of and relationships with their virtual possessions—how they become mundane parts of everyday life, how they are drawn on as resources for self-reflection and self-presentation, unexpected workarounds people devise to get a better 'grasp' on them, and, in some cases, how they become extraordinary. From this backdrop, in chapter 9 I synthesize and reflect

on findings across these studies to take a step toward unpacking how virtual possessions differ from material things, and articulate key factors shaping how virtual possessions are experienced; namely, *placelessness*, *spacelessness*, and *formlessness*. Beyond solely articulating these qualities, this chapter frames and structures an agenda for future research and practice initiatives in the HCI and interaction design communities.

The second contribution of this thesis is new knowledge on how virtual possessions can be represented in radically different and potentially more valuable forms. To do this, I draw on several studies I conducted of design artifacts, environments and prototypes that, in different ways, explore new forms and behaviors of virtual possessions, and the potential technological futures they represent. This corpus of research illustrates how the HCI community can move beyond studies of people's current practices toward making radical conceptual leaps that provocatively engage users in dialogues about the largely uncharted and unstructured virtual possession design space. Building on findings from my earlier fieldwork and design-oriented studies, in one of the final chapters, I describe the design, implementation and long-term field study of the *Photobox*, a technology probe that explores value construction activities with people's Flickr photo archives.

Collectively, these two contributions provide substantial new knowledge into understanding (i) what virtual possessions are as a class of artifacts and factors shaping people's experiences with them and (ii) how the form, presentation and behavior of virtual possessions can be radically transformed to open up new and potentially more meaningful interactions with them in the future. All of the studies I have conducted in support of this dissertation have been published at the time of its writing.

In the remainder of this introduction, I will briefly describe three formative studies that led to my discovery and focus on the virtual possessions as the topic of this dissertation.

As a part of my 2008 Masters Thesis project in Human-Computer Interaction Design in the School of Informatics at Indiana University, I conducted a study investigating the question of why valued interactive devices tend to have much shorter perceived lifetimes when compared to cherished material possessions (see Odom 2008, Odom et al. 2008, Odom et al. 2009). The main motivation of this study was to create a design framework that could support HCI researchers and practitioners in developing longer lasting interactive technologies as a matter of concerns of environmental sustainability. Interestingly, across participants, I found that when it came to people's digital things, their attachment seemed much more focused on the digital content housed on devices, as opposed to the digital device itself (e.g., the curated collections of songs and playlists on one's iPod, as opposed to the iPod itself). Participants often drew stark contrasts between the disposability of their digital devices and the perceived durability of their heirloom artifacts.

The contrast mentioned directly above led me to focus my next study specifically on heirloom artifacts, which I conducted as a research intern at Microsoft Research Cambridge during the summer of 2009. I wanted to investigate how artifacts achieve ‘heirloom’ status, the attendant practices and rituals surrounding their use, and where and how interactive technologies might be entering into (or conflicting with) the category of heirloom possessions (see Odom et al 2010). In this study I similarly found that family members deeply valued some of the digital content left behind by the departed—much more so than the digital devices they had inherited or had been bequeathed. However, participants frequently struggled with several issues that complicated the overall value of the digital content and archives left behind. These complications included not being able to manage the sheer size and scale of the departed’s digital archive, not knowing how to separate meaningful digital content from the trivial elements in the archive, and an inability to ‘possess’ the departed’s digital data that was kept in Cloud-based services (e.g., Facebook, Flickr, etc.). Collectively, these complications in part owe to the spaceless and placeless nature of virtual possessions as compared to material things, and, more generally, a lack of approaches to deal with these challenges in and outside of the HCI community.

Soon after arriving to Carnegie Mellon University in the Fall of 2009, I began working on a project investigating how interactive technologies and systems might be able to positively impact the lives of divorced families with joint custody of their children (see Odom, Zimmerman, Forlizzi, 2010). One of the most interesting findings to emerge from this study centered on how teens drew on interactive technologies and systems to create a sense of home across the houses they routinely moved between. In this context, teens’ deeply valued their virtual possessions did not take up physical space and also could be readily accessed wherever teens were. The spaceless and placeless qualities of teens’ virtual possessions starkly contrasted their material things, which were anchored to the bedrooms and homes they transitioned between. As I describe more deeply in chapter 9, teens leveraged these qualities to create a sense of continuity and consistency across households in ways they could not achieve with their material possessions; in doing so, they constructed a deeper sense of value their virtual possessions.

By the conclusion of the divorce study, it became clear that virtual possessions, and the challenges and opportunities they present, should be a growing topical concern for the HCI community. However, little was known about them. This knowledge gap naturally raised questions, such as: What are virtual possessions? How are they becoming integrated into people’s lives, and how do people deal with breakdowns? And, what could— or should—virtual possessions be in the future?

Divorced teens proved to be a fascinating target population to explore in terms of discovering the virtual possessions research topic, which led to several more fieldwork studies and design-oriented projects, which this dissertation will discuss in great detail. The next immediate step in my research following the Divorce project, I conducted a broader study (described in chapter 3) with teens in non-divorced

households to obtain a better sense for how virtual possessions are becoming integrated into their lives, how they perceive their virtual possessions, and, more generally, to begin to unpack what virtual possessions are and make the argument for why they represent an important research topic for the HCI community.

Next, to critically explore and challenge these findings, I prototyped a ‘teen bedroom of the future’ to run user enactments with teen participants (described in chapter 4). This study revealed interesting and unexpected findings that helped further develop and structure the virtual possession design space. Nonetheless, the field’s empirical understanding of what virtual possessions are and how they are intersecting with people’s everyday lives remained deeply underdeveloped.

I then focused my attention in part on expanding the scope of my fieldwork studies. I conducted qualitative interviews and observations at sites in the United Kingdom with a diverse sample of participants (described in chapter 5) and also with young adults at sites in South Korea, Spain and the United States (described in chapter 6). These additional studies helped develop a much broader, rich and diverse dataset of people’s experiences with their virtual possessions.

Nonetheless, at this time, the community’s understanding of what virtual possessions from a design perspective was underdeveloped and I turned my attention back to studies exploring how virtual archives could be embodied in radically new forms. Chapter 7 will describe the Technology Heirlooms project in which used several prototypes to engage families in a critical dialogue about how their cherished archives of virtual possessions will be passed down. In part building on findings from this study, chapter 8 will describe the design, implementation and long-term field study of the *Photobox*, a technology probe that in part aims to open up value construction activities with people’s Flickr photo archives in novel and provocative ways.

Finally, in chapter 9, I synthesize and reflect on my corpus of fieldwork projects to take a step toward unpacking how virtual possessions differ from material things, and articulate key factors shaping how virtual possessions are experienced; namely, *placelessness*, *spacelessness*, and *formlessness*. Beyond solely articulating these qualities, this chapter frames and structures an agenda for future research and practice initiatives in the HCI and interaction design communities. Chapter 10 reviews and argues for the contributions of this dissertation and discusses implications for research beyond it.

2 Related Work

The work in this thesis, which combines ideas from the social sciences and humanities, is informed by previous work in several domains, including anthropology, sociology, social psychology, consumer behavior research, material culture, human-computer interaction, and interaction design.

2.1 Theories of Material Possession Attachment

Researchers across many disciplines have explored how people's possessions contribute to their evolving sense of self. In exploring this theme, the connection between the self and possessions has been characterized in numerous ways. Goffman (1959) connects possessions and identity by describing how certain things act as props that support people in managing presentations of self. Goffman give especial emphasis to face-to-face interactions, and the roles material possessions play in mediating between different 'performances' of different aspects of one's self (or "impressions") to social groups. Throughout this work, Goffman adopts dramaturgical metaphors to illustrate how material possessions and social actions mutually shape each other, and in this relationship there exist complex issues of agency.¹

Csikszentmihalyi and Rochberg-Halton (1981) adopt a social psychological perspective in their seminal study on the significance of material possession in people's everyday lives provides an in depth look at how attachment as arising from meaning making that emerges as possessions are integrated into one's life and help reflect on one's past achievement and to form idealized future goals. Csikszentmihalyi and Rochberg-Halton characterize the process of forming attachments to material things as investments of 'psychic energy'; as people spend more time with and attention on particular things, the amount of psychic energy invested in them grows. Here, the authors make an important categorical distinction between objects that acquire meaning and value over time: those valued for action and those valued for contemplation. An important aspect of Csikszentmihalyi and Rochberg-Halton's investigation is that they emphasize the symbolic value of material possessions and, in this, their analysis is targeted at the representational value of things. This is a worthwhile approach to take and their study shaped countless future studies across different research communities. However, more recently scholars have articulated limitations of a largely symbolic orientation in that

¹ While this work was conducted decades before the onset of online places and networked computers, Goffman's theoretical and analytic framing continues to drawn on by social scientists and HCI researchers to unpack virtual possessions and computational systems support processes of self-presentation and social interaction (see Zhao et al. 2013 for an excellent example).

it can obscure how object's materiality and material qualities also shape engagement with and attachment to them.²

Material culture researchers, such as Daniel Miller (1987), have explored how possessions shape everyday practices in the construction of social values, relationships, and meaning. An important overarching aspect of the material culture perspective is that there is often a hard distinction made between subject and object (i.e. a person and her things); this, in part, functions as an analytic mechanism to illustrate how social relationships and actions are manifested through the act of consumption. In his numerous books, Miller as sought to show how material objects and the study of materiality are fundamental to anthropological research (2005). Across his broader range of work, he has investigated how material possessions play significant roles across many social practices in everyday life; however, at times these roles are unpredictable or can be seen as counter-intuitive on the surface. One key theme across several of his studies centers on the importance of *divestment*—the conscious social action or practice of dispossessing one's things. His studies of material displays within homes in South London (2009) and also of the loss of relationships (2009) are exemplary of this point. Here, he argues that 'who you are' is bound to the things that one possesses and chooses not to possess.

More recently within sociology, interest in materiality and possession is represented in the widely cited works of Elizabeth Shove and her colleagues (2007). Shove's work is predicated on a similar presumption to Miller: the relationship between material objects and identity is to be uncovered through examining the many forms that possession can take. She describes how possession is not only something that can apply to a thing, but to environments and practices. Key to Shove's analysis is emphasis on how the reflexive ways power is manifest in material practices. A somewhat different view within sociology suggests that focus should be placed on people's own orientations and practices, which can be characterized as being based on 'lay theorizing.' It is the relationship between this theorizing and material practices that produces the world of everyday life (Garfinkel, 2011). This perspective has been influential in and outside of HCI, particularly in the work of Suchman (1987).

The work of Douglas and Isherwood (1979) has also been foundational in unpacking how new value emerges as people personalize artifacts in everyday life. Here, material possessions provide a key resource that people use to make sense of the world, demarcate social relationships, and assign value to their things and the environments they inhabit. Building in part on these ideas, Appadurai (1986)

² Verbeek (2005) describes and articulates how the *material qualities* of objects play significant roles in shaping (or obscured) human relations with them. Odom et al. (2009) later interpret Verbeek's framing in relation to Csikszentmihalyi and Rochberg-Halton's seminal study in the service of developing the Personal Inventories field research method. This is method is also described in Odom (2008), Odom, Blevis and Stolerman (2008), and Martin and Harrington (2012, p. 130-131).

deconstructs the notion of value as an exercise in revealing the social relations that help create and define objects. This work provides compelling insights into understanding what ‘value’ is and how this complex notion shapes one’s relationship with an object. Appadurai unpacks the subjective nature of value and articulates how many different kinds of value emerge in human-object relations (e.g., emotional, aesthetic, spiritual, ‘knowledge’, and economic). German philosopher Georg Simmel’s earlier work (1900; 1904) is heavily influential on Appadurai’s argument: “*Value, for Simmel, is never an inherent property of objects, but is a judgment made about them by subjects*” (1986, p. 3). This general framing has since become a popular way of characterizing the notion of *value*; however, it is important to keep in mind that in this characterization value is deeply bound to a meaningful possession’s *material existence* (Renfrew, 2001).

Finally, a large strand of research within the field of consumer behavior investigates how and why people develop a deep love for their things. Russell Belk’s proposal and subsequent decades of research on ‘the extended self’ is seminal. Belk argues that “*knowingly or unknowingly, intentionally or unintentionally, we regard our possessions as parts of ourselves*” (Belk, 1988 p. 139). In this, meaningful attachment can emerge through the process of self-extension, where people attribute important aspects of their self to the persons, places, things and events symbolized by their possessions (Belk, 1988). Importantly, this process of self-extension can unfold in complex and diverse ways. For example, a possession, such as a knife (or tool), can literally extend one’s self by enabling one to intentionally accomplish a task or achieve a goal. A trophy or sports team jersey can symbolically extend one’s self by projecting one’s interests and affiliations to others. Through a process of using these things among social audiences, people develop a reflective sense of self in a relationship to a thing through anticipating as well as actually observing how people react to their possession and use (Kleine, 1995). In this way, Belk argues, material possessions contribute to people’s capacities for “*doing and being*” (Belk, 1988, p. 145).

In further unpacking the theory of the ‘extended self’, Belk heavily draws on philosopher Jean-Paul Sartre’s work *Being and Nothingness*. Here, Belk characterizes Sartre’s discussion of ‘doing’ as a transitional state between fundamental desires for humans to have or to be. In essence, having and being are an inseparable state: people desire to have possessions as a way of enlarging or deepening their sense of self, and the only way to know who one is, is by observing what one has. This point may seem excessively materialistic in that can be seen as suggesting if one has nothing, then one may not exist—and such criticisms have emerged (see Douglas and Isherwood, 1979). The main point Belk is making in his use of Sartre is: “*...possessions are all-important to knowing who we are. People seek, express, confirm, and ascertain a sense of being through what they have*” (ibid, p. 146). Belk’s synthesis of Sartre arguably has much in common on a general level with many scholars reviewed in this chapter up to this point: having possessions helps construct, sustain and develop a sense of self-definition and that “*having, doing and being are integrally related*” (ibid, p. 146).

In continued explorations of material possession attachment since Belk's framework of the extended self emerged, the concept of narrative has become central to advancing theories of possession attachment (Ahuvia 2005). In particular, consumer behavior researchers have turned to McAdams' concept of identity construction as the development of a coherent life story—a synthesis of different stories uniting events from a person's past, experiences from the present, and imaginings of the future (McAdams, 2001). Here, people gain attachment to possessions as they reinforce affiliations to groups that have been important in one's life story, and that symbolize their self-driven actions in the past and present (Kleine 1995). Consumer behavior researchers have explored possession attachment on cross-cultural levels to a limited extent; however, the majority of these studies have emphasized how possessions help members of diasporic communities retain homeland ties (Mehta and Belk, 1991).

The emergence and widespread use of digital technology has very recently prompted Belk to return to his seminal concept of the extended self and explore what it means in the digital world, where “*the possibilities for self-extension have never been so extensive*” (Belk, 2013, p. 477). Belk unpacks five main issues that the widespread everyday use of digital technology raise for the original conceptualization of the extended self framework: *dematerialization, reembodiment, sharing, co-construction of self, and distributed memory*.

Dematerialization—the ability to become attached to and, in essence extend one's self through, a single, unique thing still exists, but with the digital content new opportunities emerge that may take on a different quality and character. The dematerialization of a photo, book, or song raises questions around whether these things can become perceived, interacted with, and ultimately integrated into our lives in the same way as their material counterparts.

Reembodiment—the capacity to become ‘reembodied’ as an avatar seamlessly in and across various online places. Not only can these experiences alter how one's conceptualizes the self, they also may directly alter how one understands and acts in the material world. For example, the fact that people can and do become significantly attached to their avatar (and the range of digital information that comes with it) presents a peculiar and different kind of ‘possession’; this only becomes more complex as multiplicities of avatars emerge and represent different aspects of the self. *Sharing*—the social practice of sharing becomes altered in several ways, most notably in that once something is ‘shared’ online, there is a loss of control that can easily occur where that digital artifact may be seen or used by various other entities or audiences it was not originally intended for.

Co-construction of Self—within online places in particular (e.g., Facebook) it is possible to have a persistent virtual possession (e.g., photo) that can accrue many short messages and other annotations from a widely distributed and diverse network of one's social relations in ways that would have never been possible with material things.

Distributed Memory—the massive amount of digital content people produce that record their life experiences presents opportunities to explore one’s past in acute ways, but also introduces issues of overload and could complicate one’s ability to create cohesive *narrative of the self* over time (another issue less common in a world of solely material possession).

Belk’s revisions to the original conceptualization of the *extended self* help illuminate how the digital world we live in both opens opportunities to extend the self through various new and diverse environments and artifacts. They also show how the digital world introduces changes that in quite significant ways that affect how people extend their sense of self and also the kind of relationships that are engendered through this.

Belk’s recent article provides a rare example of new theoretical insights that help understand people’s relationships and practices with their increasingly larger and more diverse collections of virtual possessions. However, in general there still is little known about how theories related to material culture and material possession attachment can be applied to people’s rapidly growing collections of virtual possessions, particularly within the HCI community.

2.2 Related work in Human-Computer Interaction

Recently, researchers in the HCI community have begun to explore implications surrounding the increasing virtualization of material artifacts, such as photos (VanHouse, 2009, Kirk et al. 2006), video (Kirk et al. 2007), music (Brown and Sellen, 2006; Vaida et al. 2006), and currency (Mainwaring, March and Mauer, B.). Additionally, approaches to designing digital objects characterized by immaterial qualities are continuing to emerge in parallel (Hallnas and Redstrom 2001, Wright, Wallace, and McCarthy, 2008).

There is also emerging HCI research describing how people develop sentimental attachments to digital artifacts. Sellen and others (Kirk & Sellen 2010; Kirk et al. 2010; Golsteijn et al. 2012) present values-oriented approaches to designing tools to support the archiving of cherished digital artifacts. Kaye et al. (2006) describe how digital archives can function as rich resources for identity construction and presentation. Petrelli and others (2008, 2010, 2012) have explored how physical mementos can inform the design of systems aimed at creating digital mementos capable of reflection on past experiences. Durrant et al. (2009) explore how the curation of digital photos could open an expressive space for intergenerational interaction in the home. Taylor and Harper (2002) describe the ritual exchange of text messages between teens and the perceived value emerging from these actions. Finally, Peesapati et al. (2010) designed and implemented a system re-presenting social networking content back to users specifically to evoke reminiscences.

With the emergence of the Internet, people have begun to create digital selves. Social networking sites enable people to create personal online places where they can design and reformulate experimental selves. In contrast to earlier work exploring

identity experimentation among anonymous users (Turkle, 1994), recent studies have drawn attention to how performances of identity in social networking sites are unfolding in largely ‘anchored’ social relationships, where members of social groups are typically bound by offline relationships (Barkhuus and Tashiro, 2010; Zhao, Grasmuck and Martin, 2008). Additionally, Zhao and colleagues (Zhao et al. 2013, Sosik et al. 2012) have illustrated how people are increasingly becoming attached to ‘traces of friendship’, or digital messages and metadata generated on social networking sites, which owe to owing to significant social relationships. Collectively, this work has illustrated how the convergence of social and Cloud computing has created new opportunities for people to move increasing amounts of virtual possessions to online places, as well as create new valued things through online environments.

Emerging in parallel to these works is the topic of how the placement of people’s possessions in online places might affect their perceptions of and relationships these things is beginning to gain attention. Marshall and others (2007) have begun to explore implications surrounding the archiving of Internet-based personal information, which revealed people perceived information online to generally be enduring, while also perplexingly susceptible to loss. Marshall and others (2011) also investigated people’s attitudes toward ‘owning’ social media content on Twitter.com. This study reported that users desired to retain control over the content they produced and to personally archive it, although currently there are no clear ways for this to be archived.

Collectively, these works have made important contributions to the HCI community in terms of understanding how personal digital content and archives are increasingly intersecting with people’s everyday lives and social practices. At the same time, this relatively narrow focus largely does not provide insights into what virtual possessions are as a class of artifacts and how they differ from material possessions. As a result, little is known about how people construct value with their virtual possessions, and how the placement of one’s virtual possessions across local systems and devices and online services might shape their perceived value. This dissertation addresses this gap in the literature by contributing a more concrete understanding of how people experience and construct value with their cherished virtual possessions, and by illustrating how this knowledge can inform the design of more valued virtual possessions. Through this dissertation, I will propose virtual possessions as a class of artifacts for the HCI community to investigate. This is significant in two key ways: (i) it enables virtual possessions to be compared to pre-existing theories of material possession attachment to critically unpack what virtual possessions are, and (ii) it enables prior topically-driven HCI research focusing on specific kinds of virtual possessions (e.g., photos, video, music) to be leveraged within this broader framing.

3 Teenagers and Their Virtual Possessions

3.1 Introduction

As noted in the introduction, after encountering unexpected insights related teenager's uses of virtual possessions in divorced families (Odom, Zimmerman, Forlizzi, 2010), I continued my exploration of virtual possessions by conducting a qualitative fieldwork project with 21 US teenagers in their bedrooms (in non-divorced families).³ I chose teenagers for three primary reasons: (i) they are deeply occupied with the process of constructing their identities (Steel and Brown, 1995); (ii) they are heavily engaged in digital media, online communication, and use of interactive technologies (Ito et al. 2010), and (iii) they are on the vanguard of social and cloud computing, embracing these technologies and actively defining the behavior and social mores of these products and services (boyd, 2007; Taylor and Harper, 2002). Teenagers have grown up in a time when their possessions are increasingly virtual, as opposed to, for example, adults whom have large collections of material and virtual things.

Additionally, research on attachment has focused on the importance of home as a place where people can manifest a presentation of self. Researchers have reported that teenagers often feel the strongest attachment to their bedrooms (Chawla, 1992). Here, teens surround themselves with precious possessions as they experiment with their identity through display of self to parents and peers (Steele and Brown, 1995). Teens particularly tend to draw on displays of music, movies, celebrities, etc., as a way of authoring their space and communicating their values (Bovil and Livingstone, 2001).

Collectively, this background helps illustrate how invested teenagers are in identity construction, and how the bedroom (and the possessions contained within it) provides a canvas for identity exploration. However, this group clearly has limitations. For example, my teenager participants had less time to acquire massive archives of virtual possessions as compared with older populations, and I in no way mean to indicate that they are the “best” or only group to investigate. I see them as an important group and one that prior research indicated would likely be productive to study; as such, they are the first group that I chose to focus on.

³ This chapter is adapted from papers published at the DIS '10 (Odom et al. 2010) and CHI '11 (Odom et al. 2011) conferences.

3.2 Field Study Method

I recruited 21 ‘twens’ and teenagers from the greater Pittsburgh, PA area. This participant pool ranged in age from 12-17 years old (9 female and 12 male). Participants hailed from middle and upper-middle class families, and typically had direct access to the Internet.

Semi-structured interviews were conducted in participants’ bedrooms, which lasted 1.5 to 2 hours. Interviews aimed to develop an understanding of participants’ everyday lives, common activities, technology-usage trends and cherished physical and virtual possessions. The bedroom elicited reflections about participants’ relationships with material possessions, provided a basis of comparison to their virtual possessions, and revealed how participants access, engage with and organize their virtual and material possessions. Participants were asked to give us a tour of their material possessions both stored in and on display in their bedroom, and to describe their relationships with these artifacts. This was typically followed by a tour of participants’ virtual possessions, where virtual artifacts on their personal computer, phone, media player, etc. were observed.

All interviews were videotaped and field notes and documentary photographs were also taken. Following (Strauss and Corbin, 1990), the research team repeatedly reviewed field notes, video and photographs, and drew out underlying themes. Textual documents were coded using these themes. The research team also created conceptual models and affinity diagrams to reveal unexpected connections across participants. In what follows, each participant is referred to with a pseudonym, which is followed by his or her age.

3.3 Findings

Interviews and observations in teenagers’ bedrooms revealed a range of ‘precious’ material possessions. These included photographs of family and friends, artifacts such as collages created by friends, and mementos and symbols of personal achievement, such as academic and athletic awards. The display of these possessions matches findings from research on teenage bedroom culture (e.g., Bovil and Livingstone, 2001; Steele and Brown, 1995).

Discussions revealed diverse collections of virtual possessions, including but not limited to several years worth of homework assignments, blog entries, status messages from social networking systems, archived SMS messages, digital video, various self-made digital artworks, and expansive archives of digital music (often with accompanying artwork). Participants generally were frequent users of digital media, including music and video they owned and that they accessed through services such as youtube.com and hulu.com. Digital photos surfaced as a major category. Photos roughly broke down into images of family, friends and social events; photographs as art; and photographs specifically taken to document cherished material possessions such as items made by friends.



Figure 1. The curated collection of football stars in John's room deeply reflected his current interests.

In many cases, teens conveyed a general trend of moving away from shared home computers towards use of individually owned personal computers in their bedrooms: However, in some cases participants reported also using shared family computers from time to time. Additionally, all but one participant owned a mobile phone and/or media player, which emerged as common devices through which virtual possessions were accessed, made and managed.

In the following sections, I present several examples taken from field observations that capture the emerging themes: storage of virtual possessions; how virtual possessions are curated and displayed to manage presentation of self; how social metadata can be a crucial part of virtual possessions; and how artifacts transition between material and virtual forms.

3.3.1 Storage of virtual possessions: drive for accessibility

In general, interviews with participants indicated a strong trend away from storage on local computers to a reliance on and preference for cloud computing. Below, I describe instances in which mobile devices emerged as temporary storage centers; how movement towards the cloud shaped participants' interactions; and how email was drawn on to more easily move possessions from place to place.

I observed that participants kept many things on personal computers, mobile phones, digital cameras, and media players, and to a lesser extent on other forms of physical media. In addition, participants both expressed desires for their virtual

possessions to be immediately accessible in and outside of the bedroom. Devices that restricted the transfer of virtual possessions often complicated this goal. As a coping mechanism, several participants conveyed a strong preference for storing their things on a range of cloud services. For example, Suzy-17 reflects on her 3-year old archive of photos, nearly all now stored online:

“I have to have [access to] them wherever I’m at ...on my bed or at the mall. ...I’ve been uploading all of [my photos] online. Obviously I can’t look at them all and that’s not the point. I like knowing that they’ll be there if I want them.”

In fact, several participants described their mobile devices as portals to online places:

“...the biggest change is I use my phone all the time to check things like Facebook and change my status, add new information and photos, and leave comments. ...it’s as much a gateway to all my stuff online as [it is] a phone” (Bill-17).

In addition to being seen as portals to personal collections, key cases emerged in which mobile devices appeared to function as temporary storage centers. In several cases, participants reported storing photos on their devices, while waiting for the opportunity to transfer them online:

“If I take photos on my phone, I upload them right away and then usually delete [the local copies]. ...It’s better because I feel like I know where they’re at ...and they’re always available” (Michelle-16).

In general, participants perceived online services as providing unlimited and enduring storage:

“I store everything online. It’s much safer than keeping it all on my computer. I mean it [computer] could just die, but if they’re online, they’ll be there forever unless I decide to take them down” (Sherry-16).

Interestingly, in a few cases, participants described how the transition to cloud storage resulted in a perception that they would require less storage on their mobile devices. For example, Derek-15 describes his decision to not to upgrade to a larger iPod:

“I was going to get a 32GB iPod but I don’t really need the space. ...I stream music and movies from the web more now and upload most of my photos, so I thought I wouldn’t fill it up.”

Evidence of participants’ transition to the cloud also emerged when they discussed file management strategies. Bill-17 describes his shift in management practices:

“I still have my old folders where I keep things like homework assignments, music, photos, my diary... but aside from music and sometimes photos ...I’ve been putting most new stuff online for the past couple years.”

Several younger participants had never adopted concrete practices for organizing local files:

“I always try to get my files and stuff online first. Then I delete them or put [files] in a folder where I kind of keep them all ...I don’t go back there [in local folder]” (John-14).

Similar to John, it was apparent in several cases that participants maintained only a single or small subset of local backup folders in which their varying types digital content was inconsistently dumped together.

Participants both implicitly and explicitly expressed desires to be able to move their virtual possessions to the next place they were going to be; several drew on their email accounts as a workaround to transport things such as photographs and accompanying annotations, video, personal artwork, personal notes and diary entries, presentation slide decks, homework assignments, and, in a few cases, personally meaningful text messages. For example, Chris-16 reflects on how self-emailing provided the opportunity to privately access his journal, music files, and homework across school, home and friends’ houses:

“it’s the only way to know I have something saved and only I can access it. ...I’ll email myself journal entries in Gmail and later tag and archive them. ...I’ll send music files so I can play them at a friends’ house if I don’t have my iPod or I want to give them [the songs]. ...all of my friends and me, we email our homework assignments to ourselves. ...[this way] I can work on them for a while, like on at school, and then later at someone’s house or on my laptop at home.”

3.3.2 Digital Technologies and Presentation of Self

Most participants regularly interacted with their virtual possessions in order to manage their presentation of self to multiple audiences. In what follows, I describe how value emerged through redecoration; how the curation focused on different audiences; and tensions around constructing multiple digital selves for different audiences.

The display and organization of possessions in teenagers’ bedrooms play significant roles in shaping their evolving sense of self. The presentation of trophies, photo collages, and posters of popular culture icons, among other things, shape teens’ perceptions of who they are and who they might become (Steele and Brown, 1995). In this way, the bedroom presents a material infrastructure that teenagers can exert control over in order to experiment with their identity. For example, Julia-14 had an equestrian theme permeating her room, where many of her possessions (including bedroom wallpaper) directly related to riding horses. However, she had recently lost interest in horses and made plans to redecorate her room in a more “mature” way. She also had constructed a shrine to the teen celebrity Nick Jonas that had moved from being present in her room to being inconspicuously stored in her closet. Most participants shared stories of how their shifting tastes created a continuing re-authorship of their bedroom.



Figure 2. Julia-14's Jonas Brothers shrine now stored in the closet.

Several cases emerged in which participants shared how they customized mobile phone, personal media player, gaming console and personal computer display backgrounds to reflect their shifting tastes. I observed a diverse collection of background images including friends and family members, celebrities, music and popular culture imagery, personal avatars from online games, and physical artifacts symbolic of favorite hobbies. In contrast to the relatively slow rate of change in display of material possessions, in several cases virtual possessions populating backgrounds appeared to change frequently (from weekly to, in a few cases, several times a day):

“My laptop background is usually something really important to me, like a picture of my girlfriend, or right now it’s an image of where I want to go [to college]. It’s like that because I’m the only one that looks at it. Same with my phone. ...but my Playstation, that I download new skins for all the time. ...since I play [it] with my friends. ...It’s usually some kind of skin that’s from a game or a movie we all like” (Bill-17).

Similarly, Sarah-13 described a habitual practice of reflecting on her mood and recent likes and dislikes, and subsequently searching several bookmarked popular culture and graphic design websites to find new backgrounds for her computer and mobile phone weekly. She stated that:

“everything on my technology must represent me. ...I change what I like and how I feel a lot, so they change too.”

While the bedroom was a key site for identity experimentation, the presentation of some key possessions conflicted with the social and moral structure of the home, and several participants discussed their inability to display posters or to listen to music their parents found to be in conflict with family rules and values. However, several key instances emerged in which participants described feeling considerably more control over social networking sites. Michelle-16:

“...in my parents’ home, there are things I can’t exactly put up in my room. ...and things that’ve caused problems when I’ve tried (laughs). ...[like] photos of me and my boyfriend. He’s older and my parents don’t like it, so they won’t let me have photos of us here [bedroom]. ...but on Facebook I have control over what goes up about me and what it says. ...and I recently added lots of photos with my boyfriend there.”

She further elaborates on how Facebook provides a place to store and present contraband digital objects:

“Almost everything here [bedroom] is important. It all represents me. ...but there’s also stuff that I could never have here ...Mom would kill me. ...a lot of it ends up on Facebook: photos and messages of [myself and friends] out being ourselves. ...I put it there because it’s me, but a part of me I don’t need to share with everyone.”

These reflections help illustrate how of the display of virtual possessions in online places enabled some of participants to experiment with crafting and presenting different aspects of their self to different audiences. In these cases, participants frequently used the services’ privacy settings to demarcate groups, allowing particular possessions to be viewed by certain audiences. Many participants reflected on how making their status messages and specific groups of photos accessible to only friends (e.g. as opposed to parents) shaped the way they framed their online content. For example, Suzy-17 stated:

“I have lots of Facebook ‘friends’ like my friends’ parents and random people I meet. But only my close friends get access to everything. ...I would like other people to see some of my stuff or updates, and there’s a way to do that, but it’s hard to figure out and I don’t trust it, so I have to choose one [group] and with them [close friends] I’m most my self.”

I also encountered instances in which participants indicated information they made available to everyone (e.g. parents, family, etc.) on their social networking sites was frequently shaped to reflect relatively mundane aspects of self. For example, Frank-16 describes his decision to only contribute new material perceived to be ‘safe’ in the context of all his social groups:

“I want my relatives and other people to still know some things about me so I made my [status] updates public and end up posting pretty harmless stuff...[like] cheering for a sports team or ‘passed my test’.”

Despite efforts like this, I encountered other participants that described tensions emerging from accidentally sharing personal information too broadly. A classic case of

this is reflected in Bill-17's description of his mother and grandparents viewing inappropriate images of him at a late-night party:

"I got tagged in some pics from a party. ...they were full of things that would've been fine for my other friends to see. But, it was terrible for like my mom and grandma to see them. ...I had to stop going out for a while and I stopped using Facebook for a long time. ...it totally affected my social life."



Figure 3. Michelle's mobile phone served as a portal to her online places.

Laura-16 reflected on how the emergence of photos of her and her new boyfriend complicated other relationships:

"...it's a big step to be tagged together in photos [on Facebook]. ...I put some [photos of self and new boyfriend] up and thought they were restricted to [us], but they ended up being visible to lots of people like my ex and a lot of his friends that we'd see together. They all were unhappy. ...I untagged myself from most of the photos and ended up deleting some"

I also observed tensions around boundaries of social appropriateness, such as when parents added comments to their children's social networking pages. For example:

" I can try to control who see's what I put on my wall, but it's hard to control who sees the posts and comments from different people. ...My Mom posts on my wall all the time and I don't want my friends to see it. ...I guess I don't always want her to feel like she can't Facebook me. ...but my wall, where everyone can see, isn't the right place. I usually delete [Mom's posts] when I see them" (Mary-16).

Similar to Mary, a handful of other cases emerged in which participants reported deleting posts or comments from family members (usually Mom or Dad) and in some instances later contacting them through the phone or email.

The ability to fluidly craft a targeted presentation of self through privacy permissions emerged as a rich resource to strengthen a sense of social connectedness among several participants and members of their different groups. At the same time, a lack of more usable and sophisticated privacy considerations resulted in numerous embarrassing and regrettable experiences. These instances tended to amplify the tensions among social groups in participants' networks, which often motivated them to remove or, in some cases, permanently dispossess certain virtual possessions by deleting them.

3.3.3 Personal and group attributions of social metadata

Metadata emerged as a defining aspect of virtual possessions. It provided a platform for participants to collaboratively and individually personalize a possession, as well as relationally link multiple types of virtual possessions together. Below I describe how value emerged as virtual possessions acquired metadata.

In some cases, new value emerged as photos documenting a specific event or experience, once shared online, accrued social metadata; the ability to create metadata appeared to support collective reconstruction and revisitation of shared experiences with friends and family members. For example, Kate-16 describes how this activity served her desire to develop a more 'real' representation of an event:

"I bring my camera with me whenever I go out with my friends. We take lots of pictures. ... When I get home I upload them. Then I tag most of my friends [in the photos]. ...and we all tag and untag other people and post comments. ...[we] delete the ones that we don't need ...the ones that don't get a lot of comments or don't seem as good as the others." She continued to describe how this attributed a layer of realness, *"It feels like a more authentic representation of the event ...we comment and agree on everything together. ...then there's a shared sense of what happened."*

I also observed how participants used the "tag" function in Facebook to define a set of friends that extend beyond the people in a specific photo:

"We tag people that aren't in our photos all of the time. ...it's a way to get their attention and get them to comment on the photo or, if they don't, at least linking you all together. ...you're showing something happened that made you think of them. ...maybe when you were there, or maybe it reminds you [of them] later when you see it online" (Mary-16).

These comments collectively highlight key ways in which value appeared to surface through the use of metadata. For Kate it involved a deeper sense of authenticity that emerged from collaborative curation, while for Mary, value came from reinforcing an affiliation through sharing. In both cases, value emerges from the creation of the metadata instead of the creation or exchange of the initial artifact.

In addition to photos, participants engaged with metadata related to music. Interestingly, several instances emerged in which participants described giving and

receiving musical playlists as gifts, and sometimes modified metadata as a part of the gifting practice. For example, Frank-16 described his practice of replacing album art images with photos from events he attended with his girlfriend:

“Now, before I give her a mix [CD] of songs, I go in the info and put a photo of us together. ...at least it’ll come up on her iPod and it makes it different in her library from everything else.” Derek-15 also reported editing mp3 metadata to include personal notes in playlists given to his girlfriend in hopes that one day *“she would look there and find something special.”*

These reflections highlight the challenge of making gifted virtual possessions stand out among an ever-increasing collection of similar things, as well as strategies employed to make gifted music more unique and particular to the receivers.

Finally, I encountered various cases in which participants’ music collections encompassed all of the music they had ever owned, and, in some cases, expressed strong reluctance to delete songs or albums they no longer listened to. Despite my population’s young age, these kinds of collections typically represented several different life stages, at times evoking experiences of reflection on past taste and current preferences. They also to some extent mimic the collections of data common to adults who have vast backups of email, etc. In this case, the systems created metadata detailing when and how often songs had been played; metadata participants could use to examine who they were. For example:

“...I have stuff I listened to when I was really young and what I was listening to in middle school, and I’m what listening to now. ...the things I like change and I change too, and it’s interesting to see how you’ve changed through how often you listened to things and when you last did” (Kate-16).

In contrast to Kate’s case, a few participants described how these archives and records evoked reflection on more melancholy aspects of past experiences. Nonetheless, across these cases, machine-produced metadata did appear to provide rich resources for reflection on one’s self and for re-visitation of past selves.

3.3.4 Transition between material and virtual forms

I observed several examples of possessions transitioning between material and virtual forms. In what follows, I first describe how participants physically displayed their virtual possessions. I then present examples of how material possessions took on a digital form in order to move beyond the constraints of a single bedroom.

A key factor differentiating virtual and material possessions is that virtual possessions lack a lasting material form. Interestingly, I observed some participants compensated for this by keeping their computers, mobile phones and media devices always on and connected to their collections of virtual things. There appeared to be several related motivations to this behavior. Kristen-16 described methodically encoding albums in her music collection with the appropriate artwork and always projecting these images through her computer screen to amplify the material presence of her digital songs:

“so it feels like it’s more than an mp3 ...it’s there reminding you what it is. ...but you can easily ignore it too, like anything else around [my bedroom].”

Suzy-17 similarly kept her desktop monitor on to display photo collections stored on Facebook:

“They’re different from the ones on my computer [hard drive] because online they have what my friends’ said and the links they posted. ...that’s all part of the [photos] now and I want it all there together.”

James-16 describes his desire to be on Facebook as frequently as possible; when in his room he reported often simultaneously accessing his account through his phone, iPad and laptop:

“I like to be logged in to my laptop and iPad so I know when something happens, like someone writes on my wall or a photo or tags me. ...I want to see it around me. ...way better than getting a text [message] or an email about it later. ...it keeps me up to date with everything going on.”

Collectively, these practices highlight several participants’ desires to fluidly move between the material and virtual world.

I also encountered instances in which participants printed and displayed their virtual possessions within their bedroom. In particular, numerous participants had printed out cherished photographs from Facebook, often constructing large collages. For example, Kate-16 compares her previous practice of making collages with photos she had taken to her current practice of compiling assemblies from various shared albums online:

“I like them better because my friends’ personalities come out in their pictures. ...sometimes I’ll be looking at one and think about what I wrote or what my friends’ wrote [on them online].”

In a rather extreme instance, Michelle-16 described printing and archiving her favorite Facebook photos in a scrapbook, often along with notes documenting the associated metadata:

“I pick the best ones [photos] from an album ...usually they have comments on them. ...[I] write them down on notes next to the photos [in the scrapbook]. When my friends come over we look through it and add new things when we feel like it.”

I also encountered an interesting case in which Derek-15 had printed excerpts of his friends’ status messages and chats to display in his room; he conveyed a desire to be surrounded by them as:

“they represent my friends and much as my photos.”

In these instances, participants reported these virtual-made-material possessions had served as focal points for reminiscence with friends or family when in the bedroom.

needing to clearly demarcate boundaries between the two. These findings suggest several opportunities that can aid designers in generating new forms for virtual possessions and new interactive systems to engage with these things. They also raise a range of potential unintended consequences and paradoxes (Mick and Fournier, 1998) that could easily emerge if designers blindly make new products and services. Through repeated discussion and modeling sessions of the findings, I identified three specific opportunity areas for investigation by researchers and practitioners: *accrual of metadata*, *placelessness and presence*, and *presentation of selves*. This section concludes with several potentially negative consequences that should be considered when working in this emerging space.

3.4.1 Accrual of metadata

One unique quality of virtual possessions is their ability to accrue metadata over time. In some cases, metadata itself became a valued virtual possession; in others, it appeared to be an element indivisible from the original artifact. Across all these instances, value appeared to emerge as different types of metadata enabled participants to craft and keep social histories; something that had been considerably less explicit in a world filled only with material things.

Prior research (e.g., Belk, 1988) has described how material artifacts take on particular qualities that make them meaningful, such as the books parents read to their children at bedtime and grow attached to. On the surface, this seems less achievable for virtual things as they are infinitely reproducible and lack an inherent ability to gather a patina from age and use. Interestingly, this study illustrated how participants encoded new elements into virtual possessions (e.g. music collections, digital photos, textual annotations), to make them more uniquely self-expressive, or to share experiences with others. I also found machine-produced metadata (e.g. timestamps, frequency of use) provided a valued resource for connecting a thing to particular experiences. These instances suggest an opportunity to design technologies that enable users to encode a more diverse range of content into virtual possession metadata, which could shape the resulting digital artifact to be more reflective of an individual or group. For example, virtual possessions associated with a particular event could be encoded with things such as the aggregate status updates of a person when last in the event location, songs most frequently listened to during the event, or perhaps personal messages or other forms of content associated with the event that would emerge as these digital objects are interacted with over time. I imagine interactive systems could also provide richer ways of contextualizing experiences associated with virtual possessions through aggregating various types of metadata from online resources, such as weather information, or local and historical news events associated with the place in which the event was held.

Previous research (e.g, Gaver et al., 2008) has illustrated the value in converging streams of ‘ready-made’ online information onto collections of digital objects to evoke rich, personally meaningful experiences. In general, there appears to be a

large opportunity in combining human and machine-created metadata to construct more expressive assemblies of virtual possessions that evolve over time.

I also found the ability to attribute different types of metadata to virtual possessions in shared online places in some cases supported practices aimed at developing a more ‘authentic’ collective understanding of an event. New value also appeared to emerge as metadata was used to extend an artifact beyond its original content, such as linking it to other people, places, possessions and experiences. These instances illustrate how storage and presentation of virtual possessions in online places opens a space for new value to emerge from sharing, editing and, ultimately, the collaborative construction of social histories focused on virtual things. These practices collectively model Belk’s (2010) notion of *sharing in*, where people share within a social group as a way of strengthening bonds. Importantly, similar to how people can extend their sense of self through possessions, this process of extending permissions to present and edit (or collectively ‘own’ rights to edit) particular possessions with others plays a key role in extending individual sense of self *through* other people (Belk, 2010, p. 726). Offering the opportunity for collaborative curation of virtual possessions in more nuanced and extensible ways appears to be a rich space for further investigation.

Finally, the value of social metadata is not limited to only virtual possessions. I observed some cases in which participants virtualized their material things to make them available to targeted audiences beyond their bedrooms. At times, these things appeared to increase in value through accruing metadata; interestingly, as in the case of Bill’s Halo avatar drawings, they seemed to shape some participants’ perceptions of the material artifact. This suggests a significant opportunity area for designing systems for managing virtual proxies of material artifacts. These systems could collate information related to a particular artifact (e.g. locations, time and frequency of use, social audience(s) present, social metadata) to create rich personal or shared histories of a thing. I imagine they could provide valuable virtual resources shared across members as families expand and heirlooms are fragmented across multiple homes, as well as enduring social records of treasured material possessions forever lost or destroyed. Future research could scaffold and extend recent work exploring tangible interactions with digital copies of familial artifacts (Kaye et al. 2006) and digitally augmented physical mementos (Nunes et al. 2008, Petrelli et al., 2008) to investigate how virtual proxies (and virtual possessions in general) could be embodied to support interactions with individuals and groups, as they move in and between virtual and material environments.

3.4.2 Placelessness and Presence

One clear value for many material possessions comes from the fact that people can display them, such as a collection of books on a shelf in a bedroom. This study illustrated how it was difficult to make virtual possessions’ presence dynamic and enduring in a physical place; however, they could be made temporarily present in

nearly any location. This quality of placelessness provided teenagers with a feeling that their collections of virtual possessions could travel with them across social and physical contexts. While this population had less time to acquire expansive archives of virtual possessions as compared to older populations, it was clear many had a significant desire to ubiquitously access and amplify the presence of their virtual things. Several participants drew on social networking sites and email accounts to move and access their virtual possessions as they moved about their day; several also appeared to frequently use mobile devices as portals to their online places. In general, participants reported valuing the ability to ubiquitously draw on their virtual things across contexts, and instances emerged in which they appeared to use this ability to breakdown boundaries between material and virtual worlds, and to move fluidly between them.

Clearly, current services for uploading, storing, and interacting with virtual possessions are insufficient. The breakdowns shared by participants collectively point to a desire for a new kind of cloud computing that unites disconnected services, making it easier to move and access virtual possessions stored in different online repositories. There also appears to be an opportunity for designing storage systems that enable a single virtual possession to be more easily shared and made present across multiple places, and which stores archives of multiple layers of metadata as these virtual things acquire new annotations. Issues for designers include how to communicate the size of virtual possessions, and changes that have taken place as they acquire new history. For example, a digital photo frame could explicitly show metadata associated with an image; this kind of display could provide a map of a virtual possession's shifting statuses as it acquires "digital patina" through new attributions. Past research has speculated that as digital collections grow, more meaningful experiences will likely arise from collating and contextualizing smaller groups of content, as opposed to archiving every aspect of a person's digital life (Petrelli et al. 2008, Sellen and Whittaker, 2010). It seems pertinent to design tools to support the cultivation of virtual possessions into valuable and accessible assemblies as collections expand.

Finally, several of my participants' practices of uploading and accessing their virtual things through multiple online places and devices contrast to some extent earlier work investigating how meaning emerged for teens through the ritual exchange of text messages and their embodied presence on a specific phone (Taylor and Harper, 2002). As virtual possessions like archives of SMS messages, social media content, and digital photos are stored in various online places and accessed through multiple devices, key opportunities lie in exploring how new form factors and expressive materials might extend embodied interactions across platforms and environments in meaningful ways. In general, this area suggests more research is needed into understanding people's immaterial practices with and perceptions of virtual possessions across space, time and technical platforms; and how this knowledge might shape how virtual things are given form in material environments.

3.4.3 Curation and presentation of self to multiple audiences

I observed a range of ways in which study participants drew on virtual possessions to personalize technology and to project shifting tastes and identities to different audiences. Background images on mobile devices were frequently modified; in some cases, new content was actively searched to reflect evolving interests. Social networking services such as Facebook appeared to function more as a “place” where participants exhibited fluid control over expression and curation of different aspects of their identities. In several cases, the ways in which virtual possessions were framed and presented varied depending on the social group(s) that had access to them. These findings highlight how the management and presentation of virtual possessions in online and offline places offers key opportunities for creative experimentation with one’s sense of self. In particular, the ability to attribute access privileges to specific virtual possessions appeared to be desirable. In several cases, this strengthened social connections to members of different groups by highlighting unique social bonds. However, significant complications also emerged from the accidental presentation of virtual possessions to a social group (or groups) they were not intended for.

These findings suggest an opportunity to design environments that are socially reactive to the groups that are present, or to create better ways to select aspects of self to project to these different groups. For example, a system could respond to the audience present and context in which it is being used to automatically generate an appropriate display. More broadly, it is clear that current tools people use to manage online privacy are deeply underdeveloped. Opportunities exist to design systems that enable end users to create displays of multiple aspects of self to be delivered to different audiences, which extend far beyond the current model of managing permissions. This could lead to more complex and expressive assemblies of virtual possessions that, in turn, project more socially appropriate and meaningful aspects of self to particular audiences.

Several participants also fluidly moved between material and virtual environments and appropriated various everyday materials in attempts to breakdown barriers separating these two worlds. I imagine there may be opportunities in leveraging the relatively more flexible nature of online places within intimate material environments. For example, I envision one context to explore the potential consequences of this direction is through the design of a socially reactive bedroom that enables teens to easily display and curate virtual possessions and attendant metadata; that enables them to create new metadata and see when it is created by others; that transforms displays based on people present in a room, surfacing things they have in common, or perhaps making the room “Mom Approved” when a parent is nearby. I imagine a series of technology probes in this area could produce new knowledge into dimensions of social appropriateness of this opportunity area, and open the space for richer exploration in and beyond the bedroom.

3.4.4 Probing potential paradoxes and consequences

While there are many opportunities to re-imagine the forms of virtual things to increase their perceived value, it is important to critically consider possible negative outcomes. As form givers of technical systems, HCI researchers and practitioners must recognize requirements emerge from complex interplay between technology and users, as opposed to pure technological advancement (Friedman, 1996, Mick and Fournier, 1998, Taylor and Harper, 2002). When approaching this space the community should keep in mind the complexities of dispossessing virtual things and persistent virtual records, as well as potential negative social obligations and expectations that could emerge.

People actively reinvent themselves by selecting which elements of their past to keep and which to let go (Kleine and Baker, 2004, p. 9). While virtual possessions can play a potentially important role in supporting identity construction processes, how one might dispossess a virtual thing is unclear. For example, shared (and co-curated) possessions could pose problems, as consensus is required across various members on dispossession. People will need to be able to richly experience sharing their virtual things with different social audiences, while having the flexibility to retain control over rites to (dis)possession. Moreover, the persistent archiving of virtual possessions over time offers new opportunities to support reflection on life experiences; however it also creates an exacting history of who people are, leaving little space for romanticizing about the past and forgetting experiences they no longer wish to relive.

While virtual possessions can increase a sense of social connectedness across individuals and groups, they could also work to amplify differences and reinforce cliques. New technologies for presentation of virtual possessions could provide people with valuable portraits of their identity; however, they equally could promote self-obsession through creating the ongoing obligation to curate multiple selves. Accrual of metadata opens a new space to construct virtual possessions more uniquely reflective of particular experiences, while also possibly creating new social expectations to continually create these attributions. These issues must be considered and could serve as productive framing mechanisms for future research as researchers and practitioners move forward in critically determining socially appropriate and beneficial design interventions.

3.5 Conclusion

The study described in this chapter explored how teenage participants perceived, valued and formed attachments to their growing collections of virtual possessions. A goal of this initial study was to surface key issues and opportunities related to teens' interactions with virtual possessions to critically consider the benefits and potential dangers of designing new technologies that might enable people to find more value in their virtual things. My fieldwork uncovered several complications participants faced when presenting and interacting with their virtual possessions in online spaces, and key strategies employed to engage with their virtual archives in valued ways. Based on

these findings I proposed *accrual of metadata, placelessness and presence, curation and presentation of self to multiple audiences*, and *probing paradoxes and consequences* as an opportunity map to guide future research and practice in the HCI community.

A clear limitation of this study is that all of participants had frequent access to technology and hailed from middle and upper middle class families in the United States. Participants from different socio-cultural and economic backgrounds represent significant populations and would potentially produce alternative results. This suggests opportunities for future cross-cultural investigations into how different groups construct value with their virtual things; and how these processes unfold within populations representing different ages and economic backgrounds. Indeed, in chapter 6, I will describe a large scale qualitative cross-cultural study conducted with adults in Spain, South Korea and the United States (Odom et al. 2013).

Importantly, this initial study raises several issues about the social appropriateness of new technologies, and what virtual possessions could—or should—be in the future. How could the presence of virtual possessions be amplified in contexts of everyday life in valuable and meaningful ways? How might the forms and behaviors of virtual possessions be augmented to create more valuable experiences with them?

These questions point to the challenge of operationalizing design opportunities from qualitative fieldwork findings. The opportunities described earlier in this chapter present productive ways for the HCI community to move forward; however, there is no way to know if they will actually be beneficial. The User Enactments design method helps more securely move forward into largely unknown design spaces in ways that fieldwork alone cannot. In the next chapter, I will describe my use of the User Enactments design method to critically explore and challenge findings from the study described in this chapter. This next study occurs in a prototyped environment representing one of the most important places teen life unfolds: the bedroom.

4 Investigating the Form, Presence and Behavior of Virtual Possessions in the Context of a Teen Bedroom

Most teens feel the greatest sense of place attachment to their bedroom (Chawla, 1992). Here they live with their things, make sense of their lives, and work to understand the complex changes and challenges of growing up (Steele and Brown, 1995). The bedroom provides moments for solitude and reflection, a social space to engage parents and peers, and a canvas to experiment with an evolving sense of self (Hodkinson and Lincoln, 2008). Teens display and curate their precious material possessions in their bedrooms in order to explore their changing values and aspirations, and project them to different audiences. Through this process, they construct value with their things, mentally reassigning an individualized sense of worth as they possess and repeatedly use their things over time (Belk, 1988). The bedroom provides teens with their first opportunity to author a space, to create their own aesthetic and sense of style in negotiation with their parents (Steele and Brown, 1995).

Digital devices and services have become an increasingly large part of teen life (Ito et al. 2010) and teens commonly alternate their attention and interactions between their material and virtual possessions (Odom, Zimmerman, and Forlizzi, 2010, 2011). The study described in the previous chapter unpacked how teens construct value with their material and virtual possessions in their bedrooms, and how these materials shaped teens' identity construction processes, how teens work to make virtual things more present, and that teens draw on virtual possessions as critical resources for self-reflection and self-presentation to different social groups (Odom, Zimmerman, Forlizzi, 2011).

The study described in this chapter focuses new forms and behaviors of virtual possessions that support curation and presentation of self to different audiences.⁴

⁴ This chapter is adapted from a paper published at the CHI '12 conference (Odom et al. 2012). Portions also appear in a paper published at the DIS '12 conference (Odom et al 2012) and a pictorial published at the DIS '14 conference (Odom et al. 2014).

Specifically, I wanted to understand how making virtual possessions more present in the bedroom and giving them new forms and behaviors influence teens' perceived value of these things. To do this, I worked with a design research team to generate four design concepts: an auto-redecorating bedroom, postcards sent from a teen's past, electronic gift giving, and a system for curation of multiple selves. Along with the team, I then constructed a bedroom in our lab and conducted User Enactment speed dating sessions (Odom et al., 2012, Davidoff et al., 2007) with 14 teens. This prototyped bedroom provided a prism for investigating aspects of several potential futures that teens may or may not desire.

User Enactments revealed that teens desire (i) to have their virtual possessions more present as long as they can control this presence, (ii) to curate multiple presentations of self while retaining a sense of authenticity, and (iii) to explore new forms and behaviors that better support reflection on past self and on the relationship they have with another. These findings suggest significant opportunities for the HCI community to create new forms and behaviors for virtual things in order to modify people's perceived value of them, particularly in terms of the ability to investigate one-on-one relationships and supporting reflection on the past. They also reveal an opportunity to develop richer forms of metadata, and the infrastructure required for its capture, storage, retrieval, and sensitive treatment.

The study described in this chapter makes two contributions. First, it advances the HCI community's understanding of how teenagers construct value with their virtual things, alluding to future product and service forms. Second, it provides a case demonstrating how speed dating with user enactments can work to investigate potential futures.

4.1 Prior Research

As described in the prior chapter, I conducted ethnographic interviews with 21 teens in their bedrooms to investigate their perceived value of virtual and material possessions, and how these materials shaped teens' identity construction practices (Odom, Zimmerman, and Forlizzi, 2011). Findings detailed design opportunities for value construction activities with immaterial things. These include:

Value in presence—Teens worked to make their virtual possessions more present. This included: constantly changing backgrounds on personal devices; printing status updates and comments from friends to display in their rooms; and maintaining a persistent, online connection in order to monitor the virtual world.

Value in self-reflection—Teens used their virtual possessions to reflect on their past. This included investigating how many times they listened to a song; storing printed status updates; and reflecting on popular culture and other images

featured on their computer previously. They used both system logs and human constructed metadata to understand who they have been.

Value in curation of multiple selves—Teens used virtual possessions to ‘curate’ different selves to different audiences. Actions included applying interface ‘skins’ on gaming consoles; encoding photos of a shared experience into the metadata of songs in playlists given as gifts; and tagging/untagging of photos as well as restricting/granting access to photos and other social media content.

4.2 Teen Bedroom User Enactment Study

The goal of this study was to investigate how the design of virtual possessions that were intended to support identity construction activities might influence perception of value and meaning. I chose to conduct speed dating sessions with user enactments (UE) (Odom et al. 2012, Davidoff et al. 2007) to help better understand my target audience as well as potential opportunities and risks in the design space. In real-life speed dating, people have props such as a wine glass, café table and candle. They go on many very short dates in a single evening, and at the end, they know very little about any of the people they met. However, they have developed a much better and more realistic vision of what they want in a partner. Speed dating with user enactments follows the same approach. Design teams create rich scenes of possible futures. They then bring in representative participants who find themselves in a familiar scene and then experience a “sip” of what the future might be like. Prior to each enactment, participants are asked to reflect on their current practices and desires for the future. At the conclusion, they are asked to reflect on how the enactment may have complicated or supported these desires, or led to unexpected experiences. By combining wide exploration across multiple structured engagements, user enactments provide a broad perspective to find new design opportunities and to reveal potential underlying social tensions around new technology.

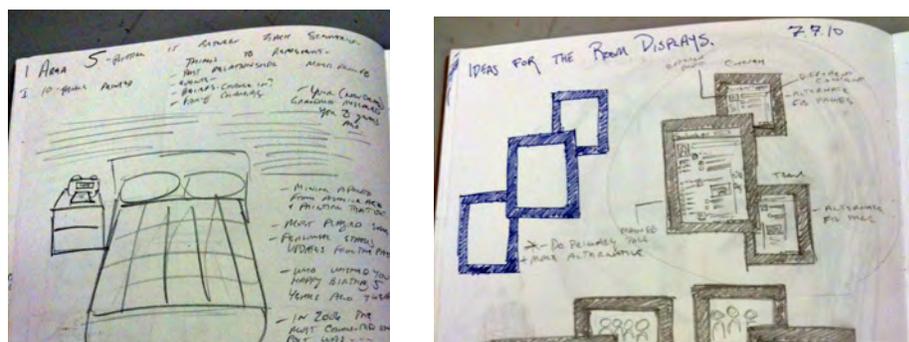


Figure 1. The design team developed 94 concept sketches over multiple sessions.

The enactments required a teenager’s bedroom, which I constructed in our lab. The design process for this began with printing photos of teen rooms I collected in the previous study and placing them on the wall. Using them as a resource, the research team then constructed a bedroom space, continually tweaking and augmenting it until it “felt” like the rooms I had visited. A major addition to the room included

twelve overlapping displays that fill the wall above the teen's desk. These were made from black and white foam-core, and I used a high definition projector to create the illusion that they functioned as independent screens. I intentionally created a set of displays that could be easily integrated into the bedroom, while at the same time might be perceived as overwhelming. I hoped this tension might provoke teens to critically reflect on the amplified presence of technology in their personal space.



Figure 2. Prototyping the bedroom took several rounds of iteration.

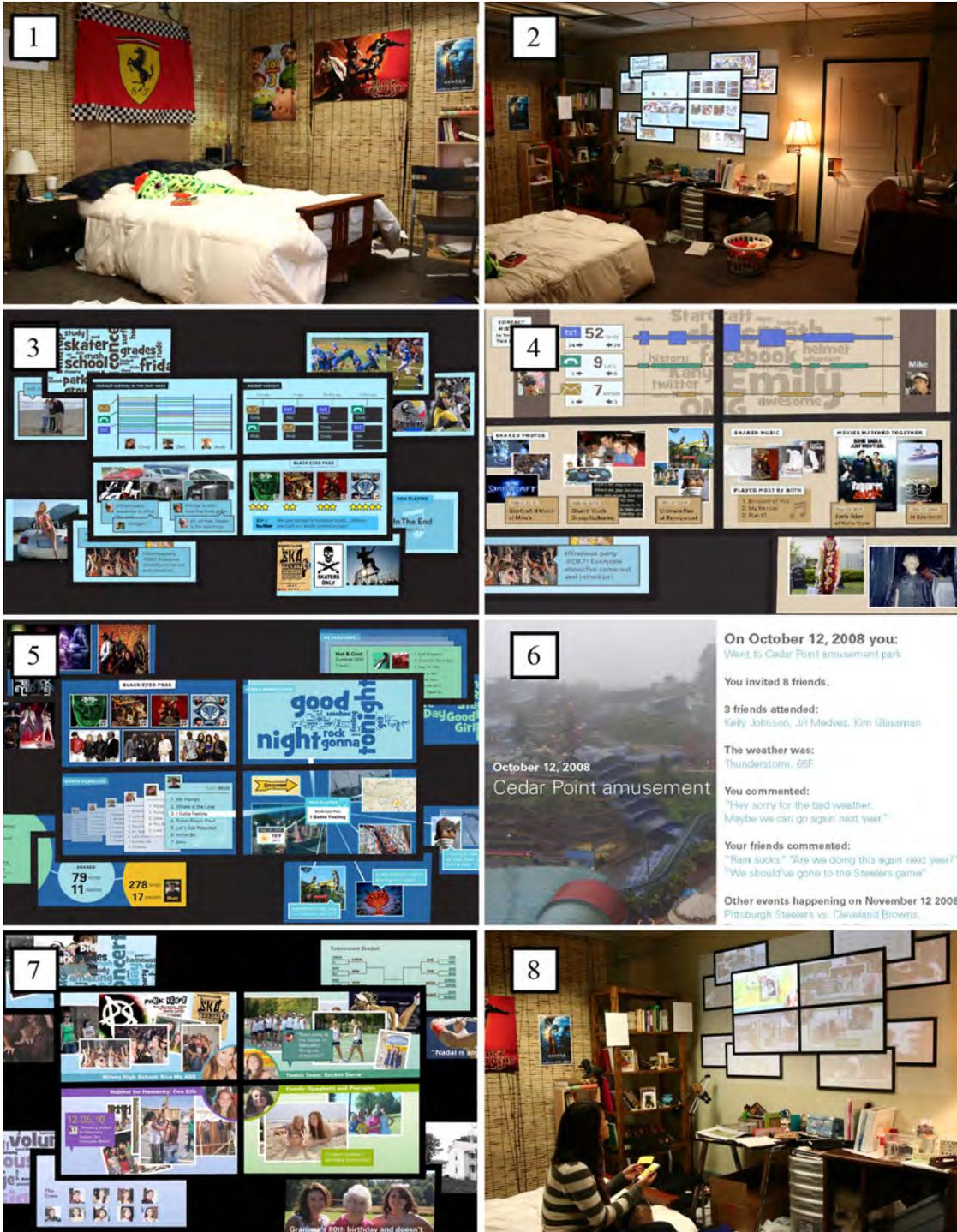
Similar to Schön's notion of design as a reflective conversation with materials (Schön and Bennet, 1996), I engaged in a reflective dialogue with the narrative and the problem framing each design raised. Through repeated meetings to critique scenarios, I iteratively refined the user enactments, often increasing the fidelity by using props and acting out scenes in order to developed a consistent narrative flow. I then repeatedly piloted the enactments. Piloting helped refine the design of the physical bedroom. It also revealed unanticipated narrative problems, which I addressed by developing a specific order for enactments. Finally, piloting helped to find the harmony between giving participants too much freedom and making the scenario mostly exposition.



Figure 3. The design team conducted several rounds of piloting before arrive on the final version of the enactments.

I crafted the scenarios around a fixed set of digital content provided by two teenagers (male and female, respectively)⁵. I chose to do this for two reasons. First, participants have different sets of virtual possessions (e.g., some have large music collections, while some listen to music online; some archive text messages, while others are less meticulous; etc.). Reliance on participants' personal collections would have removed an important control: making sure participants reactions were based on the same stimuli. Additionally, it would make the enactments only as rich as the collections teens keep *now*. Second, acquiring teens' personal collections and building personalized versions of the room would have significantly increased the amount of effort involved. One of the key challenges with designing new technology is to reduce the risk of development for things people do not ultimately desire. My intention was to ground intuitions from the previous study, and to avoid making an over commitment to a specific design direction. I needed to do UEs to help reduce the risk associated with taking a conceptual leap to an emerging design space that has few existing conventions to draw on.

⁵ See design process book in appendix for an in depth description of differences between male and female UE materials.



1. The messy teen bedroom. 2. Application interfaces were controlled through Flash and projected onto 12 foamcore displays. 3. UE1 (male) screen displaying personal information (e.g. visualization of communication patterns, provocative advertisement, etc.). 4. UE1 (male) screens auto-redecorate to present information related to friend. 5. UE2 (female) application of the gifted playlist with various metadata layered onto it. 6. UE3 Event-based postcard with metadata scraped from social networking pages. 7. UE4 (female) social affiliation management application. 8. UE4 application indicating teen is receiving a text message from a high school friend.

4.2.1 The User Enactments for Speed Dating

The following descriptions provide a glimpse at how each UE scenario unfolded and the research questions grounding them. For more details, please see the UE Teen Bedroom design process book in the appendix.

UE 1: Redecorating Bedroom—The participant enters the bedroom after dinner in order to read an Act from *Romeo & Juliet* to prepare for an upcoming exam. 12-displays show various collections, including: a visualization of messages exchanged with friends over the last two weeks, favorite music, photos of a wild party with comments, provocative pop-culture images, and personal photos related to sports and family. A confederate (of the same gender) plays the participant's friend. They show up and enter the room, triggering five of the screens to automatically re-decorate; presenting new information of shared activities and interests between the two friends. The screens highlight events both attended, images from parties, a visualization of communication patterns, and images of the two friends in Halloween costumes from a time before they knew each other. The confederate alludes to the meaning and function of the displays through a semi-structured conversation. After a few minutes of discussion, another confederate in the role of a parent knocks. The participant presses a remote to change the displays to “parent approved,” masking the provocative image and party photos. The participant then allows the parent to enter and drop off folded laundry.

This enactment explored issues surrounding the control of virtual possession displays against the backdrop of different social audiences entering and exiting the room. It investigated questions including: Do teens value a system that automatically presents digital content relevant to particular people in the room? Will virtual possessions from a teen's past (i.e. Halloween photos) conflict with their current perception of self?

UE 2: Gift Giving—The participant is sitting in the room listening to music, while waiting for a friend. The song she/he is listening to is from a playlist given as a gift to them by their girl/boyfriend. 12-displays present machine and human-produced metadata for the current song as well as a collection of annotated photographs assembled by the girl/boyfriend from visit to an amusement park together. Metadata for the photos lists the time, day, and weather information as well as a topographical map. Other screens display a set of gifted playlists, information about listening habits between girl/boyfriend and participant, and wordclouds of lyrics. After spending a few minutes in the room, a confederate friend arrives, notices the screens, and engages the participant in a semi-structured conversation alluding to the meaning and function of the displayed information.

This enactment aimed to investigate questions including: Is a digital gift perceived to be more valuable if it reveals more of the effort someone put into making it? To what extent could social or machine-logged metadata help support the work of crafting a digital thing expressive of a social relationship between two people?

UE 3: Postcards from past—The participant sits in the bedroom when a parent confederate arrives with two postcards mailed to her/him. The postcards present information and metadata scraped from a teen’s social networking account from two years ago. One summarizes personal stats, including the number of: friends on Facebook, people they most frequently tagged in photos, untaggings of self in photos, etc. The other shows an amusement park trip shared with friends, including both social information (e.g. friends that attended, comments about the event) as well as other metadata (e.g. weather and temperature, other events happening that day, celebrities visiting the park that year). After a few minutes, the parent confederate returns to say dinner is ready.

The enactment explored questions including: Would receiving a physical postcard constructed from old metadata be perceived to support or conflict with self-reflection? How far is ‘too far’ for teens to look into their past? Does revealing that the system keeps digital traces of activity make teens feel uneasy?

UE 4: Curating Multiple Selves—Sitting in their bedroom after school, the participant views four different versions of their social networking profile targeted at four different audiences: family, school friends, sports team, and church (see figure 2.4). These are linked to incoming and outgoing digital communication. They enable the teen to post status updates, comments and other content to each group individually. After a few moments she/he receives a text message from a member of the sports team, and this quadrant highlights. She/he reads the text message (on a phone provided to them). A few moments later a different quadrant indicates another text message has arrived from a school friend. The corresponding quadrant highlights and she/he reads that message. The enactment concludes when a parent confederate knocks and asks her/him to get ready for sports practice.

This enactment investigated questions including: Will teens perceive the ability to explicitly manage different presentations of self to different groups valuable? Are teens disturbed by the explicit fragmentations of their social groups, and the presence of this information in their room?

Participants and data analysis— I recruited 14 teenagers ranging in age from 14-17 (8 female and 6 male). Teens were recruited through flyers posted in several different areas of Pittsburgh and through word of mouth. Throughout this chapter I refer to each participant with a sex specific pseudonym followed by her or his age (e.g., Sally-15). The design of screens for Enactments 1, 2 and 4, which emphasize personal content, were adapted to feature sex specific names for both the participant’s character and their friends.

Before beginning the enactments, researchers gave participants a bedroom tour, introducing “their” digital and physical belongings. I primed participants for each enactment by offering brief explanations of interfaces and then describing an activity

to start with. Participants were also asked to reflect on their own everyday behaviors and experiences. This provided researchers with additional insights, and primed participants for drawing connections between their own lives and the possible future presented in each enactment.

During the enactments, I played popular contemporary music popular in the background to deemphasize that this was taking place in a lab. This proved to be a very useful technique in terms of helping participants relax and focus on the scenario at hand. Following each enactment I conducted semi-structured interviews, asking participants to reflect on their experience. I typically began by asking about their everyday practices, and then transitioned to talking about the specific enactment. This technique appeared to help participants fluidly make connections between the daily experience and the potential futures. Sessions lasted between 75 and 90 minutes.

User Enactment sessions were video recorded, which resulted in nearly 18.5 hours of video. Research team members also took notes during sessions. The research team then met weekly over the course of four months to repeatedly review the video and notes in order to draw out underlying themes. Textual documents were coded using these themes. I also created conceptual models and affinity diagrams to reveal connections across participants and across enactments.

4.3 Findings

During pre-enactment interviews, teens commonly described themselves as technology users and reported using computers and mobile phones everyday. All teens had personal bedrooms. Upon first entering the bedroom, many noted similarities between it and their own room in terms of objects and messiness. In the following sections, I present several examples taken from user enactment sessions that capture four primary emerging themes: the desire for presence and imperative of control; desire for curation of multiple selves and tensions surrounding authenticity; desire for self reflection by looking back; and desire to investigate relationships through evidence of action.

4.3.1 Presence and Control

Almost every participant had a strong, positive reaction to how the 12-displays made their virtual possessions much more present within the bedroom. They valued that the displays could both support representing their self to others and investigating who they are right now. In terms of the increased presence, teens stressed the importance of controlling the display, both in terms of turning it on and off, and in terms of managing the content.

“...I like that it’s bigger in the room. ...more available to me. I can lie around on my bed ...look at it, think about how to connect with people, but then it needs to go away. If I can’t ...it’s going to make me paranoid or obsessed.” (Sara-15)

Similar to Sara, several teens described how the constant presence of their virtual things might lead to obsessive behaviors.

Participants related the practice of displaying objects in their rooms to the 12-displays.

“It’s all the things that are out [on display] that make up a big part of who I am. ...This [motions to the 12-displays], you can see those connections between your different things. ...Those connections can kind of show who you are in a way. ...It’s not really different from physical things, but there’s no way to do that today.” (Anna-15)

Anna’s statement captures what many teens said, how seeing relationships and connections among their things could make them more valuable.

Several teens described how elements of UE1-Redecoration and UE4-Multi-self could help support self-development and discovery. They seemed very much aware of the work they were doing in their bedrooms to understand themselves.

“I’m figuring out who I am and coming into my self as a person. This could be really useful for thinking about who I am and who I might be comfortable being.” (Derek-16)

The enactments showed that the desire for control involved both turning displays on and off as well as curation of what was displayed.

“there are photos on Facebook of me and my friends that I want to have up in my room but I can’t. [parents will not allow] ...They are an important part of me and my life ...that [my parents] aren’t part of. ...I’d want to have [photos of friends] up, like posters on the wall, ...Like live with them. ...But a big part of living with them is also living my life outside of them. ... I have to have some real space away from them.” (Sara-16)

The display of specific content from electronic messages also emerged as highly contentious and in some cases inappropriate.

“having the actual messages of like texts or Facebook displayed up there, I think I would panic. Even if I could control it, what if someone walked in the room? ...[They’re] way too personal, who knows what someone’s going to send you and who’d see it.” (Sam-16)

Interestingly, UE1-Redecoration’s screens presented wordclouds of text message archives (either the cumulative sent by self or those exchanged with friend). This provoked some teens to speculate on potential workarounds offered by this alternative form:

“I write so many texts to so many people I lose track of what I’ve said. ...Those [wordclouds] feel like they’d give me time to pause and think about the meaning of what’s sent. ...It feels like a special thing that I’d have with someone else. ...Other people could see it, but we’d be the one’s that’d know what it means.” (Mary-16)

4.3.2 Authenticity and Multiple Selves

UE1-Redecoration and UE4-Multi-self explored how teens would react when confronted with technologies that explicitly displayed presentations of self to different social groups. During iterative piloting of UE-4, I used university students as stand-ins for teens. These college students often reacted negatively to the idea of displaying different representations of self to different social groups. Teen participants, however, had an entirely different reaction:

“I need them to be separate because I can’t express everything I want to if everyone is listening. ...I don’t want to seem fake, I mean I’m real to everyone, but in ways that make sense in each situation. This [application] would be really helpful.” (Mary-16)

Mary’s reflection captures how teens were typically comfortable with having multiple digital presentations of self clearly segmented and manageable.

The automatic and manually-triggered redecorations of the room to present content tailored to a person or social group in UE1-Redecoration did raise concerns. Redecorating was perceived to evoke contrived, inauthentic presentations.

“...the screens show a lot about my relationship with a friend in a different kind of way than the physical things leftover from [shared] experiences with them. But I would rather look at it on my own to think about what we’ve done together. ...Having [the screens] change when she comes in feels strange. ...It seems like I’m stalking her. ...If she’s coming [over] ...I want to focus on being there with my friend.” (Mary-16)

Several other teens described how the redecorating screens could cause peers or parents to perceive they are hiding aspects of their lives from them, potentially leading to awkward and undesirable situations.

4.3.3 Self Reflection by Looking Back

Several enactments triggered reflections on how records of teens’ interactions with digital materials could surface as resources for looking back on who they were at different times in their life. In what follows, I detail how teens drew on the applications to envision how they could be used for reflecting on the past. I will then highlight how teens unexpectedly linked the perceived value of these things with less frequent interactions with them over time.

The enactments provoked teens to consider how technical systems keep traces of their interactions as metadata and how access to this data could shape their perceptions of virtual possessions. I originally suspected the personal-behavior postcard (in UE3), which presented machine-captured metadata summarizing a teen’s behavior from two years ago, would cause conflicts by prying ‘too far back’ into the past to their ‘pre-teen’ days. Surprisingly, this was often not the case and most teens desired to, as Mary-16 stated:

“go back more into the past ...to when I can't even remember.”

Some participants described how the postcards could stimulate co-exploration of the past with friends or family:

“I don't know what was happening when I was younger and I like the idea of the [postcards] going back a few years each time I get them until they were back to when I was a baby. ...I've wondered about what was happening then, but I don't bring it up with my parents much. ...[postcards] would provide a little bit of information to start a conversation” (Eric-16).

Teens also described how mundane records of their online activities might support a new way of recalling past experiences:

“Who I'm tagging [in photos] now, shows who I'm around. [My] friends are a big part of who I am. ...Knowing that information when I'm older feels like it would make me think a lot about what I was doing then and who I was” (Tim-16).

In some cases, teens envisioned the postcards would accrue value over longer periods of time:

“...how many times I untagged myself from a photo or who was tagging me and when and where.In five years, ten years, twenty years, that could be a really special way of thinking about what was happening in my life then” (Stephanie-17).

However, several teens expressed that a lack of transparency in when and how this data was captured over time, and where it was stored, as well as the potential to be reminded of fights with parents and friends could complicate the perceived value of these things.

During interviews following UE1-Redecoration, several teens described how materials taken from bedroom walls were rarely captured. In some cases, they expressed a desire to 'save' the state of their virtual possession displays to revisit them. Anna-15 uses a bedroom wallpaper metaphor:

“Everything in my room and on my walls is a reflection of me. ...I put new things up and take other things down ...here [in this application] there are pictures of friends, bands everyone liked, different pictures of you and what you're into. ...They could keep layering on top of each other like wallpaper. ...You could peel back the layers and see what's underneath. ...it would be making a saved record [of my life] from what I do over time.”

Other teens described how revisiting the spatial layout of virtual possessions decorating the room could stimulate a different experiences of remembering:

“...when I'm older it would be cool to bring up all of my digital things and how they were arranged in my room during different years. ...it feels different than thinking about an experience that's in a photo. ...It's not about remembering an experience I had, more like what it felt like to be in my room when looking up at how I arranged everything” (Marisa-17).

When probed further on how frequently she would use this kind of application, Marisa stated:

“I’d probably come back to it every four or five years. Like after I finish college or I’ve gotten married. ...what I’d treasure is going back [to it] when my life is changing and immersing myself in who I was and think about where I’m going.”

Marisa’s comment captures how several teens speculated the value of these things as resources may in part be tied to the rate at which they are encountered. Interestingly, the potential value of infrequency became one of the largest unexpected themes, emerging across several participants and enactments. This theme emerged in some cases in relation to the multiple selves application (in enactment 4). Eric-16 describes saving different ‘states’ of his different social groups to revisit in the future:

“...the meaning won’t come from seeing them everyday. ...It’s like the photo albums of me when I was a child. I look at them every other year. ...This [application] would be like that. You could save what you’re doing ...and have it as a special way of thinking about who you were by who was around you.”

4.3.4 Understanding relationships through evidence of action

The majority of digital content represented across all UEs usually centered on some form of evidence of action. This included forms constructed to explicitly reinforce a social relationship, such as the gifted playlist in UE2. It also included many implicit forms symbolic of shared practices or exchanges, such as the graphical breakdowns illustrating the number of times tagged in a photo with a friend (UE3); or the times a song has been listened to collectively among friends (UE2). In what follows, I describe how teens drew on these forms to envision how they could support reflection on valued social relationships.

In UE1-Redecoration, the communication summary screen becoming present as the friend enters provides an implicit evidence of action; it illustrates the frequency of SMS messages, emails and phone calls exchanged between two friends. This screen in particular provoked several discussions. Katie-17 describes how these records could construct a social portrait only readable to friends in the relationship:

“It makes me think of a landmark to remember people by. I can look at it and see when we were interacting and think about what we were doing. ...It’s something that only her eyes would understand.”

Marisa-17 envisions how the low resolution of this implicit form might stimulate more active recollections of relationships compared to photos:

“...in a photo album there are lots of memories and in this there are lots of memories too. ...The way I think I would use them to remember is different. Like with a photo album, I look at it, I see each photo and, like that, I remember what was happening then because I’m seeing it. ...With the [communication visualization] only I know what went on when all those messages were sent and so I have to think back, and put it all together myself...”

Many teens described holding onto the physical cases and discs from mix-CDs given to them by friends even though they accessed the music on digital music players. Some teens reflected on the less expressive qualities of other digital gifts:

“...for me, one of the most important things about getting a card that someone made is having it around during that momentary time that’s special in my life. ...[and] think about what went into it. ...With e-cards there’s nothing personal about them, nothing real went into it so they don’t feel like they represent much” (Eric-16).

However, reactions to the gifted song playing in UE2-Gift tended to contrast Eric’s sentiment. Tim-16 describes the explicit evidence of work conveyed by the application:

“It’s using the digital medium in ways that are hard to do with the physical. ...What I mean is a person can put together these photos and tag them with comments and put other information ...the point is all of this comes together to make an experience that’s different than listening to music someone gave you sometime. ...I see it like a handwritten letter. ...when I read it, it’s like that person is coming through the paper because they went through the trouble to write and had an intention. ...[the digital gift] feels like the [girlfriend] put some effort into making it say something.”

Tim’s statement captures what several teens remarked on, how different kinds of metadata could be used to explicitly convey the work that went into crafting a unique digital thing symbolic of a valued relationship.

4.4 Discussion and Implications

Findings from this study produced a range of insights on how the presence, form and behavior of virtual possessions shape teens’ sense of identity and how they might help them better curate different aspects of self. In what follows, I first discuss how user enactment sessions challenged findings from my prior study (discussed in the previous chapter) and produced unexpected results, specifically in terms of: increasing presence, balancing authenticity and multiple selves, and looking back on the past and exploring personal relationships.

4.4.1 Increasing Presence

I previously observed teens working to display virtual possessions in their bedrooms and to breakdown boundaries between the material and virtual world (Odom, Zimmerman, Forlizzi, 2011). However, from this fieldwork, it was unclear if teens desired systems that significantly amplify the presence of their virtual collections. I

expected teens to find the 12-screen display to be invasive, overwhelming, or even inhibiting. However, nearly all had positive reactions, valuing how it could provide a better understanding of their things and support their work to understand themselves and their relationships. These perceptions were clearly contingent on teens having control over the presence (and absence) of their virtual things but not the presences of the displays.

There is an opportunity to rethink the bedroom in terms of digital displays as well as how new interaction methods might lead to better situated control over screens' contents. In addition, there is an opportunity to better leverage screens currently found in bedrooms (mobile phone, computer, television), helping them to work together as a more integrated and artful display system. Further, virtual possessions can be made present in many ways, and screens are only one option. There is also an opportunity for creating physical forms (e.g., the postcards in UE3), light based forms or even auditory forms, which could support familiar ways of manipulating the presence and absence of things.

4.4.2 Authenticity and Multiple Selves

The prior fieldwork study also described how teens drew on their virtual possessions to curate different presentations of self to others. The user enactments made this “fragmentation” of a teen’s self more explicit through UE1’s auto-redecoration and UE4’s curation of four different selves. I wanted to investigate if future technologies should acknowledge or even reinforce the fragmentation, or if they should work to make teens feel more whole.

Redecoration particularly seemed like a good idea, as it is less explicit than UE4’s four selves and it builds on the inherent strength of virtual possessions to instantaneously appear and disappear; something physical possessions cannot do. However, teens perceived the socially reactive display in UE1 as potentially inauthentic and attention seeking. Teens instead desired to be with friends or family when in their presence, and then to use virtual possessions to reflect on these relationships later when alone.

The multiple selves screen in UE4 raised issues over unwanted self-disclosure. Teens appeared quite comfortable when faced with seeing their self as multiple, curated selves. They felt the fragmentation could somehow make their lives seem more manageable. In some cases, they envisioned how saved records of these fragmentations could provide resources for reflecting on personal growth across life transitions and stages.

One explanation of this could be that teens have more segmented lives than other people. They move between their home and bedroom, partially controlled by their parents, and their high school, controlled by both peers and school rules. As they work to construct a self identity, they have the experience of being at least two people much more than young adults who create a separate life when they leave

their parents' home and begin to control their own space. In keeping with Giddens (1991), this surface-level fragmentation can be crucial to teens' work to construct a unified life narrative and, in essence, develop a concrete sense of self. Nonetheless, these issues are indicative of how the teen world is different from other populations, and what is expressed in this chapter must be viewed carefully before being applied to other groups of people. It does however raise some interesting general issues for investigating how people living together, such as couples, form and learn to share space, and share physical and virtual possessions that are representative of the couple or collective group.

4.4.3 Exploring the past and personal relationships

Finally, my prior fieldwork revealed that teens used virtual possessions to reflect on their near past self. They often did not possess many virtual things that dated more than a few years into their past. UE1's presentation of Halloween photos depicting the teen at a young age as well as discussions following UE3's postcards both aimed to provoke teens to confront their earlier in their lives. I anticipated teens would find they complicated their current self-image; however, this often was not the case. Many teens desired to go deeper into their past, and they perceived collections of metadata operationalized by the postcards to be valuable for looking back on their practices. At the same time, their reflections indicated the value associated with the cards may come from occasional interaction, rather than constant presence—a notion resonant with emerging research on slow technology (Hallnas and Redstrom, 2001, Odom et al. 2012, Odom et al. 2012).

Several UEs used forms that summarized personal relationships by revealing evidence of action. I displayed visualizations of communications sent and received (UE1), wordclouds of text messages indicating the frequency of word usage (UE1), favorite shared media (UE1), interfaces for making digital gifts more present (UE2), and experiences like trips shared together (UE3). While most social networking visualization tools currently offer a view of a person's complete network, these unintentionally provided windows into individual relationships. Teens reacted positively to these concepts, often describing how they could become aesthetically integrated into bedroom practices and provide mechanisms for actively expressing the social bond shared with another person. They clearly desired ways to see the evidence of the actions taken by themselves and others as a way of understanding who they are with that person and possibly where they want to go with that person.

4.4.4 Design Opportunities and Considerations

Collectively, the findings described in this chapter suggest many opportunities for the design of new technologies that increase the perceived value of teens' ever growing collections of virtual possessions. They highlight the importance of both human and machine-produced metadata. Systems that elicit human produced metadata and devices and systems that generate their own metadata have not been designed to support reflection on past self or reflection on the relationship with another. Going

further, this indicates an opportunity for richer forms of metadata that can better support these desires. The opportunities include infrastructure for capture, storage, and retrieval; devices that keep and share metadata; and interactive tools that support display and reflection. Here, I detail two specific opportunity areas to advance the form and behavior of virtual possessions and open up new ways for teens to draw on them as resources in the bedroom.

Ability to investigate one-on-one relationships—A common factor shaping teens’ perceived value of virtual possessions centered on how they could provide resources for investigating a one-on-one relationship with a friend. These findings generally match prior research on teens’ ritual exchanges of text messages to express and affirm close relationships (Taylor and Harper, 2002). However, the digital materials used in these social processes are becoming more diverse, and questions surrounding how they could enrich social relationships are complex. Socially reactive virtual possessions becoming present when friends and family entered the room was clearly disruptive. Teens wanted to develop relationships with specific people when they were around, and to use technologies to explore, reflect on and “live with” these relationships when alone.

There is an opportunity to develop systems that capture metadata related to shared activities. In particular, teens described how being “tagged” together with friends on social networking sites enabled them to explore experiences with particular people over time. This kind of data could summarize how shared actions between two people have evolved over time. This opportunity highlights how everyday interactions with digital technology create layers of metadata, which could provide unique resources for viewing, exploring and expressing social relationships.

There is also an opportunity to use virtual possessions to represent actions between two people. The visualizations of SMS and email exchanges between friends in UE1 provoked several reflections from teens on how they could provide a new kind of “landmark to remember people by” (Katie-17). These low-resolution exchanges triggered speculations on how this communication could support active recollection of shared experiences. This also led to the visualizations being perceived as publicly presentable within the room, while remaining privately ‘readable’ only to those in the relationship. In a sense, systems can capture actions that are evidence of friendship, which help build and sustain a specific relationship. These materials can help create aesthetic forms of digitally mediated social exchanges open to being actively drawn on, or simply persist in the background. This direction could build on the history of work in HCI at the intersection of ambiguity in design (Gaver, Beaver, Beneford, 2003, Sengers and Gaver, 2006) and slow technology (Hallnas and Redstrom, 2001, Odom et al. 2012) to explore how these visual and interactive forms could be integrated into and slowly emerge as facets of bedroom culture and space over time.

Supporting reflection on the past through new materials—Teens’ reflections across enactments showed how virtual possessions could provide resources

for reflecting on their past. Several teens desired to ‘save’ versions of displays. Anna drew on the metaphor of wallpaper to describe how she would use saved states of her bedroom to “peel back the layers” and experience a sense of place from the past. There seems to be an opportunity to create applications that record the history of people’s virtual possessions and enable them to view how they changed in the future. For example, an application could save versions of desktop images on past computers. As virtual possessions grow in number, more opportunities to create a history of their arrangement will also grow.

Teens also strongly perceived value in aggregations of metadata that capture information about their actions from the past (e.g., the postcards in UE3). It is currently unclear how to extract both human and machine-produced metadata from third party services. New systems can be developed to begin archiving digital records to create new resources for reflection. An example of this could be a background display that visually communicates thematic shifts in one’s status updates, or simply the occurrence of momentous and mundane events over many years across life transitions.

Several teens also wanted to visit their virtual possessions several years into the future. This suggests opportunities for systems that anticipate making virtual possessions re-emerge in people’s lives over longer periods of time. An example of this could be a system that actively archives summaries of events attended or photos posted online, and delivers them to their owners years into the future.

Practical and ethical issues for designers and developers—There are many ways to advance the form, presence and behavior of virtual possessions to investigate significant social relationships and reflection on one’s sense of self. However, these opportunities also raise possible negative outcomes. When exploring these emerging design spaces it is important to consider how complications could emerge around metadata and evidence of action, as well as new risks of persistent digital records.

While metadata could enrich close friendships, it could also emphasize counting actions as opposed to the value of individual actions. Metadata captured by systems could become the currency by which relationships become defined; this may not always be the most relevant way to support social relationships. Additionally, as virtual possessions are increasingly created through and archived by third party services, they are given a lasting permanence different than material possessions. This makes virtual things increasingly vulnerable to surfacing in unintended contexts, highlighting how complex being able to ‘forget’ them will be. Future systems should support this need and, indeed the act of forgetting can itself be considered an opportunity (Bannon, 2006, Mayer-Schonberger, 2011). These issues are crucial when critically considering the role of future technology in positively supporting the forming and sustaining of social relationships, moving toward a concrete concept of self, and reflecting back on the past. These should be considered

as the HCI community moves forward in developing systems that support value construction activities with virtual things.

4.5 Conclusion

In this chapter, I described a study conducted using user enactments with US teenagers to investigate the role of future technologies in the bedroom could play in supporting (or complicating) identity construction processes in the context of teen life. The broader aim of this study was transition from ‘what-we-know-now’ from prior fieldwork with teens, to a future-oriented investigation of how new systems could be created to enable teens to engage with their virtual possessions in valuable and values-oriented ways. In this way, User Enactments provided a way of moving beyond studies of teens’ current practices. It allowed the research team to engage teens in confronting possible benefits and tensions as they drew on their own experiences to make sense of possible futures. Findings highlighted several new opportunities for increasing the presence and advancing the form and behavior of virtual possessions, and key tensions related to their development.

4.5.1 Broader discoveries and their implications for future work

The conclusion of this study simultaneously led to three key moments of discovery in the context of my dissertation work: (i) proposing virtual possessions as a class of artifacts for the HCI community to consider, (ii) the need to move beyond ‘hyper-local’ studies people’s virtual possession and toward a more global, cross-cultural perspective, and (iii) that the HCI community could benefit from better understanding and incorporating methods that directly engage people in exploring potential technological futures. In what immediately follows, I will describe these in more detail, and how each of these themes connects to subsequent chapters in this proposal.

Considering Virtual Possessions as a ‘class’ of artifacts for HCI research—Constructing the user enactment scenarios, the physical bedroom, and the design artifacts embedded in the bedroom, required a significant amount of critical reflection on the findings and implications from my 2011 teen fieldwork study (Odom, Zimmerman, and Forlizzi, 2011). Through this reflection it became clear that virtual possessions can be analytically, categorically and theoretically applied as a class of things in the context of HCI research and practice. This is important for a few key reasons.

First, the HCI community has a long history of exploring people’s experiences with different specific types of virtual possessions. This work has spanned diverse topics such as email (Whittaker and Sidner, 1996), photos (Kirk et al. 2006, Durrant et al. 2009), music (e.g. Brown and Sellen, 2004, Volda et al. 2006, Leong et al. 2008), money (Mainwaring 2008), and other virtual things that never had physical forms,

such as GPS locations (e.g., Brown et al. 2007) and text message archives (Taylor and Harper, 2002). However, these works are fragmented, often existing in parallel to each other. Encompassing them into a broader framing as types of ‘virtual possessions’ can be productive in terms of understanding their relation to each other, creating a more cohesive whole of this trajectory of HCI research, and developing new knowledge on what virtual possession are and what the could be in the future.

Second, the class of ‘virtual possessions’ directly draws on a large, yet cohesive corpus of theoretical and empirical work outside of HCI; namely, theories of material possession attachment and material culture. Juxtaposing literatures on theories of material possessions to virtual possessions can be a productive way of understanding what virtual possessions are and how they are similar to and different from material possessions.

This discovery shaped my future work by provoking me to conduct additional fieldwork projects with more diverse populations in terms of age, occupation and culture (Odom et al. 2012, Odom et al. 2013). This discovery also prompted me to more seriously consider how theories of material possessions relate to and differ from the observations and accounts of people’s experiences with their virtual possessions.

Expanding the scope beyond hyper-local studies—It also became apparent that a tension exists between the fact that interactive technologies and systems are often designed for a global marketplace, while studies in the HCI community tend to focus on hyper-local settings (my study on US teenagers in their bedrooms being no exception). Hyper-local studies are often conducted in newly emerging research spaces where knowledge about them is nascent (see Edmonson and McManus, 2007 for a deeper discussion of methodological fit to field research). The aim of such hyper-local studies is typically to conduct research –which is usually open ended and qualitative – with a small portion of a population to obtain a rich, descriptive understanding of what big research issues occupy the emerging space being investigated. This type of research is certainly worthwhile, and in the next chapter I describe a smaller scale study specifically investigating how Cloud computing environments shape people’s perceptions of their virtual possessions.

However, at the conclusion of my fieldwork with teenagers and the UE bedroom study, it seemed as though the field of HCI was at a point where the scope needed to expand beyond hyper-local inquires as one way of facilitating future innovations in the research space. My research projects up to this point had synthesized prior work in and outside of HCI that related to virtual possessions, and had generated a deeply textured understanding of how a sample of US teenagers perceive virtual possessions now and potentially into the future. What was missing is centered on two key things, which will be described in the following two chapters.

First, it had become clear across my work that the placement of virtual possessions within Cloud computing environments was transforming people’s interactions, relationships and perceptions of their valued virtual things and archives. At the same

time, some of the experiential qualities of a virtual possession once placed in the Cloud seemed to complicate people's conceptions of these things as their 'possessions'—often in quite fundamental ways. To gain a better grasp on how the Cloud was increasingly intersecting with people's interactions with their virtual possessions, I conducted a qualitative fieldwork project in the UK that specifically targeted these concerns and which is described in the next chapter.

Second, building on the Cloud possession study, I conducted a broader inquiry into how people in different locations in the world are experiencing their virtual possessions. If interactive technologies and services are designed for a global audience and marketplace, do people worldwide experience their virtual possessions similarly? Do people's value construction activities with their virtual possessions differ across cultures?

These are clearly big questions that cannot be answered in a single study. However, they present clear motivations for conducting a broader cross-cultural project investigating people's experiences with their virtual possessions. At the same time, the sheer scale and logistics of conducting such a study introduces significant methodological and practical challenges; challenges that the method and practices of a user-centered design approach is not capable of supporting. My advisors and I collaborated on a grant to secure financial support from Vodafone to conduct a cross-cultural investigation of people's value construction activities with their virtual possessions in Spain, South Korea and the United States. This grant proposal was funded, and we embarked on a yearlong cross-cultural project conducted across three cultures, languages, and time zones. This project remains was of the largest funded research grants affiliated with academic universities in Vodafone's history. Findings from this project are described in the chapter six (and published in primarily in Odom et al., 2013; but also emerge in Seok et al. 2013 and Lee et al. 2013).

5 Lost in Translation: Understanding the Possession of Virtual Possessions in the Cloud

“...the more I talk about it, the idea of owning something digital seems lost in translation.” (P4)

The convergence of social and computing, along with the growing presence of networked devices, are creating new opportunities for people to move personal files to online places, as well as create new digital content through online services. Despite these real and growing changes, relatively little is known about how they might shape people’s orientations toward their virtual possessions.

The standard view, especially the one outlined in contemporary advertisements (e.g., Crossett, 2011), is that, with ‘the cloud’, people will be able to keep their digital content more securely and, potentially, more cheaply. By moving away from local storage, people can be sure that when their devices crash or get stolen, or when they suffer from the myriad other mishaps of daily life, their virtual archives will be safe. There is no doubt that such concerns do motivate people to move the virtual possessions they care about online. For example, in chapter 3, I reported on the fear that drives many teenagers to seek remote back-up: the likelihood that they might lose their devices or get them stolen, combined with their own poor data management practices, make cloud-like services especially appealing.

But, perhaps this view requires deeper, more critical examination. In this chapter⁶ I discuss how there are many reasons people engage with the cloud when producing, accessing, sharing and keeping their virtual possessions. Such activities have many benefits, yet, at the same time, the result of these new kinds of interactions can also alter people’s orientations to their virtual belongings in complex and nuanced ways. It can lead to complexities, concerns and conundrums in the way people reason about and act upon their online resources. I argue that part of the complexity here is

⁶ This chapter is adapted from fieldwork conducted during an internship at Microsoft Research Cambridge in the summer of 2011. Data collected from this project has appeared in several publications, including the CHI ’12 conference (Odom, Sellen, Harper, Thereska, 2012), the CSCW ’13 conference (Harper, Thereska, Lindley, Banks, Gosset, Odom, Smyth, Whitworth, 2013), and in a book chapter in *Trust, Computing and Society* (Harper and Odom, 2014).

bound to the design of the devices and services that people use. As people move forward into an ever more networked, multiple device and data-centric world, it is important to investigate and design around human centered preferences and orientations to digital archives, where storage, and ‘safety’, is only one manifestation of that orientation.

It is the purpose of this chapter to present research findings based on this premise. I explore field data gathered from qualitative interviews in the United Kingdom with a diverse sample of 13 people in which I examined how they orient both to their physical and virtual possessions. Specifically, I investigate similarities and differences in how they consider their material possessions, their locally kept virtual possessions, and their ‘possessions’ in the online world. Here, I show that possession is at once a noun for a type of object (material or virtual) and a verb that labels ways of treating things, again both material and virtual. This field data also illustrates how people are concerned not only with their own possessions, but with others’ possessions too. Beyond this, I show that their key concern is that possession be bound to notions that these things can be ‘seen’ somehow and experiences—in its location and in the way it is handled by those who have rights to it and, importantly, how it is not handled by those who do not.

With this as a background, the last section of this chapter considers how the design of services that allow for the production, gathering, sharing, and storing of digital stuff may proceed in such a fashion that these declarative properties may be embedded in productive and meaningful ways. Specifically, I articulate several design considerations to sensitize the design space encompassing cloud-based interactive systems to better support the possession of personal virtual possession, and the many properties associated with it. To do this, I suggest, may not require simple tweaking of current technology, but careful reconfiguration of many aspects of interaction design around virtual possessions.

5.1 Field Study Method

The approach I adopted was to recruit a diverse sample of people to elicit a wide range of rich descriptions about how possession of personal digital content is perceived and experienced online. This approach clearly has limitations; for example, it makes the results hard to generalize to any sub-population of population. However, considering the paucity of work in this area and following Edmondson & McManus (2007), I wanted to begin with a diverse group to gain a rich, descriptive understanding of the space as a whole to inform what might be salient issues for future research.

With that in mind, a total of 13 participants (7 female and 6 male) were recruited through word of mouth and advertisements; all came from the South Eastern region of the United Kingdom. Participants were screened over the phone to ensure I recruited a range of ages and occupations. Participants’ computing practices and

expertise varied; however, all owned personal computers, used them relatively frequently (the majority on a daily basis), and had maintained at least one online account at some point (e.g., email, dating website, Facebook). Importantly, in this chapter, when I say “online places”, I mean any internet-enabled service. This includes but is not limited to cloud-based storage services (e.g., Dropbox.com), social media/networking sites (e.g. Facebook,), email accounts, and other sites (e.g. location or photo sharing services).

The resulting sample represented people at many different life stages and in many different occupations. The ages of the participants were as follows:

Teenagers [P1 (aged 16), P2 (aged 17), P3 (aged 16)]; Mid-20s [P4, P5]; Mid-30s [P6, P7]; Mid-40s [P8, P9, P10]; Mid-50s [P11, P12]; Mid-60s [P13]. Occupations included student, architect, bank teller, homemaker, tour guide, and retired dancer.

Semi-structured interviews were conducted in participants’ homes, lasting between 70-120 minutes. Interviews aimed to develop an understanding of each participant’s orientations toward their (i) material things, (ii) locally stored digital content, and (iii) digital stuff appearing in online places. I began by asking participants to describe the material things they possessed that they considered important. I also asked participants to describe material things that were once valued, but possession had since been relinquished (if any came to mind). Participants then gave us a tour of where these artifacts were kept in the home (in the case of teens, this occurred mostly in their bedroom). This was followed by a tour of participants’ digital stuff kept on local devices. I similarly asked participants to describe what they perceived to be valued digital things, with emphasis on probing motivations and strategies for holding onto these things. I then asked participants to give us a tour of their digital stuff kept in online environments. Across these themes, I asked participants to reflect on similarities and differences among their material and digital things; I paid close attention to the language participants used to categorize and describe similarities and differences. I was careful to not offer participants any definitions of ‘possession’ throughout the interviews; when necessary I prompted them to clarify their orientations toward their various material and digital things.

All interviews were audio-taped, which produced nearly 18 hours of recordings. I conducted all of the interviews. The research team I was a part of (namely, Abigail Sellen, Richard Harper and Eno Thereska at Microsoft Research Cambridge) met weekly to review and analyze the data. Documents for each interview were created and contained transcribed segments relevant to the research questions (as opposed to idle chit chat). Documents were coded by researchers before weekly meetings; overlaps and differences in interpretations of the data were discussed. Data were then organized into themes. Meetings were also held with researchers outside of the project to challenge assumptions and to corroborate the themes. In what follows, I present several examples taken from field observations with participants, which feel capture the core themes emerging across qualitative interviews.

5.2 Findings

In what immediately follows, I briefly describe the main findings related to participants' material possessions and their perceptions with regard to virtual possessions kept locally on devices in the home. I then unpack apparent differences that emerged as participants compared these orientations to their digital things kept in online places or when attempts were made to move them from one to the other.

5.2.1 The Possessing of Things: Material and Virtual

Interviews and observations in participants' homes confirmed the insights that Miller offers in his book *The Comfort of Things* (2009). The way participants spoke about and presented their possessions revealed a range of deeply held values, values to do with who they were and how they wanted to convey that to those they shared their lives with – at home and at work (and even to strangers, like me, the researcher). It came as no surprise that material possessions emerged as being essential to participants' identity construction practices. A sample of the materials used in identity production included photographs of family and friends, mementos from trips, and objects symbolic of personal relationships. All the homes I studied contained family heirlooms (except P5 and the bedrooms of P1-P3). In some cases these things were on display in the home. Examples of these included handmade ceramics on a living room mantle and photographs prominently displayed on tables and other domestic surfaces. Other artifacts were stored away (in closets or cupboards) but the participants brought them to bear by reporting on how they 'knew' where these things were, and though they might be hidden away in the service of their preservation, their presence remained real, nonetheless. One example of this was a family bible in a bedroom chest. Discussions also revealed material possessions participants had intentionally discarded. The impetus for some of these behaviors simply owed to a loss of utility (e.g., broken mobile phone). But participants also described why some things were discarded because they evoked painful memories or no longer represented their values or desires. Here it became clear that what was gone from the material record became another resource to account for identity.

In addition to material things, all participants owned or had access to a personal computer they were the primary user of. Interviews revealed virtual collections of varying sizes kept locally on these machines and other devices (e.g., digital camera, mobile media player). Across all participants, the personal computer functioned as the primary place where their digital content was locally kept. These collections contained such things as: music files, photo collections, personal documents, personal diaries, financial documents, computer game information, and so on. Older participants emphasized the importance of their digital photo collections documenting family members; some of which were expansive. This may be related to the fact that, aside from P10, all participants aged 30 and above had children. It was clear that parents perceived these archives to be deeply valued; in fact, several desired to pass them down to their children.

Some participants raised concerns over their growing size, their importance notwithstanding. For example, P9 compares his archive of nearly 4000 photos (kept on his PC) with physical photo albums,

“...The digital ones, they are my possession, but I don’t know exactly what’s in there anymore and that sense of not knowing, or not easily knowing, makes possessing them feel somewhat different.”

This quote captures how a lack of awareness of the contents of one’s personal archive shaped the perception of possessing it. As I will describe, lack of knowledge in this respect emerged as a core factor shaping participants’ orientations toward their digital things online, and did so in several ways: the role of curator can become complicated if one does not know what one is curating.

Younger participants (P1-P5) reported keeping less expansive digital archives locally. I observed older participants organized their personal content relatively carefully, often copying it to external hard drives or physical media. By contrast, younger participants generally had less developed practices for organizing files locally, and reported rarely backing their content up. This may be due to the trend among younger participants to put content such as digital photos online (Lenhart, 2010). However, this transition appeared to cause complications when these participants were asked to discuss their orientations toward these virtual things, particularly in terms of issues of control over and awareness of these things once they were online.

5.2.2 Transitioning to Online Places

Several factors shaped participants’ motivations to put their personal digital possessions on the Internet. These relate to matters which have to do with identity through the management and display of possessions. Collectively, these can be broadly characterized as the following: (i) to share digital content with others (and potentially acquire new value through the accrual of social metadata similar to cases described in chapter 3), (ii) to make virtual things more ubiquitously accessible, opening up the possibility of drawing on these things across different physical places, and (iii) to put in an alternative place of storage for back-up purposes (in case hardware should break down, for example).

While the second and third reasons above treat the online world similar to a networked “storage box”, the first reason—to share information with others—is perhaps the most compelling. This is because posting information to online sites for sharing fundamentally alters and potentially adds value to these possessions. At the same time, it is clear that the attribution of social metadata, such as comments and tags, seemed to change participants’ perceptions of the digital thing itself. In a sense, these virtual “things” are transformed into actions and, through this process, transformed into something else.

For example, P8 describes the distinction between digital photos on her hard drive and the ‘same’ copies uploaded online:

“...they get comments from my friends and family, and those acknowledgments and stories become part of them. ...When I think about the photos as my possessions, I think about the ones on my computer and the ones on my Facebook as different. My [local] photos are me saving them for my family, for the future. ...On Facebook, the photos are me and my family and the connections we have with other people through the comments. I want both of them.”

Discussions with younger and older participants also illustrated how metadata was used as a resource to create a sense of sharing things among friends. For example, consider P2 (my youngest participant):

“I upload photos of when I’m out with friends. ...Like one time is at the mid-summer fair. I posted photos [on Facebook] and tagged [my friends]. ...We write things if something catches our attention or [we] remember something happened in that photo. ...I posted them, but I put them up there to share and it’s like when we all write on them and tag them, it’s those things that make it feel like we all have them together.”

These reflections help illustrate how the act of sharing online shapes orientations toward this content, possessed in some sense collectively, but still content which participants wanted to keep for themselves. This also shaped participants’ orientations toward their own material possessions and digital collections kept locally in the home. Further, while my research described in chapter 3 unpacked this general phenomenon in the context of teenagers [15], these findings illustrate how it was widely applicable to participants from various generations.

5.2.2.1 Complicating and complicated notions of possession

The case of social metadata, as a motivation for posting online, highlights how the notion of “possession”, in the ways it has traditionally been described, begins to break down in online places. When I talked to participants more closely about whether they ‘possessed’ this content, and how it compares to digital content they keep locally, or indeed physical possessions, I found that it begins to make people question what this means, and struggle to articulate it.

This is nicely summed up by P8 who describes how placing photos into his Flickr account both created deeply valued virtual things he desired to possess, while simultaneously prevented him from doing so:

“...When I think of my most important possessions, this is at the top of the list. But at the same time, I have no idea how to get them, not just the photos, but everything together. ...that’s where ‘possessing’ them breaks down. ... I want them, I’m entitled to them, and they’re there [motioning to screen] but do I have them? ...it feels like there’s this illusion that they’re mine. ...it’s a very strange thing that I do not know how to resolve.”

So, what does it mean to “have”, to “own” or to “possess” something? It is clear that the online world brings into question notions that people almost take for granted in

the material world. In fact, it may help to appeal to participants' orientations toward what it means to possess something in the physical world to see how those basic concepts are altered, undermined or made more complex once people's stuff begins to live on the network or in the cloud.

I examine how these basic, implicit assumptions are challenged. In doing so, I will show that two emergent themes run throughout: that posting something online, in today's world, can mean *relinquishing control* over the things that people care about, but also *losing awareness* of what exists, where it is, who has access to it, who is accountable for it, and what is being done with it.

5.2.3 Knowing possession and ownership

In the physical world, one of the characteristics of the things people possess is that they generally have some sense of what people own and where these things are, at least in some approximate way. People organize their possessions in containers, put them in special places, or at least have some loose idea of where something they value resides. At the highest level, people's homes, offices and even cars act as a kind of physical boundary around the collection of material things they possess, and within those people may have special places to further contain them, as against other members of the household, for example.

When it comes to virtual possessions kept online, there is no equivalent sense of a place where something resides, let alone a clear boundary to understand the limits of what belongs and does not belong to a person. Participants expressed concerns about not knowing "where" their data lives, what it means for something to reside online, and not really knowing where the entirety of their valued things might actually exist. In this way, notions of where one has things are entwined with knowing what one has. In other words, it is difficult to take inventory of what you own without knowing where to look.

An excellent illustration of this was given by P12, who had recently experienced a hard drive crash, losing her digital photo collection in the process. As it turns out, many of these photos were also on Facebook, and she had recently taken to copying the online photos onto the local hard drive on her new laptop:

"...I feel like I need to copy them somewhere, have them covered. ...I do that and I've done that and I don't even think about why I do it. I am scared of losing them, but I didn't realize it until I started talking, right here, consciously you know. ...I use the sentence 'I've got some photos', so I've said it, but I don't know really if I possess them, not until they're here [pointing at laptop], at least then I know where they are."

Despite her recent loss of data on her local hard drive, P12 was driven to move her things from an online place to her local hard drive to have a better understanding of where they are, which appeared in part tied to the experience of possessing them. Being aware of where something resides, and being able to point to that physical

place, reinforced her perception of owning those things, despite the fact it might be risky in the long term, as she had learned.

5.2.4 Having access when desired

In the physical world, another benefit of knowing where things live is that people can have quick access to them. A major concern voiced by participants centered on their perceptions that since they had no discernable control over the services that host the place(s) where their virtual possessions “live”, they might temporarily or even permanently lose access to them.

In all, 10 of 13 participants noted similar concerns. For example, consider P4’s discussion of her Facebook content:

“I have this fear that all of a sudden it’s going to get shutdown and they’re going to wipe [it] and I won’t be able to get it back. So it doesn’t feel like I’m fully possessing it, I mean I feel like it’s my information ...but it’s like I’m not in charge of it fully. Like it’s at the mercy of someone else.”

P6 similarly described a deep attachment to her travel blog, which she now thinks of as a travel memento:

“I put a lot of work into it, but it doesn’t feel exactly like mine because, let’s face it, that site isn’t going to be around forever. I’m thinking to back it up, but how do I do that? If I put it on a CD it’s probably going to get lost.”

The teenagers I interviewed in this study all used social networking sites, uploading digital photos, among other things, frequently. All three teens, along with P6, reported maintaining minimal digital photo collections locally, generally opting to delete photos from their computer, camera, or phone after they had been uploaded. Discussions revealed these participants generally considered their online content would last indefinitely into the future. However, they did raise other concerns, when reflecting on differences between their access to and control over their material possessions compared to their digital things online:

“What if Facebook would block me from coming in or didn’t recognize me ‘as me.’ I might never get those things back. I’d be distraught. ...With Facebook, there are so many things on there that are important to me but they’re different than my [physical] things because there’s this chance I’d never be able to get to them. That fine line can change a lot about how I think of them. It’s like possessing them, but not quite.” (P2).

Alongside fears that services or organizations might block access to people’s treasured digital things, the following poignant example shows that this can also happen because others may have rights over content that undermine your access. P5 described how the deletion of his departed friend’s Facebook account (by the bereaved parents) also erased the social metadata his friend had created previously:

“Those comments were a big part of what I had left from him. ...his personality really came out in them. ...Now they’re gone, just gone and they can’t be replaced. Even if I could get them back, it wouldn’t be the same. It’s not just the text ...it’s the time he wrote it, the day he wrote it. It’s like this marker of him and it all came together into something special. ...made me realize how fragile things online can be.”

What I want to highlight across these instances is that while it came naturally to participants to describe their material things, they often struggled to articulate how these orientations mapped to their virtual possessions in online places. Specifically, this helps illustrate how participants simultaneously had deep convictions that their online content belongs to them, while feeling ambivalent over whether access to them would continue to persist. This appeared, in part, to be due to a loss of control—participants could control what was stored in and presented through their online places, however higher level concerns over how these places would endure appeared to unsettlingly place their contents, as P4 put it, *“at the mercy of someone else.”*

5.2.5 Being accountable for care and protection

A related issue is that knowing where something is kept is often bound up with a responsibility to care for and protect those objects. In other words, it is not solely a matter of knowing where things are, and being able to access them when desired, but there is accountability implicated in many things that are possessed. This can be a duty to keep those objects safe for someone else’s sake, or to pass on to future generations (Odom et al. 2010; Kirk and Sellen, 2010). What the interviews revealed was that keeping things online in some sense hands that accountability over to some unknown, unseen entity—and further that people may have very little faith in its persistence or reliability.

These issues were highlighted by three participants in possession of digital content that they had acquired from departed friends or family members. In one instance, P9 described how her lack of trust in online services complicated transitioning digital photos and documents from her father’s computer to the cloud:

“I felt like I needed to protect it ...[put] it in a special place. ...I did think about putting it online, but it didn’t feel right. ...It probably wouldn’t [disappear], but who knows? ...What if it was accidentally erased? ...Those are chances I can’t take.”

When probed further on the very real possibility that the hard drive in her personal computer could crash, she pointed to a higher level moral concern:

“I know my computer could die, but at least it would be on me. ...it’s my responsibility to take care of it. Leaving it up to a website, there’s no guarantee it’s going to stay around. I can’t live with that.”

As another example, P8 described complications after uploading digital photos that had belonged to a departed friend to his DropBox.com account:

“My first thought was to put them on DropBox, like if my computer dies, they’ll be somewhere else. Then this whole thing came out [about] nothing on DropBox being safe and heaps of people’s accounts weren’t as private as they thought. ...I had this wretched feeling, like I was being lazy about him. ...I took them down immediately. ...They’re backed up on my [computer] hard drive and on a CD. I’m more in command of their destiny.”

What is interesting in both of these examples, (and in P12’s earlier reflection on backing up photos onto a new hard disk after the old one died), is that having data in some physical form appears to reinstate a sense of responsibility and control over it. This is despite the fact that such storage devices can and do become corrupted.

As a final example, P5 was in possession of five digital photos downloaded from Facebook that a friend had tagged him in on the same day of his accidental death. His reflection further highlights how a lack of awareness and control diminished his sense of guardianship over this content:

“...there’s all these contradictions with putting something of that weight online because there’s a need to watch over it. ...[but] there’s this sense that it’s more out of my hands. Maybe someone copies it, or it gets deleted, or gets harder to find. ...maybe nothing happens, but it’s about the fact that when it goes online it is in a situation where all those things become possible.”

What is interesting about this last example is that it draws attention not just to the issue of personal accountability, but to the issue that the uncertainty about handing over care of cherished data to an online entity is potentially exacerbated by the actions of others. It is this issue that I turn to next.

5.2.6 Giving access or rights to others

One aspect of possessing a material thing is that there is some level of implicit control over others’ access to it. In other words, if a person possesses something, then she or he has the right to alter that thing, or to give or loan it to someone else. On the flipside, others have no rights to alter, take, or borrow a person’s possessions without permission. Again, this is an issue that becomes more complicated in the online world.

Part of this owes to the fact that digital things can be copied. Those copies can easily be controlled by someone other than the original owner. This is illustrated in the following example where P12 described an undesirable experience she had on an online dating site:

“I used to be on a dating site and I had a photo of myself on it. ...after a disagreement, a man I’d been talking to took it from my page. He sent me a message saying, ‘If I can’t have you, at least I can have your picture on my computer.’He put it on his desktop [background image]! ...that was ‘my’ page, ‘mine’, he shouldn’t have been able to do that! I couldn’t get rid of it [on his computer] because it’s not ‘mine’ anymore. ...I possess the original copy, but that doesn’t feel like mine anymore because of what happened.”

Similarly, P1, one of the youngest participants, described how lack of awareness of the duplication of photos online could shift perceptions of possessing them:

“...the real way you can keep some possession of a photo online [is] knowing who can look at it. ...once someone has viewed it they take some possession of it, but if I am the one letting that happen, then it’s still mine. ...but if someone gets the photo without you knowing, then I don’t know if you can ever really get it ‘back’. Because who knows what’s going to happen with it once they get it.”

In a more drastic example, P5 described the experience of having his house burgled in comparison to when possession of his Facebook account was temporarily assumed by an ex-lover and his personal content was altered:

“When [my account] got hacked, it’s more like they came in and dressed me up in a weird way that’s not quite me. ...so it is weird, like getting burgled with everyone watching but not realizing that someone else is making me look different.”

These instances highlight how the fact that digital content can be taken, copied, or otherwise appropriated by others profoundly undermined participants’ notions of possession. Clearly part of the complexity bound up in these examples is tied to the ‘public’ and ‘semi-public’ online places they unfold in, where digital content is visible to anyone (e.g. travel blog) or select subgroups of people (e.g., social networking sites). Nonetheless, these complications were in part due to the affordances of digital media and its inherent reproducibility. They were also the function of the lack of awareness of the actions of others—not knowing who had access to personal content, who at looked at it, and who had appropriated it—as well as lack of control over all of these aspects of the data. This is summed up nicely by P5’s reflection on his photos and social net- working content spread across Flickr and Facebook:

“I ‘have’ them so ‘I should have access to them and be able to decide who else does too. ...but once it goes online it, it’s like a void. ...who knows where it will go, or really where it is. ...For me possession is about knowing my things.”

5.2.7 Being able to dispossess

A key property of possessing a thing is the ability to relinquish possession of it. Whether by throwing away love letters or deleting digital photos on their computer, all participants described experiences of relinquishing possession of things they no longer wanted in their lives. In all but two interviews (P1, P3), stark contrasts to these instances emerged as participants described how these processes unfold in online places. For example, P12 describes relinquishing possession of photos on her computer compared to on Facebook and Picasa:

“...online, well I can try to delete something, but who knows? Who deletes the deleted? Where does it go? I don’t know, but I don’t think it disappears, and that’s odd come to think about it. ...You can’t very well possess something if you can’t ‘unpossess’ it.”

P5 describes recurrent complications experienced as he compares relinquishing possession of material things symbolic of a past relationship to similar digital things on Facebook:

“all of a sudden a photo of my ex comes up that she’s tagged me in and I want to be done with it and I’m trying to get rid of those things. ...In the real world, I removed these stimuli from my life. ...[online] it can feel impossible.”

P4 similarly described how she fully relinquished material things associated with a past relationship, while similar associations continued to linger on Facebook. She concluded the discussion with this reflection:

“There’s this ironic thing about the idea of possessing something online. ...you can feel like you can’t really ‘have it’ but then when you don’t want it, it’s not always so easy to get away from it.”

P4 provides a salient point capturing the complex nature of possessing digital things online: when possession begins and ends, particularly as it is understood in the material world, can remain highly ambiguous in online places that are neither entirely ‘public’ nor ‘private’.

5.3 Discussion and Implications

It is clear that people’s notions about what it means to own virtual possessions can be both complicated and difficult to articulate—difficulties exacerbated by the shift of personal data to the cloud. A key contribution of the study described in this chapter is to present evidence that helps illustrate just what these are. What should be clear is that, even though people may deploy different strategies, the choices people make reflect a common set of concerns and orientations. It seems too that commonalities in the concerns and strategies described through this study can be understood with reference to how people think about and deal with physical things. Either this is because there is something fundamental about the link between materiality and possession, or it is that such notions are so deeply embedded in people dealing with the physical world that people cannot but help use them in their dealings with the digital. Nonetheless, some of the properties of the virtual are themselves so new that no analogue for them can be found (a notion I will further unpack in chapter 9). This helps makes the case that the HCI and interaction design communities needs to develop new ways of thinking about properties of virtual possessions, which in turn could help in better articulating ideas, models, and architectures to support ownership of virtual possessions in the future. At the same time, when translating notions of possession from the material to the online world causes difficulties, there may be ways of leveraging concepts of physical ownership to improve the way people deal with virtual materials.

One powerful motivation for putting things online is to share them with others. Material things are of course shared too, but the virtual allows new forms of sharing.⁷ This sometimes alters the thing itself in ways that are more difficult to achieve with material things. For example, the history of some real artifact can be reflected in the markings that give it a patina. But who made the markings or why they were made is often lost over time—the markings cannot tell that tale. But, social metadata may be much richer in that respect: the residue they leave may allow for much deeper interpretations of doings-with-the-object that can change people's perceptions of the digital things in question.

It is not all positive. Placing things online can have perplexing effects for people, in particular when it challenges ingrained notions about material things. This includes the fact that material things reside in places—places that one can control access to, and keep safe if need be. Possession becomes a difficult concept when the thing possessed has no geographic locale. This issue shed light on how deep concerns and unresolved tensions can emerge when valued things have to go online—this can mean relinquishing control over that thing, and this itself implies something about the 'owners' competence.

The reverse of knowing where something is, is knowing that something is gone. In the physical world, once something is destroyed, it no longer exists. In the online world, the notion of deleting something is undermined when objects can be replicated many times over. The irony here is that the very thing that may drive people to put things online, to share them, leaves those materials susceptible to the actions of others. All of this has implications not just for a person's sense of control of digital objects, but their awareness of them: location is no longer a resource that can be used to judge the safety of a thing. Likewise, absence in a location is no guarantee something no longer exists.

There are many other such complications. Some are paradoxical. For example, putting things online is most often done to make them available to oneself or to others. But it can also raise the possibility that access to those things will temporarily or permanently cease. Part of the fragility of online things is not a mirror of the delicate nature of local hardware, such as the PC. It is because of the apparent arbitrariness of the services and service providers, as well as network fragility. At least with a PC, a person can own responsibility for damage to it; with the cloud, there is often little knowing why access is denied.

The point here is that online digital things (or even online places) break "the rules" of how people understand possession of material things. Further, these are issues that seem not to overly concern people in their day to day lives. Not, that is, until something unsettling happens. Just as with a car, ownership of it does not really preoccupy the owner until the day their car is stolen. Likewise, it is when a hard disk

⁷ See Belk (2013) for an additional discussion of how digital technologies are enabling new kinds of sharing as it relates to identity construction processes.

fails, a photo is appropriated by someone with mal intent, or when one suddenly loses access to the things they care about that these complications dramatically and quickly emerge. Apart from such events, people's feelings about digital ownership are better described as either uncertainty or uneasiness, revealing themselves very much in the process of asking participants to reflect on their own experiences and perceptions.

5.3.1 Design Considerations

How might interaction designers and researchers think about new ways to design cloud technology? One approach could be to create better digital rights or digital identity management solutions, or through more secure storage systems. However, such incremental enhancements may only further burden people's interactions with the cloud and potentially further complicate notions of ownership. The sensitive and complex issues outlined above suggest that it might be worthwhile to re-examine how people interact with the cloud and with the virtual things they keep there in a more fundamental way. Next, I outline several design considerations emerging from this study that suggest areas for future research. Some of these have to do enabling people to have better control over the virtual possessions they care about, and others focus on augmenting people's awareness of interactions with their stuff. Other ideas suggest potential ways forward may center on proposing new properties for files, ones that extend beyond today's file types.

Knowing what you have—What would it take to give people back a sense of “having” a collection of virtual possessions, of feeling ownership? One of the main findings was that a lack of awareness of the totality of a person's digital assets was a major factor in undermining a sense of possession. This was in part due to the fact that these materials “lived” in many different places—in fact too many to keep track of. A workaround for many was to create local copies of possessions kept in online places to be able to give these materials a sense of place on a hard disk, or on CDs in a shoebox, even if this could be a risky strategy in the long run. For one thing, this potentially complicates the situation for people grappling already with too many copies of too many things (Feinberg, 2013).

A different approach is to bring together interaction designers and systems developers to create a circumscribed but virtual place where all of the virtual assets one cares about are represented. In other words, this could be a representative place where ‘my stuff’ can be found, even if, in technical terms, it exists on many different servers, or many applications. Such a collection or visual inventory would allow these materials to be browsed through, giving users a sense of what they have. Critical here is that people could also use this as a way to find where the original objects can be located. In other words, objects in the inventory can be interrogated and used as quick ways to navigate to the place where the data resides, offering up access to its original context, metadata and so on. Such an approach could help reinstate that essential sense of awareness that people wish to have, while offering up

the control they need to be able to find the objects they care about. This direction also opens up questions about how different forms and presentations of a person's virtual inventory could shape interactions with and perceptions of it, and how they could be embodied through applications, devices or appliances.

Retaining guardianship—Another issue that arose was the need for people to have some way of caring for and protecting certain kinds of virtual possessions, without depending on some other entity for guardianship. The findings showed participants had a strong desire to be accountable for safeguarding significant digital materials for future generations.

One approach to this would be to propose a new kind of file property that could be called *permanency*, which would provide the capacity to make a virtual possession incapable of being deleted and thus to ensure its safety. There are, of course, Web services that offer this kind of security, but this is to place the trust in some organization “in the ether”, something participants were clearly concerned about, especially for their most sensitive materials. I propose instead that the possessions themselves and the architecture of where they are stored should have demonstrable properties that prohibit or make especially difficult the destruction of them. These immutable file types and how they might be constructed will of course be a technical challenge, but the essential value of them would be to place control over guardianship back in the hands of the owners of the data. Additionally, recent work outside of HCI (Mazurek et al. 2012) has described new techniques for interfacing cloud computing with personal networks and devices. Those techniques could be used to create ‘private clouds’, where cloud services obtain ‘leases’ from the user for how long their data can be ‘used’ and when the cloud-based caches of this stuff expires. These advances could potentially enable people to backup the files they care about simultaneously on multiple devices, and thus deeply safeguard them, while, in a sense, still keeping them ‘in the cloud’—suggesting a body of work that could be productively drawn on in the service of future research in HCI.

Giving rights or access to others—A core motivating factor for putting things online is to share them with others. These actions occurred through various platforms, such as email services, social networking sites, and personal blogs; they offered opportunities to connect with people and in some cases accrue social metadata. The act of sharing online can also transform the thing in question when this metadata comes to extend the meaning of that originating object or stuff. The thing then becomes something that is collectively possessed. Yet this can be problematic, leading to confusions over ownership and uncertainty about the actions of others in relation to an object, such as whether it has been copied and so on.

Here, it might be valuable to devise a means by which people can retain some sense of the originating file, and of the life history of an object: allowing shared possession but pointing in some way to the original object. In a sense, this could extend a representation of a virtual possession to people without fully relinquishing it to them.

If a person can extend such rights to people for joint ownership, it must also be possible to withdraw those rights. People's ability to give up their rights to access virtual things is dramatically underdeveloped in online places. Current architectural design in many systems provide little choice other than letting data persist on the network or removing it completely, which, as illustrated in through this study, can have significant consequences for the people invested in these things. There is a need to more sensitively handle the nuanced social connections among people. In some cases, this might mean removing connections among some people, while retaining others.

Another approach would be more focused on awareness rather than different mechanisms for control. In this approach, people can query any object they own to view other people's actions in relation to that object. In doing so, they can find out who else has made copies, who has modified an object, who has added metadata, and so on. This would be a kind of *object lens* enabling people to interrogate their virtual possessions to see what has happened to them, and who has interacted with them. This obviously raises some challenging issues for privacy. But, it might be that the owner or creator of the "original" possession has certain rights or priorities to view subsequent actions upon that thing, as is the case now with many online services.

Being able to relinquish possession—A final aspect of ownership, confounded by the online world, is the right to get rid of something that one owns. People might be able to remove material possessions from their lives that evoke memories they wish to forget, however people may be peculiarly unable to free themselves of these things in the digital world (Mayer-Schoenberger, 2011). Collectively, there is a clear need for people to be able to permanently dispossess things online (Sas and Whittaker, 2013).

Just as virtual possessions might have properties that make them permanent, so should it be possible to delete them forever from the context of an online system. In part, this requires that these kinds of possession keep track of actions done to them, and copies taken from them, making sure that this network of relationships is bound up with the action of permanently deleting that thing. Moreover, such possessions should enable people to see that this is possible, so that if they want to keep copies, one must negotiate the right to do so. This could be applied to not only virtual possessions (e.g., photos), but other data created as a result of interactions, such as social metadata or machine-produced metadata (e.g., timestamps, frequency of views). Emerging work in the Systems community, such as the Vanish project (Geambasu et al. 2009), is beginning to develop new techniques that could help address some of these concerns. More generally, this and the other considerations I have outlined suggest that there is a significant opportunity for HCI and Systems researchers to work together in developing new interventions that could influence the design and implementation of cloud-based systems.

5.4 Conclusion

The study described in this chapter explored how a reasonably diverse sample of people perceived and interacted with their virtual possessions in the cloud. A goal of this study was to focus specifically on the cloud environment to explore how it shapes people's fundamental notions of what it means to 'possess' their virtual possessions. This study uncovered complex and paradoxical ways that the cloud can open up new opportunities for people to construct new value and meaning with their virtual possessions, while, at the same time, complicate these processes by calling into question the nature of the possession itself. Based on findings from fieldwork, I outlined several design considerations that could potentially support people with higher levels of control over and awareness of their virtual possessions, without comprising some of inherent value enabled through keeping them online.

On a more general level, this research illustrates that the 'materiality' of virtual possession is of prime importance for future HCI research. This turns around the subtle and delicate properties associated with the term *possession*. Through this chapter, I have illustrated that 'to possess' is not merely a noun nor a verb, but a complex set of actions that transform the relationship between a thing (virtual or material) and a person. Like material possessions, virtual ones too play an important role in how people assert their identity, realize their aspirations and interconnect with the lives of others. It is no surprise, then, that as people of contemporary interactive technology increasingly engage with their virtual possessions, seeking to place them in secure storage, sharing them with others, and sometimes wanting to know 'who has them' or 'where they have gone', that they end up worrying about rather profound issues. In the next chapter, I broaden my scope of investigation to explore young adults' perceptions of their virtual possessions across sites in Spain, South Korea, and the United States. Interestingly, several themes emergent in the study described in this chapter will also surface in this larger field study.

6 Fragmentation and Transition: Understanding Perceptions of Virtual Possessions among Young Adults in South Korea, Spain and the United States

My prior research described up to this point in the preceding chapters helped unpack a general perspective of virtual possessions as a research topic for the HCI community. However, virtual possessions remained difficult to characterize. Part of this complexity owes to the fact that virtual possessions are *placeless* in that they can be accessed anywhere and lack physical presence. They are *infinitely reproducible*, often with no distinction between an original or a copy. They are *formless* in that they can easily be mashed up with other things to match specific devices or applications. These qualities make virtual possessions seem less like material things, and make it difficult to obtain a sense for what they are and what they could—or should—be. Additionally, relatively little is known about how people construct value with their virtual possessions and little research has explored this topic outside of contexts in the United States (US) and United Kingdom.

To advance a more cross-cultural understanding of people’s value construction with their virtual possessions, I led a fieldwork project that included in-home interviews with 48 young adults at sites in South Korea, Spain and the US.⁸ Young adults were selected to focus on as they occupy a transitional life stage; they are still engaged in exploring who they want to become (Erikson, 1980). They also have had the opportunity to acquire large collections of virtual possessions. My goal was to gain

⁸ This chapter is adapted from a paper published at the CHI '13 conference (Odom, W., Zimmerman, J., Forlizzi, J., Higuera, A., Marchitto, M., Canas, J., Lim, Y., Nam, T., Lee, M., Kim, D., Row, Y., Seok, J., Sohn, B., Moore, H. 2013). Other portions of this work have appeared in two other papers published in the proceedings of IASDR 2013. (Seok, J., Kim, D., Lim, Y., Nam, T., Lee, M., Lee, Y., Row, Y., Sohn, B., Zimmerman, J., Forlizzi, J., Odom, W., Higuera, A., Marchitto, M., Canas, J., Moore, H. 2013), and (Lee, M., Nam, T., Lee, Y., Row, Y., Lim, Y., Kim, D., Seok, J., Odom, W., Zimmerman, J., Forlizzi, J., Higuera, A., Marchitto, M., Canas, J., Moore, H. 2013.).

insights on how virtual possessions are incorporated into young adults' everyday lives in these various cultural settings, and where similarities and differences exist.

The fieldwork described in this chapter revealed that young adults typically lived in “unfinished” spaces, with many of their most precious material possessions packed away or fragmented across other geographic locations. Participants desired to interact with their virtual possessions in terms of the activities and events that made up their life story or in terms of important social relationships. They drew on their virtual possessions to explore life aspirations; however, the social appropriateness around these practices varied across countries. Finally, this group experienced significant fragmentation of their virtual possessions, including having their possessions spread across many cloud services, having precious virtual things trapped on old devices, and due to the challenge of combining material and virtual things into a hybrid collection.

The research described in this chapter makes two contributions. First, it provides one of the first studies conducted at multiple sites in the world exploring people's value construction practices with virtual possessions. Second, it advances current understanding of how people construct value with their virtual possessions in the context of the HCI community and outlines several opportunity areas to guide future research and practice.

6.1 Field Study Method

This field study involved conducting in-home, semi-structured interviews with young adults in South Korea, Spain and the US. These sites were selected because they represent three large regions (Southeast Asia, Southern Europe, and North America), they have distinctly different cultures, and they have general similarities in terms of technology accessibility and infrastructure. The international research team undertaking this project was based across three universities at sites in these regions: Korean Advanced Instituted of Science and Technology (Dajeon, South Korea), University of Granada (Granada, Spain), and Carnegie Mellon University (Pittsburgh, PA, US).

As a whole, the research team was interested in how technologies and services get adopted into these different local settings and, in particular, how these processes shape young adults' value construction practices on a rich, descriptive level. This approach has limitations; for example, it makes the results difficult to objectively generalize beyond participants' experiences. However, considering the paucity of work on people's value construction practices with their virtual possessions, I wanted to begin with a small population in order to gain a descriptive understanding that can drive future research.

48 participants (8 male and 8 female per country) were recruited using flyers posted in public locations, online advertisements and by word of mouth. All participants were young adults aged 25-35 years old. This group was selected for several reasons.

First, they are making a transition from pre-adulthood to early adulthood (a phase that can last up to between the ages of 40-45 years old (Erikson, 1980)). In this transition, they are beginning a more independent life, forming new family and romantic relationships, and establishing a niche in society. Throughout this process, young adults draw on their possessions while pursuing personal and professional aspirations, and to live out or bury aspects of their emerging adult self (Erikson, 1980). This trajectory of social change could provide valuable insights into how virtual possessions are integrated into young adults life story construction practices, and comparative similarities or differences to material things.

Participants were technologically similar. All used computers relatively frequently, maintained at least two online accounts (e.g., email, Facebook), and owned smartphones. Across countries, participants exhibited a range of occupations including construction worker, actor, yoga instructor, nurse, house cleaner, lawyer, accountant, and electrical technician; none were fulltime students.

No participants had children. Prior research has shown that having a child can substantially alter one's growth into adulthood (Nomaguichi and Milkie, 2003), causing a shift to family- oriented construction of identity, which is often reflected in presentations of possessions in the home (Csikszentmihalyi and Rochberg-Halton, 1981). Parents were excluded from this study to better understand how young adults draw on virtual and physical possessions for self- growth and value construction.

Semi-structured interviews were conducted in participants' homes that lasted between 1.5 to 2 hours. Interviews were conducted by local researchers who had a native understanding of the language and culture. Interviews aimed to develop an understanding of each participant's orientations toward their material possessions, locally stored virtual possessions and virtual possessions appearing in online places. Participants were first asked to describe and show us their precious material things (e.g., "If your house was burning down and you could grab five material possessions you couldn't live without, what would they be?"). Next, participants were asked to describe their precious locally stored virtual possessions. This was followed by a similar tour of their things online. Participants were asked to compare and contrast their material and virtual possessions, paying close attention to the language they used to describe similarities and differences. A special emphasis was placed on how participants' possessions, both virtual and material, became valued, meaningful things in their lives.

The interview protocol for this project was iteratively developed in English with participation from all three research teams. After several rounds of critique and pilot interviews, the final protocol was translated into Korean and Spanish by local teams. All interviews were audio recorded, producing 70+ hours of content. All recordings were transcribed. Researchers took field notes and documentary photographs during each interview. Field notes were reviewed immediately following each interview, and tentative insights were noted in reflective field memos (Glasser and Strauss, 1967).

Weekly international conference calls were held to discuss emergent findings and general progress.



Figure 1. An image from the five-day workshop held at KAIST University in Dajeong, South Korea.

Analysis of the data was an ongoing process throughout the study. Each country-specific team individually conducted preliminary analysis, searching for emergent patterns and themes across field notes, recordings and photos to draw out underlying themes (Miles and Huberman, 1994). All teams then gathered for a five-day data analysis workshop. This was also a highly iterative process (see figure 1). Country-specific teams presented their own analysis on their country's data to each other. During this workshop, all teams also explored and analyzed the raw data documents that had been coded during preliminary analysis and translated into English. The research team collectively created conceptual models and affinity diagrams to reveal unexpected connections and differences among participants. Discussion of design implications followed, with emphasis on observed similarities and differences between countries. In the following sections, several examples taken from field observations are present that help illustrate the themes. I refer to each participant by her or his sex, participant number, and country (e.g., M1-Spain stands for Male 1 from Spain).

6.2 Findings

Interviews and observations revealed a range of insights on young adults' lives. Korean participants had an average age of 30.0 (SD=1.78). They worked at least eight hours per day and had long commutes. None owned a car due to both cost and traffic. Most had experienced difficulties in finding work and many had moved away from their family (in some cases their spouses) for work. Only three lived close to

family, and all reported using various devices and services to keep in touch with loved ones.

Participants in Spain had an average age of 31.2 (SD=3.32). They usually worked between six to eight hours per day, and the workday was often divided by a two-hour lunch and siesta. Nearly all had experienced trouble gaining full employment, and many were unsure with the stability of their current job. The majority lived within walking distance to family members and friends, and they would see and interact with them frequently at homes, cafes, and bars. Many speculated that they might soon need to move away from their life long hometown in order to find work.

US participants had an average age of 28.5 (SD=2.4) and described working at least eight hours per day. Almost all owned a car and had been employed in their current job for over a year. Roughly half had family members within the metro area, which they visited at least once a month. The other participants, with family farther away, also frequently used devices and services to stay in touch with loved ones.

No participants owned their own home. US participants had larger residences and the largest amount of cherished material possessions that extended deep into their pasts. These were usually kept out of sight in drawers, under beds, or in closets. Participants in Spain and Korea tended to keep smaller collections of sentimental material possessions on hand, while storing the bulk of these things at their parents' houses or apartments.

Interestingly, almost every residence observed in this study had an unfinished aesthetic; participants had not taken much authorship of their space. Nearly all participants talked about their current residence as temporary, even though many had lived in the same place for several years. They all had uncertainty in their lives in terms of employment, intimate relationships, and/or current city of residence, and many were looking forward to a future “home” once the uncertainty subsided. Collectively, these findings match prior research on the transitional nature of young adulthood (Erikson, 1980).

Participants engaged in value construction activities with their cherished possessions — both material and virtual — in terms of events, activities, and relationships that made up their life story. When creating collections related to a person, event, or activity, they often experienced a sense of fragmentation that complicated their work. This happened in a variety of ways. Virtual possessions, such as SMS messages, could get trapped on old or non-functioning devices. They also struggled to integrate virtual possessions of different types together (such as digital photos and SMS messages), and to integrate their virtual and material possessions into holistic collections around an activity or person. Additionally, participants experienced anxiety over how their virtual possessions were fragmented across the different cloud services they use, and how these services could complicate their sense of ownership and control over these things. Interestingly, across cultural groups I found many

more similarities than expected, which I detail in what follows and reflect further on in the conclusion of this chapter.

6.2.1 Unfinished Aesthetics and Transitional Situations

It was evident that participants had not exerted strong authorship over their domestic environments. Participants commonly perceived they would be ‘somewhere’ else soon, while also grappling with, as M1-Spain put it:

“the future [being] totally full of uncertainties.”

Participants also commonly perceived they would be ‘somewhere’ else soon where, as M3-USA stated:

“my things and honestly my life direction will be more together again.”

These sentiments, in part, were manifested through a lack of decorations or possessions on display in domestic settings. While participants in the US had the largest collections of material things, it was common across countries that cherished material possessions in participants’ homes were packed away in deep storage (Kirk and Sellen, 2010), archived in boxes tucked away in closets or shoeboxes hidden under beds. For example, F2-USA, whom had lived in her current home for over two years, describes her motivation for keeping cherished things out of sight:

“It’s not that I don’t want to see those things. They’d help me feel more settled as a whole. ...I’ve been living in this state of transition for a few years now. ...even to me, this place looks sterile. ...It’s where I’m at right now.”

This statement is exemplary of behavior witnessed across interviews. Participants frequently characterized the unfinished, fragmented qualities of their living environments as reflections of their transitional life stage.



Figure 2. From Left to Right. (A) F3-Spain’s apartment in a holding pattern, neither packed nor unpacked, (B) F8-Korea’s apartment with only a handful of material things without anything occupying the walls, (C) F2-USA’s underdeveloped bedroom aesthetic did not reflect her personality.

Nearly all participants also deeply valued the lightweight nature of their virtual possessions:

“I have my eye on the future ...and I’m going to be moving. ...I don’t want to give up special things that remind me of great memories. I can’t exactly lug around photo albums. ...my [virtual] things

are significant because I can keep acquiring things that remind me of my experiences without being weighted down” (F3-USA).

In several other cases, participants explicitly valued the ability for their immaterial things to be available across geographical settings and, as F8-Korea stated:

“I can revisit them anytime without locational limitation.”

These reflections help capture how participants valued the nature of their virtual possessions in relation to the current and anticipated future demands of their transitional situations. Young adults valued the ability to continue acquiring artifacts highly symbolic of life experiences without some of the hardships associated with material possessions, and that their virtual archives had the capability to fluidly travel with them to their future, unknown destinations.

6.2.2 Life Story-oriented Possessions

While the domestic settings observed in this study were sparsely decorated, young adults did describe a range of beloved material and virtual possessions. All participants drew on key possessions as resources to explore or re-enforce where they wanted to go in life and who they wanted to become. These possessions frequently took the form of curated collections. Examples included book collections, RSS feeds, material and virtual archives of prior academic work, and archives of material and digital images that depicted desired future situations, such as getting married. Additionally, collections of digital images depicting cities associated with their next major life change (e.g., New York and Seoul) were common among Korean and US participants. These images often occupied backgrounds of computers and mobile phones, and were changed frequently.

This trend was notably less common in Spain. Here, many participants instead expressed anxiety about moving away from their childhood home to find employment. At the time of the study, Spain had an overall unemployment rate of more than twenty percent.



Figure 3. From Left to Right. F4-Spain’s archive of annotated cinema tickets, M5-Korea’s photos ranked to signify which one’s ‘best’ captured life experiences, F4-USA’s LCD snow globe housing sentimental photos kept in a hybrid archive of material and virtual possessions.

Participants commonly described these collections of aspirational possessions as unfinished and ongoing. For example, F4-USA describes the ‘aspiration board’ she created, which was one of the only things on display in her living room:

“It shows a lot of things I want to accomplish in my life. ...getting married, owning my own yoga studio. ...it keeps me balanced, reminds me what I want to do. ...I always thought when I finish it I’d save it and start a new one, but it’s not done yet. ...There are things I’m still trying to figure out about myself and my future.”

While this quote portrays one of the most complex examples encountered in this study, it is exemplary in how it captures the unfinishedness we observed across aspirational collections.

Aspirational possessions were also projected through social networking sites. However, the perceived social appropriateness of this action emerged as one of the biggest differences I encountered across countries. In the US, many participants reported productive outcomes emerging from this behavior. In these cases, young adults notified people in their social networks about new progress toward, for example, completing a marathon or receiving a new professional certification. US participants commonly reported a core motivation for this behavior was to acquire comments and ‘likes’ from people in their social network.

Research teams from Korea and Spain noted that it was considered inappropriate to project personal aspirations to social audiences in their cultures. These conventions have different motivations. The Korean research team noted that it would be highly undesirable for young Koreans to appear explicitly ambitious among their peers. This may be due to tensions produced when values of individualism are introduced in collectivist-oriented cultures, such as Korea (Hofstede, 1980). The Spanish research team noted that its Catholic-influenced upbringing and culture made it inappropriate for young Spaniards to express a strong desire to want more than others have. This matches findings from prior research on Roman Catholic countries (including Spain) illustrating strong trends in social values emphasizing conformity, tradition, and benevolence toward others, over self-direction and self-achievement (Roccas and Schwartz, 1997). Interestingly, in both Korea and Spain, participants maintained private collections of aspirational possessions online, whether through diary-oriented blogs or private personal homepages (e.g., via Cyworld.com) containing images, videos and text entries that could only be accessed by the owner.



Figure 3. F4-USA's unfinished 'aspiration board' on display in her living room.

All participants also reported being most deeply attached to material and virtual possessions capturing their life experiences, which helped develop their life story. Participants frequently described using these objects as resources to reflect on past experiences and construct a sense of who they are. These possessions were broad, including material collections of cinema and concert tickets personally annotated with details, annotated diaries and scrapbooks containing photos and mementos from trips, large digital photo archives, and, in some cases, archives of virtual correspondences with loved ones, and snippets of significant social networking content (e.g., a Facebook wall screenshot). Archives of digital metadata also emerged across discussions. These things included metadata related to personal interests, such as records of accomplishment logged via computer games and music playlists illustrating changes in personal taste. They also included shared metadata constructed with other people, such as comments and 'likes' attributed to social networking content and rankings of 'the best' digital photos capturing a particular experience or event.

Observations and interviews with participants indicated that *fragmentation* affected their cherished material and especially virtual possessions in disruptive ways. As young adults struggled to transition to a more holistic sense of self and a more cohesive living situation, they desired a similar cohesiveness reflected in the organization and use of their valued possessions. Their virtual things were fragmented across devices, systems and online services. This complicated young adults' desires to adapt virtual possessions to existing value construction activities with their cherished material possessions and, in particular, their work to create more holistic archives around a person, event or experience. These breakdowns prompted participants to develop innovative workarounds to better support their values and desires.

6.2.3 Workarounds to construct holistic archives

An overarching theme across interviews centered on participants' practices of creating holistic archives of cherished possessions, which captured life experiences, events and close social relationships. Interestingly, few participants drew concrete distinctions between their material and virtual possession; they typically saw them as significant parts of their life story that belonged together. Moreover, participants regularly expressed how valuable cohesive archives of significant possessions were, as opposed to individual elements, would be:

“I want them to be separated from all the lesser [meaningful] stuff. But also, it’s kind of like they’re more valuable if they’re together. They tell the bigger story of who you are. ...Now I have so many digital things, it’s not very easy to do. Can feel downright impossible” (M2-USA).

This reflection helps capture participants' desires to collate cherished possessions to create hybrid archives (Kirk and Sellen, 2010), and how this process in itself could function as a value construction activity. However, the fragmentation of virtual things across obsolete and working devices and online services disrupted these kinds of activities, making it difficult to impose the same kind of structure and organization to valued virtual possessions as compared to material things.

In spite of these breakdowns, I observed several attempts to create more holistic archives. The first, and most common, involved materializing virtual possessions. In many cases, participants made material copies. This included printing and binding volumes of sentimental email correspondences or selected collections of cherished digital photos. In the extremist case, F4-Spain described writing out by hand an archive of SMS messages that detailed the progression of her current romantic relationship, which filled four A5 format journals. However, all participants across cultures reported either dramatically slowing down these practices or abandoning them altogether. This was due to the cumbersome work required to produce material copies of virtual things, and the increasingly unmanageable size of the physical materials produced.

The second approach I observed involved the virtualizing of material possessions. This workaround was typically achieved through creating digital images (e.g., via a digital camera or scanner). Participants described this approach as a way to create virtual representations of cherished material possessions, which they were geographically separated from. I encountered several instances in which US and, especially, Spanish and Korean participants had meticulously created virtual copies of analog photos kept at other loved ones' homes. A variety of other virtualized possessions also emerged across this study, which included personal diary entries, archives of schoolwork and awards, newspaper articles featuring the participant, large-scale artworks, and musical instruments. While most participants maintained this approach, several concerns emerged around the authenticity of a virtualized material possession within the archive. For example, M3-USA reflected on images of his guitar (currently stored at his parents' home):

“...obviously it’s not the real thing. It’s more a reminder of when I was in a band and how I want to keep pursuing music once I’m somewhere I can have it. ...it’s not just the photo, but that it’s in this folder with other photos from that time in my life. ...having it in there creates a collection of experiences together. That’s what gives it value” (M3-USA).

This reflection highlights a perception common among several participants: a cherished material possession, when virtualized, transforms into something else that can be deemed valuable and meaningful through its relationship to other life story-oriented virtual possessions in the archive.

The final workaround involved the integration of archives of virtual possessions with pre-existing archives of cherished material possessions. While this approach was the least common, it provided salient insights into how virtual things might extend to existing practices with cherished material archives. Several participants used USB sticks and key chains, Flash memory cards, external hard drives, and in one case, a dedicated laptop, to keep collections of cherished virtual possessions with cherished life story-oriented material possessions in their homes. It was common for participants across cultures to attribute value to simply keeping these kinds of materials together, even when not in direct use. The most compelling example emerging in this study was F4-USA’s use of USB-enabled trinket and keychain-based displays to keep curated collections of digital photos with related material possessions stored in her closet. These devices contained roughly 60 digital photos, each with a particular theme (e.g., images of Yoga training and past Christmases with family); they were some of her most cherished possessions which had become integrated into her weekly and annual practices:

“...the Christmas one, I keep it in a box in my closet with other things, like handwritten Christmas letters and a few decorations that’ve been passed down in my family. ...Each year I open up that box and I get the snow globes out, put them in my house and turn them on ...Like all those memories are right here [on snow globes] with everything else, I can hold them. I know exactly where they are.”

Whether through a Flash memory card or a dedicated device for viewing photos, these instances illustrate how participants appropriated existing technologies to create embodied forms of cherished virtual possessions. This emerged as way to extend pre-existing practices and rituals to key collections of virtual things as they were meaningfully integrated into cherished material archives.

6.2.4 Fragmentation of possessions across online services: tensions over awareness, control and authenticity

All participants reported having a variety of valued virtual possessions across social networking and cloud storage services. These things were broad, and included digital

photos and metadata (e.g., comments and ‘likes’) 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).

Despite using these online services relatively frequently, participants across cultures conveyed concerns over their longevity. When asked to compare their online things to material and locally stored virtual possessions, participants frequently described a lack of awareness about where their virtual things were. For example, F3-USA reflects on temporarily losing access to her photos, hyperlinks and comments she has accrued on her four year old Facebook account:

“Facebook will say ‘try again later’, like I can only go back so far. ...I put it up there so I should have it, but now it’s gone. Maybe it will come back, maybe not. That’s the kind of thing that can make online stuff a lot less meaningful. ...it’s there one minute and gone the next and you have no idea why.”

Similarly, participants in Korea and Spain were frequently skeptical over the durability of social networking services and their potential to, as M5-Korea put it:

“disappear suddenly one day.”

These reflections capture the conundrum many participants struggled with: the desire to have a deeper sense of possession over their cloud-based possessions, while having no clear way of productively achieving this goal. These findings also match results from a study I conducted in the UK investigating peoples’ perceptions of their cloud-based possessions (Odom, Sellen, Harper, Thereska, 2012), which is described in the prior chapter. On a general level, these combined findings suggest that a loss of awareness of and control over people’s possessions in the cloud may be emerging as a global phenomenon.

Across Korea, Spain and the US, I observed many participants creating workarounds in the form of physical copies or locally stored digital copies of cloud-based possessions. These were most commonly social networking information, for example a screen shot of a Facebook photo with comments or paper printouts of Facebook wall entries during an eventful time period. Interestingly, participants nearly always expressed dissatisfaction with this workaround because it complicated the authenticity of the virtual possession itself once it was removed from the online system. For example, F8-USA reflects on her archive of Facebook data that she downloaded several months ago:

“...it became less meaningful. ...People will go back and comment on a photo of mine I posted years ago. But what I downloaded doesn’t have this information, so it becomes a weak substitute. Once the real thing online changed, it’s like that thing on my hard drive has changed too. The real thing is what’s living in the system. ...I wish I could have the ‘real things’ on my computer instead of in

Facebook's hands. Then I would feel a lot better about having them for the long term, after Facebook implodes, you know."

I also encountered participants making material copies of online virtual possessions. For example, M3-USA compared his practice of printing locally stored digital content to printing personal content from his Facebook account:

"With a photo online, on Facebook, it's connected to time because there's always the possibility that it can change. And the fact that it can, changes the way I think about it."

These examples help illustrate the paradoxical nature of virtual possessions kept in social networking systems that the several participants struggled with. Young adults desire more control and awareness over these kinds of virtual possessions; however, their workarounds to support this tended to render these things into something different and less meaningful over time.

6.2.5 Complications and workaround with cloud storage services

Loss of control over cherished virtual possessions also extended to cloud-based storage services. Unexpectedly, most participants viewed cloud storage services as temporary platforms to move valued virtual possessions between geographically separated computers. They expressed distrust of these services, questioned their longevity, and were apprehensive about what happened to their cherished virtual possessions in storage:

"It is not pleasant to keep my private data on a server which belongs to one company. So, I do not use the [Ndrive] cloud service" (M6-Korea).

When probed on underlying issues shaping this perception, several participants conveyed concerns over whether online services replicated their personal files in alternate locations they did not have access to, causing further undesired fragmentation and loss of control. In some cases, participants migrated their practices of sharing digital content with loved ones from cloud-based storage services back to email services, which were perceived to be more secure. In Korea and Spain in particular, young adults adopted the strategy of maintaining a cloud storage account and opting to share their account login information with loved ones. Family members could then individually download photos by using the account information before deleting them online to minimize the potential for copies to be made out of their control.

Participants across cultures also opted to maintain Internet-enabled external storage devices in their homes, which were used to back up cherished virtual possessions and to periodically share these things through remotely accessible folders. Participants valued having an increased amount of control over who had access to their virtual possessions, and awareness over where they were at any given time. However, the

biggest and most common concern this approach raised was the vulnerability that a single point of storage introduced to their valued archives and the susceptibility to lose years worth of memories.

Interestingly, in Spain and the US, there were a handful of cases in which participants stored redundant copies of their archives across a select set of networked computers that were owned by family or friends. For example, M1-Spain described storing cherished virtual possessions on his own computer as well as on a shared folder of a close friend's computer. He perceived this approach as a safer and more private way to ensure the safety of both peoples' cherished virtual archives. In another case, M8-USA described the significance of creating shared remote folders on his brother and sister's computers in their respective households:

"I wasn't thinking too deeply about it when I did it, but over time I have really come to value it. ...there's significance in storing important things in places I trust, with people I trust. ...I'm doing the same for them, looking over their things too. It's a different way of knowing your things are safe. Something we could never do with our physical stuff."

M2-USA similarly described maintaining a remote folder on a computer in his parents' home in which he keeps cherished photos, email messages from a departed friend, and videos of his college graduation:

"...it's not just about the things themselves, but also where and how they're kept. ...it makes sense to keep them in my parents' home right now. It's a safe place. ...they watch over a lot of things from my past already."

It is important to note these are sophisticated workarounds that were developed by some of the most technically proficient participants in my sample; all of whom were employed in technology-related fields. However, these instances do provide insights into 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 had a higher level of awareness and control over their virtual archives and, subsequently, more value.

6.3 Design Opportunities and Issues

Findings from this study show that virtual possessions play significant roles in young adults' lives across Korea, Spain and the US. They provide valued resources for young adults to reflect on their past and present self, and to speculate on the future. While there were some differences, the findings from this study produced significantly more similarity across cultures than expected. This similarity could arise from the fact that interactive technologies and services are often designed for the global marketplace, and impose a universal structure that impacts people regardless of their region.

It was clear that virtual possessions often defied organizational structures. Similar to their value construction practices with material possessions, participants wanted to create cohesive collections of meaningful experiences and social relationships. Young adults desired a stronger sense of possession over their virtual things. They wanted to more fluidly draw on these things as resources for reflection, and to keep them in places socially signified for cherished possessions.

Interactive systems fragmented young adults' virtual possessions across devices or services. Several coping strategies emerged: materializing virtual possessions; creating digital copies of material possessions; storing virtual possessions within archives of material possessions; and creating remote storage on locations on loved ones' computers. These findings suggest many possible new forms and behaviors for virtual possessions and new interactive systems. They also raise a range of considerations when designing new products and services. Through repeated discussion and modeling sessions with the research team, I identified three specific opportunities areas to guide future research and practice in the HCI community: (i) Supporting life story-centered archiving, (ii) Improving cloud archiving, and (iii) Prototyping "Home". I also note several potentially unintended consequences that should be considered when working in this emerging space.

6.3.1 Supporting Life Story-Centered Archiving

Findings from this study highlighted how young adults struggled to create holistic archives of virtual possessions symbolic of valued life experiences and relationships. In particular, young adults wrestled with an inability to integrate related material and virtual possessions. This suggests a large design opportunity for moving away from current system structures that keep similar file types together, and moving towards organization shaped by experience-based or relationship-based metrics.

This could enable cherished virtual possessions to be more easily and artfully combined into meaningful collections. For example, experience-oriented metadata—either constructed by a machine as a byproduct of use or by a human through a reflective annotation—could play an important role in bringing together various kinds of virtual possessions related to a particular event (e.g., photos, video, social media comments, people present, ticket purchase information, weather report, calendar events, coordination emails and SMS, etc.). This new form of infrastructure could lead to the creation of experience-oriented assemblies of virtual possessions in more valuable ways. There is an opportunity to create new services providing rich APIs to enable mashups of virtual possessions based on these new kinds of organizational structures. This could enable young adults to re-imagine the forms and behaviors of their experience-oriented archives, while retaining control over the process.

This study also revealed it was common for participants to create and accumulate digital copies of cherished material possessions they were often geographically separated from. Beyond this, observations illustrated how young adults perceived

digital copies of material possessions to gain value through their connection to other related virtual possessions collectively capturing a particular period in one's life story. This suggests a design opportunity for developing easier techniques for people to create rich virtual versions of their material things. Recent advances in integrating 3D scanning into domestic artifacts and surfaces could be leveraged in the service of this direction (Kirk et al., 2012).

Finally, several instances emerged in which participants embodied curated collections of sentimental virtual possessions on physical storage media and attributed significant value to keeping these things with archives of cherished material possessions. This suggests an opportunity for new physically embodied forms of virtual possessions that can be more aesthetically integrated into the material collections. This design direction could support and extend recent emerging works exploring opportunities in designing embodied, smaller scale storage systems for sentimental digital content (e.g., Petrelli et al. 2010, Nunes et al. 2008).

6.3.2 Improving Cloud Archiving

Cloud computing services often complicate fundamental notions of what it means to 'own' or 'possess' virtual things (Marshall & Shipman, 2011, Odom, Sellen, Harper, Thereska, 2012). This represents a growing issue for the HCI community. The study described in this chapter helps by providing new insights into several opportunity areas. First, this study revealed young adults wanted to know where their virtual possessions were in the cloud, and if or when they had changed. In the context of social networking, participants made material copies of virtual possessions and saving local copies of these cloud items on their hard drive. Across cultures, these workarounds were perceived as inadequate. Participants described how taking social networking content out of the service complicated the authenticity of these artifacts. If new attributions of metadata were made online, then the printed or locally saved copies were no longer the 'real' thing. Ultimately, young adults wanted to be able to create holistic archives whether they were kept locally or online, while retaining the ability to have virtual possessions continue to 'live' in social networking services.

In the context of cloud-based possessions, this suggests a large design opportunity in reconsidering how social networking-based service offerings are presented. Virtual proxies of social networking-based possessions could be leveraged to help young adults integrate things into their cherished archives, while retaining social networking content's innate ability to continue to be transformed through human and machine-produced metadata. These proxies could open a space for creating more holistic archives without having to compromise the additional value construction activities of social networking services.

Additionally, it was clear participants across cultures had a strong distrust of cloud services designed to support online storage of virtual possessions. There were concerns about the longevity of the services as well as possible actions that participants could not control. Ultimately, placing one's most treasured virtual

possessions under the guardianship of a third party service conflicted with young adults' desires for their things to be treated with safety and care.

Interestingly, in Spain and the US, there were a few young adults who had created remote folders distributed across geographically separated computers. Participants used remote folders to mirror their cherished virtual archives across multiple locations, ensuring these collections would endure and be accessible by others. These examples highlighted how not only were participants' virtual possessions safely backed up on their own terms, but also how meaning was attributed to the remote social contexts in which their things were stored. These behaviors made virtual collections even more valued. This suggests an opportunity for creating new services that would more easily enable, for example, family members to create networked folders on each other's computers. There could also be new, embodied forms of these networked archives, which could communicate the safety and status of the owners' and their loved ones' virtual archives. This opportunity area could productively expand ongoing research exploring the design of family services (Egelman et al. 2008) and, more generally, the design of technologies to mediate intimacy among loved ones (Vetere et al., 2005).

6.3.3 Designing Tools for Prototyping “Home”

A clear theme across cultures centered on the observation that young adults had not exerted strong authorship over their domestic environments and had not constructed a strong sense of “home”. Cherished material things were packed away in storage, waiting for a future home.

However, participants continued acquiring possessions, and they valued how virtual possessions could support this goal without material burdens. This suggests an opportunity for designing interactive systems to explore how the presence of virtual possessions might be amplified in people's homes. This could be achieved through relatively lightweight strategies. One strategy could involve building on recent technical advances (Schwarz et al. 2012) and repurposing the many digital screens, large and small, in the home. These screens could support dynamic representations of curated collections of virtual possessions without adding any new technological or material objects. However, this direction would need to be approached with caution. Findings indicated stark differences across countries in terms of the social appropriateness of disclosing personal aspirations and ambitions, which would need to be taken into account.

This study also revealed a resistance to acquiring new material possessions across cultures, which connected strongly to the lack of authorship over domestic spaces. Young adults were in a holding pattern, waiting for more certainty before committing to a home aesthetic. While this situation did not appear desirable for participants, there appeared to be no viable alternative. This suggests an opportunity for exploring the creation of new tools that support young adults in exploring different possible aesthetic and spatial layouts, which on a broader level, might

enable them rapidly prototype many different ideas of ‘home’ they might desire. The virtual materials produced from such systems could become valued imprints of a young adult’s life, and could support creative explorations into more heterogeneous conceptions of what home could be (Aipperspach, Hooker, and Woodruff, 2008).

6.3.4 Considering Unintended Consequences

While there are many ways to advance the form of virtual possessions to increase their perceived value, it is necessary to critically reflect on possible unintended outcomes. It is important to consider how complications could emerge around virtualizing life story-oriented materials.

While young adults clearly valued the lightweight nature of their virtual possessions, it remains unclear whether explicitly supporting this trend is desirable. For example, keeping sentimental possessions in their parents’ home(s) prior to entering older adulthood may play an important role in fostering meaningful interactions among parents and children later in life. Designing new systems to virtualize people’s cherished material things could disrupt these practices. Creating systems that enable young adults to have more virtual possessions could also potentially prolong a state of unfinishedness. At the same time, it is possible that young adults may need unfinished aesthetics as a way of speculating on who they want to become and how they wish to imbue their space with a sense of home. Designing new technologies to automate these processes or make them more efficient could subvert the work people need to do to reflect on their life and explore their goals and aspirations. These issues should be considered as the HCI community moves forward in developing systems that support value construction activities with virtual possessions.

6.4 Conclusion

In this chapter, I have explored how a sample of young adults across Spain, South Korea and the US perceive, form attachments to their growing collections of virtual possessions. A goal of this study is to identify findings and design opportunities about young adults’ relationships with their virtual possessions. From this the HCI community can then more readily begin to critically consider potential benefits and dangers of designing new technologies intended to enable people to construct more value with their virtual possessions. The fieldwork I presented described complications young adults faced when interacting with their virtual possessions, as well as practices developed to workaround these tensions. Based on these findings, I proposed *supporting life story-oriented archiving*, *improving cloud archiving* and *prototyping ‘home’* as opportunity areas to guide future HCI research.

While this study contributes a cross-cultural exploration of people’s value construction practices with their virtual possessions, it was nonetheless conducted in only Southern Europe, South East Asia, and North America. South American and African countries remain conspicuously absent from existing literature on virtual possessions. Future research can investigate how different groups from these

geographical areas construct value with their virtual things, and how this varies for different cultures, ages and economic backgrounds. Such future studies could also help construct a more concrete understanding of fundamental similarities and differences between the perceived qualities of material and virtual possessions.

6.4.1 Broader Reflections

The study described in this chapter represented a huge undertaking across four institutions in the Spain (University of Granada), Korea (KAIST), the US (Carnegie Mellon University), and Germany (Vodafone headquarters). It remains one of the largest university-affiliated projects Vodafone funded in its history. It also represents one of the first large scale, qualitative cross-cultural studies in the HCI community. This study posed significant practical and methodological challenges. While beyond the scope of this dissertation, further reflection on the practical and methodological issues this project raised has appear in a paper in the proceedings of IASDR 2013 (see Lee, M., Nam, T., Lee, Y., Row, Y., Lim, Y., Kim, D., Seok, J., Odom, W., Zimmerman, J., Forlizzi, J., Higuera, A., Marchitto, M., Canas, J., Moore, H. 2013).

Finally, this project successfully contributed new knowledge about how people construct value with their virtual possessions, and, in doing so, further mapped the virtual possession design space. However, additional design research is needed to practically apply these findings and transition from what-we-know-now about people's practices to a deeper understanding of what virtual possessions should be in the future. In the next two chapters, I will describe research that presents radically different ways people could experience and interact with their life story-oriented virtual possessions and archives in the future.

7 Technology Heirlooms: Considerations for Passing Down and Inheriting Virtual Possessions

The fieldwork project described in the previous chapter contributed new knowledge about how people construct value with their virtual possessions, and, in doing so, further fleshed out the virtual possession design space. However, additional design research is needed to transition from people’s current practices to a deeper understanding of what virtual possessions could, or should, be in the future. In this chapter, I describe a study of prototypes that present radically different ways families could experience, interact with, and pass down their life story-oriented virtual possessions and archives in the future. The three design artifacts described in this chapter can be seen in parallel to the lifestory-centered archiving opportunity area described in the previous chapter in several ways. First, in different ways, they each move away from current system structures that keep similar file *types* together, and towards organization shaped by experience or relationship-based metrics. Second, the Timecard design explores how human and machine constructed metadata could be used to bring together virtual possessions related to a particular event or experience in one’s life (in this case, in the context of family life). Third, all three designs represent embodied, curated collections of familial virtual possessions; this is implemented in ways that could enable virtual collections to be more aesthetically integrated into existing material collections. The project described in this chapter is a field study I designed and executed as a research intern in Socio-Digital Systems group at Microsoft Research Cambridge that aimed to draw on the Technology Heirloom prototypes to engage several families in a critical dialogue about the potential futures embodied in each devices.⁹

In what follows, I first provide a brief background motivating this project. Then, I describe the three ‘technology heirloom’ devices—Digital Slide Viewer, Timecard, and BackupBox—and the methodology I developed and used in this project. Finally, I describe findings from the study and their implications for design.

⁹ This chapter is adapted from a paper published at the CHI ’12 conference (Odom, Banks, Kirk, Harper, Lindley, Sellen, 2012). For additional background on the Technology Heirlooms prototypes see Banks, Kirk and Sellen (2012) and also Banks (2011).

7.1 Introduction

Material artifacts are passed down across generations of family members as a way of sustaining social relationships and bolstering ideas of shared heritage, history and values. These heirloom objects often offer connections to the past that extend before and potentially beyond the current owner's life. As people live more of their lives "online" and as interactive technology continues to become more ubiquitous, it is critical to ask how virtual possessions will find their place among the collections of material possessions that connect people to the past. After all, interactive technology makes it possible for people to accumulate vast and diverse archives of virtual possessions. In the future will children look back over their grandmother's digital photos or Facebook content to explore what her life was like? Will these virtual possessions be passed down the same way as material possessions are?

Research in the HCI community illustrates a diverse range of ways people draw on virtual possessions to reflect on and reminisce about the past (e.g., Kirk and Sellen, 2010). Very recent work has described new complications that are emerging as loved ones pass away and leave complex assortments of virtual possessions for the living to come to terms with (e.g., Odom et al. 2010, Massimi and Baecker, 2010, Massimi, Odom, Kirk, Banks, 2011). Many of these issues point to the fact that people are experiencing a rapid growth of personally meaningful virtual possessions. However, little work to date has progressed beyond explorations of current practice to explore how these sensitive virtual archives might persist over time, across owners and across generations in the future.



Figure 1. Three 'technology heirloom' devices: the Timecard (left), BackupBox (center), and the Digital Slide Viewer (right).

With this in mind, a research team at Microsoft Research Cambridge designed three devices as a way of provoking a critical dialogue with people to reflect more concretely about how virtual possessions might be inherited in the future. The aim was to use these design artifacts to explore how the processes of passing down virtual possessions among family members might be better supported as well as to reveal potential unintended consequences that could emerge. The three technology heirloom devices are: the *Digital Slide Viewer*, which packages treasured family photo albums in the form factor of a traditional slide viewer; *Timecard*, a device that enables people to assemble, present and hide away digital content of multiple family

members along a chronological timeline; and *Backup Box*, which locally stores a person's Twitter archive on a daily basis in a form that can be handed down.

I conducted in-home interviews with eight families, using the devices to provoke discussions about how technology might fit within (or complicate) their practices of inheriting and passing down virtual archives in the future. These sessions opened up discussions that provided insights into how families desired to treat their archives in ways not fully supported by technology. They also revealed emergent tensions as members critically considered futures embodied by (and beyond) the devices and reflected on consequences that could emerge. With these findings in mind, this chapter concludes with a discussion of four design considerations aimed at sensitizing the design space toward better supporting the work of inheriting, living with and passing down significant digital materials: *designing technologies to be put away*; *supporting the moral work of safeguarding*; *enabling multiple roles*; and *enabling multiple representations in the archive*.

7.2 Methodology

Three working devices were designed to critically explore potential future interactions, experiences and practices surrounding the inheritance of virtual possessions. Although these design artifacts offer some diversity in design, I synthesized a methodological approach that united them. Specifically, the devices were used them to provoke reflection on the things themselves and encourage a dialogue about (and beyond) the stances and potential futures they embody. The methodology I designed for this study drew from a number of approaches, including speculative design (Gaver and Martin, 2000), critical design (Dunne and Raby, 2001), reflective design (Sengers et al., 2005), technology probes (Hutchinson et al., 2003), and design-oriented HCI (Fallman, 2003).

The process leading to the development of these devices consisted of the following. The research team conducted review sessions of theoretical literature and empirical studies (many are noted previously). Then many design concepts were ideated and progressively refined; several conceptually related sets were clustered to construct an understanding of the overall design space. Comparable to Schön's notion of design as a reflective conversation with materials (Schön and Bennet, 1996), the team engaged in a reflective dialogue with theoretical and empirical materials, and iterative development and critique of the design concepts themselves, to arrive at the final devices.

The form and presentation of each device was intended to be resolved to the extent that, at first glance, it might appear relatively familiar in comparison to other domestic artifacts. It was our design intention that the devices' material aesthetics could evoke a sense of the warm qualities associated with antique or heirloom objects (e.g., veneered oak composing an old chest compared to plastics encasing many contemporary appliances). The three devices are designed as a visual family, each encased in a European Oak veneer with a single surface of color. Further, the digital

technology of each artifact is integrated into a form characterized by affordances that enable them to be fluidly opened up and put away. These design choices were influenced in part by prior work illustrating how the qualities of certain materials, such as wood, can inspire a perceived sense of durability (Odom et al., 2009); and how the invocation, experience and putting away of inherited objects—virtual and material—appears central in supporting meaningful, self-determined interactions with them (Odom et al., 2010).

Nonetheless, it is important to point out that the notion of ‘designing an heirloom’ can seem contradictory. The ways in which an object achieves heirloom status is highly idiosyncratic and heterogeneous; what one family may regard as an heirloom will likely not retain the same meaning for another. Additionally, heirlooms often directly owe to the people that possessed them previously and the material histories inscribed through their use over time.

Thus, it must be stressed quite crucially that I did not aim to evaluate these design concepts *per se*. Indeed, a more traditional ‘evaluation’ would require a deployment for many years—if not decades—to understand how the devices shaped people’s practices and experiences as they accumulated virtual possessions and were (or were not) passed down to another generation. Rather, the devices were used to provoke discussion around—and beyond—the potential futures they embody and inspire; and to explore issues and insights that emerge through these discussions. Additionally, the devices were populated with a fixed set of virtual possessions from a research team member’s personal collection, as opposed to each family’s specific content. This team member’s virtual archive captured years of personal and family experiences, as well as materials left behind after the loss of a close elder family member.

There are two reasons for this choice. First, families have different sets of virtual possessions. Reliance on families’ personal collections would have removed an important control: making sure participants reactions were based on the same stimuli. Additionally, it would make the devices only as rich as the collections families keep *now*. Second, acquiring families’ personal collections and building personalized versions of digital content on each device for each family would have significantly increased our efforts. One of the key challenges with designing new technology is to reduce the risk of development for things people do not ultimately desire. My intention was to ground intuitions from prior research, and to avoid making an over commitment to a specific design direction. I needed to use this methodology to help reduce the risk associated with taking a conceptual leap to an emerging design space that has few existing conventions to draw on.

Nonetheless, this approach clearly has limitations. The virtual possessions left behind by, for example, a teenager or middle-aged person would be different. However, this approach did appear effective in providing families with enough context to understand and relate the devices to their own lives, while remaining open enough to encourage them to envision new ideas or uses. In what immediately follows, I

describe each of the concepts in turn, and then provide details on the field study and participants.

7.2.1 Digital Slide Viewer

The Digital Slide Viewer is a device for the local archiving of different collections of a family's digital photographs. The device is an augmented vintage analog slide viewer popular in the United Kingdom in the 1970s. Physical slide tokens, laser cut from acrylic, symbolically correspond to photo albums previously stored online or locally by a family. The slides and viewer are stored and organized in an oak case. Each slide has a unique strip of color on its back, which is recognized by a color sensor to determine which album should be made viewable from internal memory. When a slide is inserted, the photos in the corresponding album become viewable, which may be sequentially explored by tilting the device left, to move backward, or right, to move forward, in the set. The digital slide viewer is driven by a Gadgeteer¹⁰ microprocessor board, which several sensors and devices are plugged into, including: a 100x100 pixel display; an SD card (in an internal SD reader) for image storage; an RGB reader for detecting a unique color present on each slide token (to invoke different photo collections); and a breakout board with two tilt sensors for supporting navigation. A mini USB connection powers the device. Content for the photo albums was supplied by a research team member and models their exact organization. These 20 albums cover a diverse range of events over several years, including family trips and moments in a young child's life as well as mundane experiences (e.g., a family informally creating artwork together).



Figure 2. From left to right: The viewer in case with the slides; View of a photo; Families often desired to store the slide viewer in spaces where other significant artifacts were kept.

Issues framing the rationale for this concept included: How would the form and presentation of this device be perceived to support or complicate participants' existing practices of viewing family photos, against the backdrop of their own physical and virtual albums? How would integrating digital photo albums into an artifact that may already be familiar to some members shape perceptions of these virtual possessions?

¹⁰ .Net Gadgeteer see: <http://research.microsoft.com/en-us/projects/gadgeteer/>

7.2.2 Timecard

Timecard enables family members to construct and present a timeline representing the life of a loved one, which is stored and displayed on a dedicated device. Timelines can be created for a departed family member as a form of memorial, or simply to map the lives of several family members as a matter of preserving family history. Family members can add digital content (e.g. text, images) to the system via a web interface and backend online service, which is used to transfer content locally to the device. During the upload phase, people are able to attribute specific dates to the content, which dictate where items appear on the timeline. The Timecard case includes doors that enable it to easily be opened up or put away; the touch screen sits behind the doors. It is stand-alone and can sit on a shelf or on display elsewhere in the home. A fanless mini-PC runs the Timecard application displayed on the screen.

Photos can randomly cycle in full screen mode. Touching a photo brings up a timeline view of all the images of a person chronologically; the timeline (and collated content) can then be explored via the touchscreen. In addition to personal annotations, family members can attribute metadata of historical events (scraped from Wikipedia) to the timeline to help better contextualize the life and times of an ancestor. I wanted to explore the extent to which this design choice might make the life stages of different ancestors more meaningful for future generations. A research team member that had recently experienced the loss of an elder close family member provided the content Timecard presented in this study. This included physical objects and photos that he had been bequeathed (which were later scanned), as well as photos over the years that depicted the member in different life stages.



Figure 3. From left to right: Children from F4 interact with historical metadata; The timeline UI view; Several families placed Timecard (closed up) on display with other things in the home.

Issues framing the rationale for this concept included: How might technologies fit within, extend or complicate families' practices of remembering and commemorating the lives of loved ones? How could these narratives be passed down and how could chronology affect these practices? I was also interested in where families perceived they would keep an artifact like this in their home and how it would be treated considering its potentially sensitive nature. For example, would enabling content to be made public shape perceptions of its placement in storytelling practices?

7.2.3 BackupBox

BackupBox is a virtual store of a lifetime of Tweets posted to the micro-blogging website Twitter.com. Through a WIFI connection, it copies messages from the internet to a self-contained hard drive. There they are preserved for a future time when they might be drawn on as a resource to revisit the mundane and extraordinary moments of a family member's life captured by their Twitter account. Twitter was selected in contrast to other social media accounts (e.g., Facebook) as the 140 character limit for each entry could potentially produce more concise and easily accessible entries. However, during the study participants speculated on how their own digital materials (e.g., Facebook content) might relate to—and extend beyond—the BackupBox concept, which I will discuss in detail later in this chapter.



Figure 4. From left to right: The removable lid; Mom2 presses a icon to open a Tweet; UI design for an opened Tweet.

The physical form consists of a box with a removable lid; this is intended to conceal the growing twitter archive so as to not attract attention, while still inviting exploration if a family member chooses to open it up. The user interface presents Tweets in chronological order along the X axis; the Y axis indicates the time of day each Tweet was posted. The interface is navigated via a touch screen and each Tweet item in the timeline is symbolically represented as a non-descript flower; touching a specific element will present the contents of the message. A fanless mini-PC runs the BackupBox application displayed on the screen. Considering the potentially sensitive nature of some messages, this design choice could potentially provide an additional layer of comfort by requiring people to physically invoke the content beyond just removing the lid. The Twitter content on BackupBox was archived from nine months of the device routinely backing up a research team members' Twitter account.

Issues framing the rationale for this concept included: Would the BackupBox surface tensions around the processes of passing down personal digital content that is created and stored online? Would family members perceive a physical instantiation of a digital service to be valuable? Would family members perceive social media content, such as Twitter data, to be similar or different to existing perceptions of materials to be passed down in a family archive?

7.2.4 Participants and Data Analysis

I recruited eight families (F1-F8) from the southeastern region of the United Kingdom to participate in my study. This approach clearly has limitations; for example, it makes the results hard to generalize to another population of users. However, I wanted to focus on a specific group to gain a richer descriptive understanding of the space as a whole to inform what might be salient issues for future research. Two parents from each family participated (with the exception of (F5); only the mother participated). All families had at least one child; F2, F4, F5, F6 and F8 all had young or teenage children, all of whom participated in the study. F1, F3 and F7 had children in their early to mid-twenties which all lived outside of the parents' home; four out of five of these young adults participated. Three families (F1, F6, F7) had members representing two generations that participated (i.e. children and parents); the remainder had members representing three generations that took part in the study (i.e. children, parents and grandparents). Five of the eight families had experienced the loss of at least one grandparent in the past five years; all inherited objects from these experiences. In total thirty-six people participated in the study—fifteen children (ages ranging from nine to twenty five), fifteen parents (mid thirties to early fifties), and six grandparents (late sixties to late seventies). The occupations of parents ranged from schoolteacher to IT consultant to plumber; occupations of non-student children included sales attendant, law clerk, and barista; all grandparents were retired. I recruited this participant pool as they could offer a range of experiences with material and virtual possessions.

All interviews were conducted at the parents' home, where family members collectively convened prior to the interview. The choice of the parents' home appeared most appropriate as they typically housed an assortment of artifacts ranging from heirlooms that had been passed down over at least one generation, to objects that were anticipated to be passed down to their children. One home visit was conducted per family and lasted between two to three hours. Visits began with parents (at times together with grandparents and/or children) giving us a tour of their home, with emphasis on where they kept heirlooms or objects that might become heirlooms. They were asked to describe stories associated with these artifacts, how they were received, who is responsible for them, and reasons for keeping them in particular spaces. I also explored if members possessed virtual collections they desired to hold onto (and potentially pass down), and where they were kept. I then asked members to gather a selection of artifacts emerging in the tour and to arrange them in a central room in the home. This was to provide a rich backdrop of participants' possessions that could serve as a basis for comparison when exploring the devices.

All participating members then reconvened in the central room (often living room or kitchen). I conducted a brief discussion to clarify experiences surrounding the artifacts arranged in the room. I then began sessions using the devices. I was careful to make clear that all the devices are concepts to be used as starting points for

discussion about and beyond them; family members were encouraged to envision what they would (or would not) want them to be. One device was introduced at a time, and each had a specific semi-structured session conducted with it. However, members were free to go between devices if desired. For each device, I offered a short narrative providing background context, illustrating how it could be interacted with in the process. These introductions were kept brief. Emphasis was placed on family members exploring the device and coming to their own interpretations of it; they were encouraged to imagine what kind of future each device projects and consider what that would be like.

At appropriate moments during sessions of exploration and discussion, I posed open-ended questions. Questions were designed to critically elicit reflections on topics including: how narratives persist with personal artifacts as they are passed down; how and when cherished objects are used; what kind of family ‘image’ they construct; how physical and digital archives are maintained and how the social roles of members surrounding their care may change; and where they will go when they are passed down. Members were asked to contrast their descriptions with how the device might or might not fit within their practices. I altered the order devices were introduced to families across the study. After all devices had been discussed, I asked members to take us on another tour of their home, this time considering where they would keep them in their home and why.

All interviews were audio recorded, which resulted in nearly twenty hours of recordings; photographs were additionally taken to document objects and spaces discussed during the interview. I listened to recordings and transcribed segments relevant to heirlooms and interview questions (as opposed to general chat), which were organized into themes. Meetings were held with the research team to discuss and corroborate emergent themes; we coded the textual documents using these themes. In addition, I created affinity diagrams using sticky notes to order findings across families and reveal unexpected connections.

7.3 Findings

In what follows, I present several examples taken from field observations with families, which capture the core themes emerging across the field interviews. I refer to participants by their role— GF (Grandfather), GM (Grandmother) Mom, Dad, S (Son), D (Daughter) —followed by a number indicating the family. In the case of children, the reference includes a second number indicating the child’s age. For example D4-13 would stand for a 13- years-old daughter from family 4.

7.3.1 The Storage and Safekeeping of Family Heirlooms

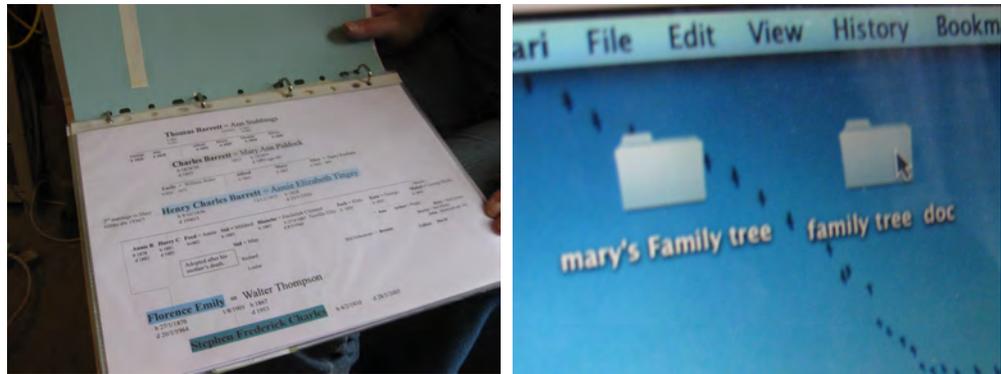


Figure 5. Family members described a variety of their physical and virtual heirlooms at the beginning of each interview session.

Interviews in families' homes revealed a diverse range of material and digital artifacts members kept and desired to pass down. In what follows, I first describe families' perceptions of their material heirlooms and their collections of virtual possessions. I then detail how families drew on the devices to envision alternatives to better support their practices.

Despite representing some of their most valued possessions, families commonly described 'using' their heirlooms infrequently, at times several years lapsing in between these instances. It was also common for families to clearly differentiate heirlooms from other domestic objects:

"We don't use them like you'd use a [television] remote. ...Their purpose is something bigger." (Mom3).

Instead, practices surrounding heirlooms were bound up with having them present and ensuring their safekeeping. Dad1 describes an album containing photos and memorabilia of his family's ancestors:

"we rarely go back to them. ...it's having that peace of mind that they're there [motioning to bookshelf] and we'll see to it that they're there until it's time for my kids to take them."

Safekeeping was understood as occurring across generations and was bound up with the passing on of items. In some cases, older members preemptively passed down heirlooms to ensure their transfer to the next generation:

"...making sure [they] make it through time, that feels as important as the things themselves. ...telling my daughter what they mean, the people they represent, while she has them, that's going to help them last" (GM5).

Similar to their material heirlooms, families sought to safeguard treasured collections of virtual possessions for future generations. These included things such as: digital photos, videos, documents, and to some extent, artworks and music.



Figure 6. During home visits it was common for participants to present a large inventory of their material heirlooms (left). In several instances participants directly juxtaposed cherished material artifacts in relation to technology heirloom prototypes when comparing and contrasting their respective qualities.

Various tensions were bound up with the notion of safeguarding collections of virtual possessions; especially practices related to their backing up. For example, it was a common strategy for families to use external hard drives to back up their virtual collections. However, in some cases the extra task (and hassle) of updating a secondary storage location led to the external hard drive being routinely neglected. In others, families described a general distrust over the longevity of their personal computers, which led them to create extensive backups on physical media (e.g., CDs or DVDs). Tensions also emerged with this approach, namely due to doubts over how long these media would last and the physical space their storage required. Other concerns included the potential to lose the physical media:

“the problem with CDs is if we lose one ... we’d lose a whole a chapter of the kids growing up” (Dad8).

Participants also brought up concerns that the aesthetics of physical media failed to convey the preciousness of the virtual possessions kept on it. As Mom7 put it:

“they deserve better than that.”

The use of online services to store digital family collections is an alternative to creating local backups, and members from all families reported using photo sharing services (e.g. Facebook, Flickr) or email to share select family photos with specific people to varying extents. However, these services were viewed as supporting *sharing* rather than the *safekeeping* of sentimental content:

“We put things online to share them, not to preserve them. ...all our intimate [digital] memories, we want to know where they are, keep them in order. ...the thought of them being where someone could get at them. That makes us uneasy” (Dad6).

Parents in two families (F4, F7) maintained accounts through the cloud storage service dropbox.com, and similar concerns also emerged:

“I’ll put things for my work or my music in drop- box, but I wouldn’t put anything too valuable to us there. What if our account was hacked or deleted? ...it feels too risky” (Dad7).

When possible, I probed teenagers’ perceptions of storing content online. Similar to general findings from the teen study described in chapter 3, they typically reported fewer immediate reservations about hosting personal content online. However, they reacted strongly against integrating their own virtual possessions into their family collections. These reactions were largely motivated by concerns that this could result in unwanted self-disclosure and, relatedly, that their personal collections may reveal aspects of their life that would be inappropriate within the family archive.



Figure 7. Family members interacting with the Technology Heirlooms during in home interview sessions.

7.3.2 Embodied Digital Forms: Settling In and Setting the Tone

The embodiment of virtual archives in physical forms conveyed through the technology heirlooms prototype provoked discussions across home visits. Below I detail how families saw ways in which physical properties might enable them to treat,

relate to and live with sentimental virtual possessions. A primary theme across interviews centered on how capturing virtual family archives in forms distinct from the computer might both project and engender a deeper sense of care for these possessions:

“Putting our family photos and videos and all in a different folder [on our computer] doesn’t do them justice. There is so much on [our computer] that we won’t give a toss about in a year. ...our photos, videos, that’s the bit that matters.[The devices] get away from all the clutter. ...they show you care and makes you want to care for them, tend to them” (Mom3).

GM5 similarly noted:

“there’s something about being able to say ‘what’s important, it’s all in here’ and pick it up, give it to someone or keep it in a special place that suits it.”

Other families speculated on potential benefits of storing digital content in domestic spaces populated by their treasured material things. For example, when considering where the Digital Slide Viewer would be stored in their home, F1 selected a small living room cupboard that housed several sentimental items:

“...having it packed up next to the Chinese boards and albums and medals. ... seeing it age with them, the things we’ll always have. It feels right. ...we want to hold onto our [digital] family photos like those things I suppose. Putting it there makes it feel like it’s findings its place. ...with our things, in our home” (Mom1).

Four of the eight families (F3, F5, F6, F8) I interviewed possessed only a single computer, all of which were desktops set up in home office or kitchen locations. These families in particular reflected on how moving their sentimental digital archives to other domestic places could better prime interactions with them:

“we have this chest. ...It has little trinkets and bits and bobs that we’ve saved over the years, some old stuff from me Mum. ...this is where it [Digital Slide Viewer] should go. Opening [the chest], seeing those things and bringing out the [digital] slide box, that’d be a more natural way of coming to them [photos] than booting up the computer” (Dad6).

Mom6 then continued:

“We’ve got this habit about the chest. When we get into it, it sets a tone. It’s time to take a moment and look through them. ...having it [Digital Slide Viewer] in the chest, it’d blend right in. ...with what we’re already doing and the things that’ve always been there.”

Mom8 contrasts Timecard’s location in her living room with the home office-based computer:

“I don’t walk by our computer in the office and think of the memories that’re on it. ...This feels somewhere in between. ...it’d remind me of the memories in there, but if it’s closed up, we could walk past it and leave it at that. ...That makes it feel like a more complete part of our life.”

Additionally, the vintage form factor of the Digital Slide Viewer itself appeared to help set the tone for reminiscing about the past. Members of several families recognized its form, which led to discussions about their lives when they last used one. After one such discussion with her son and granddaughter, GM2 noted:

“seeing something familiar from the past, it triggers all these memories and associations I haven’t thought about in a while. ...it feels like a real way of starting to get back to the past and remember it, with the photos and all.”

Often younger members were actively included in these discussions as the device was passed around; in some cases, they initiated discussions themselves:

“D4-13: Mummy you had one of these. Is this what you used to look at pictures? M4: Yes I did. It was [grandmother’s], she can tell you where she got it from.”

This sample of reflections helps illustrate how giving digital collections physical properties might better support the dynamics of living with them over time, from intentional engagement to simply letting them persist among other significant domestic possessions and spaces.

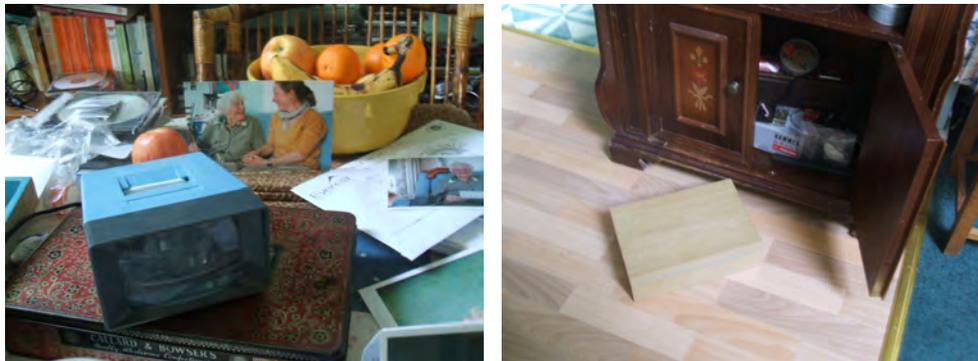


Figure 8. The ability to integrate cherished virtual possessions with similar material possessions within the home heavily resonated with across families participating in this study.

7.3.3 Re-visiting Archives and Changing Social Roles

Families adopted several practices to construct a meaningful whole out of heterogeneous collections of possessions they desired to pass down. In this section, I provide an overview of these practices, before detailing how Timecard in particular provoked discussions about potential benefits and complications technology might present in this context.

A common practice across families was the use of notes and other materials to explicitly detail the history of family possessions to preserve their meanings. These instances ranged from Dad2’s collection of his great grandfather’s medals and other artifacts from World War One, to Mom6’s scrapbook owing to her own life as well as to several departed ancestors. Across these examples, family members included short notes and, at times, materials detailing local and historical events occurring

when specific artifacts were in use to help communicate their significance to future generations.

It was also common for families to consciously re-visit collections of important material things to avoid creating an archive of undesirable size and scale, and to underpin a sense of coherence. I found both parents and grandparents engaged in this practice and while at times difficult, it was considered an essential part of ensuring cherished familial artifacts made it to the next generation.

The constraints families imposed on their material archives did not always translate to their virtual collections. Mom5 contrasts her family's physical photo albums with their virtual archives:

“With the [physical] albums we have to decide what to put in there and what’s not quite worth it. ...On our computer they pile up. We have so many photos on there now and we keep taking more. ...It starts to feel endless, really.”

In two cases (F5, F6), families elected to print out physical copies of digital photos and integrate them into physical albums, to make them easier to manage and pass down. However, when posed with the question of how (or if) families would wish to cull their digital collections for the future, most members were ambivalent.

While archives of material things supported heterogeneity in a way that digital archives did not, they were typically associated with one branch of a family. Discussions of Timecard highlighted that having a place to collate content from multiple sources would also be desirable:

“...thinking about when my Dad passed away. I have some digital photos of him and my sister does, and we both have some of his things. ...If we were able to put some of them [digital things] together, when we’re feeling up to it, that would be meaningful. ...We could have something celebrating his life, and us with him” (Dad7).

Mom1 speculated on the potential benefits of distributed curation of sensitive digital materials over time:

“having a place where my brother could add an event in one of our parent’s lives and I could leave it for a while, and then add something. ...let things come out slowly over time, that would be valuable. ...it would create a new record of our family.”

Virtual archives were also noted for supporting collaboration within nuclear families. However, this raised concerns. Some families perceived that this could complicate meaning:

“If everyone is putting in things like moments in history or notes about a person, it’s going to make things confusing. There has to be some kind of quality control” (Dad1).

Timecard triggered other families to consider how social roles of members would be supported:

“We [parents] take most of the responsibility for preserving things about our parents’ lives and our lives with the kids. ...I like how we could all see it and add to it. That is useful for everyone. But we [parents] need to be able to make sure it doesn’t become a mess” (Mom6).

In some cases Timecard triggered intergenerational discussions among living family members in the room about past experiences and family history. For example, after interacting with a metadata tag relating to the date of India’s independence (15 August 1947), D4-13 felt prompted to ask her Grandmother about her life during this time period. After describing what her life was like as a young girl then, GM4 reflected on what she remembered of her father immediately following World War II. At the conclusion of GM4’s story, Dad4 remarked:

“well, that’s a bit of our family history I haven’t heard. I wish we could’ve recorded [it] in this box [Timecard], right then and there.”

Dad4 highlights the potential value of capturing emergent conversations about family members’ own lives; this opens a space to consider how such records could make interactions with the device richer in the future. However, some discussion emerged about how perceptions of past experiences can shift over time and how technology could pose challenges:

“Even if we remember things from the past the same, the way we feel about them can change. ...like if a photo or summit later reminds us of a falling out we had with a relative. We chuck it in the bin to be done with it. ...So if I put something in there [motioning to Timecard], I should also be able to take it out” (S3-25).

His remarks represent discussions that emerged with the Timecard and the Digital Slide Viewer: the need to take things out of digital archives as fluidly as they are put in.

7.3.4 Tensions Over Virtual Possessions in the Family Archive

The design intention behind BackupBox was to provoke family members to consider the potential role of social networking data, such as Twitter updates, within family archives. BackupBox was highly contentious across families. This section will detail several related kinds of criticism emerged.

Several families possessed diaries written by ancestors now considered important parts of the family archive. These diaries tended to contain mundane information (e.g., a list of household chores completed on any given day) with a sprinkling of extraordinary events (e.g., marriage of family member, birth of child). When asked to speculate on similarities and differences among the diaries and BackupBox, family members drew strong distinctions. Dad7’s perception of the difference between his father’s diaries and social media content is exemplary of members of several families’ sentiments:

“when I open one of his diaries and see what he wrote, I know he sat down and thought for a moment, and that feels significant. ...with stuff like Twitter, people rattle things off, sometimes without thinking ...the intention is different and I suppose that makes a huge difference.”

Backup Box also raised issues over the potentially vast amounts of social networking content other family members would have to reconcile with. D3-22 prospectively considered what it would be like to receive her brother’s social networking archive:

“He posts stuff to Twitter and Facebook literally all of the time. I can’t imagine how many updates there would be for one or two years, let alone a decade. How would we deal with that?”

Other participants speculated on how years worth of Twitter data could trap a small amount of meaningful insights from a person’s life within a sea of trivial entries, potentially making it difficult to explore or let go of:

“If I got, say, Mum’s Twitter. I’m sure there’d be some stuff I’d enjoy seeing, but I’d have no idea how to find it. ...I’d probably keep it, but not know what to do” (D1-21).

When D3-22 concluded reflecting on her brother’s social media content (mentioned above), she noted:

“And it’s so much about him, but not all that much about us. ...or our family.”

This statement captures deeper concerns echoed by members of several families: that social media content is often targeted at different audiences, which could make its place in the family archive controversial. Mom2 describes how this quality could lead to undesirable experiences:

“online it’s easy to act [in] very different ways to different people. Even I confess to that, and I wouldn’t exactly want other people to know about this. ...it feels a little scary that we could learn something about someone that maybe we weren’t supposed to know, or didn’t want to.”

Teenagers in the families I interviewed in this study typically were frequent users of social networking services, and also reacted against the inclusion of their content in the family archive. D6-17 reflects on her personal social media content:

“I could see looking back on it myself, but it would be weird if other people in my family used it to think about me. I’d rather make myself something that would go in it. ...something that’d show my family something special about me.”

Related concerns also emerged around how a device like BackupBox could cause family members to self-censor the social networking content they posted, or paralyze these practices completely. Some families proposed ways to work around these tensions, such as using a special hash tag or a specific application to send updates only to Backup Box.

7.4 Design Opportunities and Implications

It is clear material and virtual possessions hold significant places in families' lives, and that these are envisaged as retaining this significance over time and across generations. A key contribution of the study described in this chapter is insights it surfaced on how technology might open up new opportunities for passing down and inheriting virtual possessions, as well as new complications that they could introduce. Findings revealed a range of ways families desired to treat and live with their cherished virtual possessions. Several of these cases were characterized by their desires to treat these archives differently, integrate them into more appropriate places in the home, and tend to their care and safety. Other instances suggested how technology might better support social practices of creating more cohesive sets of virtual possessions to be passed down, creating archives from multiple branches of the family, and documenting conversations that emerge around them. The devices also raise a range of potential consequences that could emerge if careful consideration is not given to new technological interventions. In what follows I present several design opportunities and implications for the HCI community to guide future research and practice in this emerging design space.

7.4.1 Designing Technologies to be Put Away

Similar to material heirlooms, participants perceived value in supporting the dynamics of living with treasured virtual archives, from knowing their location, to tending to their well being, to actively interacting with them. That the physical forms, material qualities and affordances of the technology heirloom devices enabled them to be packaged away, discretely displayed, or actively explored seemed to resonate with families and some of their existing rituals, practices and values. Reforming virtual possessions in this way allows them to fit into the wider ecology of archived materials in the home and situates them within a familiar context of possession-mediated reflecting, remembering and learning about the past. Beyond designing explicitly for 'use', this consideration emphasizes the aesthetics of integrating treasured virtual archives into environments as a whole over time, a notion parallel to 'slow technology' (Hallnas and Redstrom, 2001). Collectively, these findings suggest that to support more sensitive and nuanced engagement with cherished virtual familial possession requires the artful design of technologies that can be put away, drawn on alongside others, and which evoke rich experiences when interacted with. This is more complex than it sounds; comments about the fractious intrusions of waiting for machines to 'boot up' are indicative of this.

7.4.2 Supporting the Moral Work of Safeguarding

Notions of the value of 'deep storage' (Kirk and Sellen, 2010), redolent in the interviews, highlight clear unresolved tensions between virtual and material possessions. For example, the wooden materials encasing of the technology heirloom prototypes may last one hundred years (or longer), while their technological

components may last for only five years. This highlights the need to design new storage systems that are extremely robust and can handle sporadic use. There are opportunities to explore combined advances in solid-state storage and low power consumption. Although even with hardware innovation it is hard to imagine end users not having to engage with some degree of archive maintenance, as such advances will not resolve significant issues of evolving file format standards and ensuing compatibility issues. However, the ritual work of preservation may accommodate issues of safeguarding. Several instances from the findings suggest that tending to material heirlooms is itself a significant act: rituals of care could therefore be appropriated as opportunities for the physical maintenance and updating of these technologies.

7.4.3 Enabling Multiple Roles in the Archive

One of the largest issues the prototypes provoked families to consider was the various roles members play in maintaining family archives, and how they would be supported in these roles by future technologies. From contributing new materials, to curating collections (organizing and editing etc.), family members play important roles in sustaining the family archive (Kirk et al., 2010). So while technologies might open up opportunities for mirroring archives across homes, richer combinations would need to be carefully considered.

Families suggested Timecard's indirect, distributed nature could create an opportunity for mapping family history 'slowly over time'. In other cases it seemed to open the opportunity to support storytelling and the recording of family history. Both of these opportunities potentially illustrate how virtual possessions from the past might accrue value through repeated interaction, and resonate with prior research (Frolich and Murphy, 2000, Stevens et al., 2003) suggesting the prospect of integrating multiple family perspectives as beneficial.

However, it was clear that family members' approaches to archiving were expected to differ, and this raised concerns over how quality control could be upheld. These issues raise significant questions for future research. How does the architecture of new technology reinforce the moral accountability of access to the content? Who has the right to delete or edit entries? How is this accountability represented in the system? What is the communicative structure that envelops the virtual archive and provision of material within it, and how is this negotiated through technology? Better understanding these concerns seems a crucial part of designing new systems to support the persistence of a family's virtual legacy across generations. Research proposing implications for 'forgetting' as a feature in system design (e.g., Bannon, 2006, Sas and Whittaker, 2013) could be leveraged in future explorations, as could emerging research on multi-lifespan design (Friedman and Nathan, 2010).

7.4.4 Enabling Multiple Representations in the Archive

While previous research suggested people desired to pass down their social networking content to other family members (Odom et al., 2010), families across this study reacted strongly against having a technology like the BackupBox. In particular, these instances highlighted tensions around integrating social networking content from members within the collective family archive. Participants made key distinctions between the thoughtful recording of one's life believed to be reflected in their ancestors' diaries, and their own practices of posting less mindful social networking content targeted at multiple audiences, often outside of the family. These reactions surfaced clear boundaries members had for how they wanted to author their presentation of self within the family archive. Prior work has explored how technology could productively support members in presenting different representations of their selves to each other through novel tools for curating family photo collections (Durrant et al. 2009). While there are clear differences between curated photos and social networking data, this work could be leveraged to further explore how different aspects of unique social bonds between family members could be preserved, while also leaving space for authorship of one's self image in the family archive as a whole.

7.5 Conclusion

This chapter described the design and study of three devices aimed at provoking families to consider how technology might fit within their practices of inheriting, living with and passing down virtual collections in the future. Families' reactions revealed several ways interactive technologies fell short of supporting the values and practices they associated with physical heirlooms, and highlighted new opportunities for design. While researching in this space is inherently challenging, the methodology I used provided a way to engage family members in confronting potential benefits and tensions projected by the technology heirloom prototypes and to draw on their own experiences to make sense of possible technological futures. These reactions provided salient points to consider as people increasingly acquire cherished collections of virtual possessions that they may desire to pass down alongside material possessions that have achieved heirloom status.

Based on these findings, *designing technologies to be put away*, *supporting the moral work of safeguarding*, *enabling multiple roles*, and *enabling multiple representations in the archive* were proposed as opportunity areas for future HCI design research and practice. Importantly, the technology heirloom prototypes did not explicitly explore how to address the challenges that the sheer size and scale of virtual possessions pose as families increasingly amass larger archives. Designing new forms and ways of interacting with massive archives of sentimental materials marks a clear area for

future research, which I will explore specifically in the next chapter through the long-term field trial of the Photobox.

8 Designing for Slowness, Anticipation and Re-Visitation: A Long Term Field Study of the Photobox

The convergence of social, cloud, and mobile computing has made it increasingly easy for people to create, store, and share digital content. These new technologies have enabled people to create vast collections of their life experiences—a valuable resource for connecting with others and reflecting on one's own life. As an example, the social media service Facebook hosts approximately roughly one quarter of a trillion photos. This makes Facebook the largest single photographic archive in the world by orders of magnitude and, with an estimated 350 million photos uploaded to it daily, this archive continues to rapidly grow.¹¹

These huge archives pose new challenges for HCI. As the archives grow larger, they become increasingly invisible, lacking the material presence that might enable people to notice and engage with the archive in the course of their everyday lives. It is also difficult for people to grasp just how big their archives are. Because they do not take up physical space, people feel less inclined to curate their collections and conserve domestic storage space (Odom et al., 2013). In parallel to these emerging issues, there has been a growing concern within HCI to develop new approaches enabling people to experience their personal virtual content in more succinct, accessible, and meaningful ways (e.g., Petrelli et al. 2010; Sellen et al. 2007).

While people are amassing more diverse kinds of virtual possessions, the project described in this chapter focuses on digital photos, one of the most enduring and expansive contemporary forms of personal content.¹² I wanted to investigate new forms of interaction that potentially enable meaningful experiences with photo collections by making them more material and by building in support for self-

¹¹ See <http://mashable.com/2013/09/16/facebook-photo-uploads/> for more details and data related to digital photographs uploaded to Facebook.

¹² This chapter is adapted from a paper presented at CHI 2014 (Odom, Sellen, Banks, Kirk, Selby, Regan, Forlizzi, Zimmerman, 2014). An earlier reflection on the design process of Photobox itself appeared in the proceedings of DIS 2012 (see Odom, Selby, Sellen, Kirk, Banks, 2012).

reflection and re-visitation of the past. In addition, I wanted to investigate the use of *slow technology* (Hallnas and Redstrom, 2001), and how this contrasting concept could challenge the idea of domestic technology being always on and accessible. I also wanted to explore how slowness might grow anticipation and create an interaction pace that better supports self-reflection.

To investigate these issues, I worked with the Socio-Digital Systems group at Microsoft Research Cambridge, UK to implement Photobox, a domestic technology that prints four or five randomly selected photos from the owner's Flickr collection at random intervals each month (see Figure 1). I then deployed this device in three homes for fourteen months, using it to open a critical dialogue with households about the increasing digitization of their photo archive and about the experience of living with slow technology.



Figure 1. H1's initial installation. This Photobox sits on top of the table, while the laptop rests in plain sight underneath.

The field study revealed an interesting change in attitude around slow technology, from frustration to appreciation. Participants drew on the photos to reflect on past life events and celebrate (or let go of) aspects of earlier life stages. Reactions also indicated a renewed interest and appreciation among participants for their Flickr photo collection. Finally, Photobox provoked reflection on the role of technology in the home and even prompted subtle changes in routine.

The project described in this chapter makes two contributions. First, it provides new insights on how slow technology can build anticipation and influence perceptions of value and meaning for digital collections of photos. Second, it provides a rare

example of how a long-term deployment can be used to understand how the experience of a technology can change over time.

8.1 Methodology

Photobox was created with the goal of exploring how slowing down the consumption of digital photos and making them material could generate anticipation, while also providing pause for reflection on and re-visitation of elements in the archive. Another area the design aimed to investigate was how these qualities could shape the perception of the digital photo archive in general. Specifically, the aim was to create a technology that might challenge the always-on-and-accessible qualities of many contemporary consumer devices. Here, the aim was to create a design artifact, which had a form that did not demand attention from its owner(s) nor require participation to enact its function. This methodology drew on several approaches including speculative design (Gaver and Martin, 2000), reflective design (Sengers, Boehner, David, Kaye, 2005), technology probes (Hutchinson et al. 2003) and research through design (Zimmerman, Forlizzi, Evenson, 2007).

8.1.1 Process, Rationale and Implementation

The process leading to the development of the Photobox consisted of the following. The design team reviewed theoretical literature and empirical studies (a sample of which are noted in the prior section). Then, an ideation phase occurred in which many design concepts were generated and then progressively refined and clustered several conceptually related sets to construct an understanding of the overall design space. Follow this was a process of iterative development and critique of the design concepts themselves to arrive at the final design (see Odom, Selby, Sellen, Kirk, Banks, 2012 for more detail on our design process).

It was an intentional choice to have the form of Photobox appear familiar to other non-digital cherished things, aiming for its material aesthetics to evoke a sense of warmth associated with older domestic artifacts. This final design choice help support the goal of creating a new device that, in its form, seemed quite distant to contemporary ‘technology’ (i.e. oak compared to plastic). The two main components of Photobox are an antique oak chest and a Bluetooth-enabled Polaroid Pogo printer (which makes two by three inch prints). The choice to use a chest that had already gathered a healthy amount of patina helped evoked the notion that it was a well-aged artifact that could support the idea of re-visiting past experiences whose materials could inspire a sense of perceived durability (Odom, Pierce, Stolterman, Blevis, 2009). To this end, a printer was used to make digital photos material, contrasting the potential durability of paper prints with digital files.

The oak chest was augmented with an upper panel to hide the technological components (see Figure 2). The printer was installed behind the upper panel with a

3D-printed acrylic case securing it to a small opening in the panel (to allow a photo to drop onto the central platform of the box). This helped integrate all technology used to print photos into a form that enabled it to be fluidly opened up and later put away. This choice was influenced by prior work articulating the value of *designing technologies to be put away* (Odom et al., 2012).



Figure 2. Clockwise from top left: Augmented writing box (open) refitted with wood panels and brass lining; 3D printed acrylic case for printer; Printer power supply hidden in upper panel; Power cord exiting rear of box through brass fixture.

Every month the Photobox prints four or five photos randomly pulled from its owner's Flickr archive. To do this, at the beginning of each month, the participant's Flickr archive is indexed. The .NET Photobox application, paired with a Python script I wrote, then enacts the following set of procedures (which I call *layered randomness*). It randomly makes a binary decision to print either four or five photos that month. Then, it randomly selects four (or five) photos from the index and generates four (or five) randomly selected 'future print timestamps', which specify the print time and date for each photo. Each photo is uniquely associated with a timestamp respectively. When the date and time arrive associated with a time stamp, the matching photo is printed. This application runs on a laptop that communicates wirelessly with the Photobox printer via Bluetooth. Members of our research team lived with the three Photobox prototypes for a four-month period to debug the system prior to deployment and to develop a general sense for how many photos should be printed each month.

Photobox's behavior was intentionally designed to be autonomous, not requiring input from the user. This choice was partly influenced by prior work describing how ceding autonomy to a system can enable new ways for people to meaningful

experience their digital content (Leong, Vetere, Howard, 2008) and, more generally, open a space for pause and contemplation (Woodruff, Augustin, Foucault, 2007). Another approach could have been to curate a special selection of photos from a person's collection to appear in their Photobox. However, randomness was selected to introduce a potentially unfamiliar and disruptive machine behavior. I wanted to explore how people might confront a technology delving into their personal archive and how their perceptions might change over time.

8.1.2 Participants, Data Collections and Analysis

I recruited three households from a large Midwestern city in the United States to participate in our study (nine people in total). This approach clearly has limitations; for example, it makes the results hard to generalize to a wide population of users. Similar to the aim and ambition of the seminal technology probes paper (Hutchinson et al. 2003), and several field studies since then (Gaver et al. 2006; Gaver et al. 2007; Helmes et al. 2010), I wanted to initially focus on a smaller selection of households to gain a richer descriptive understanding of the space as a whole to inform what might be salient issues for future research and practice. I recruited participants through flyers, word of mouth and online advertisements. All participants were familiar with technology, owned digital cameras, and at least one member of each household owned a Flickr account with unlimited storage. No households had children. In the remainder of the paper, I use pseudonyms to describe household members.

Household 1 (H1) consisted of Tim (aged 48, bookstore clerk) and Britt (42, librarian), a married couple who had lived in their current home for ten years. Tim and Britt shared their Flickr account, contributing photos to it nearly equally; they had approximately 4,500 photos in their seven-year-old archive at the start of the study.

Household 2 (H2) consisted of five roommates (two female, three male): Heather (31, massage therapist), Zack (28, grocery store employee), Thomas (30, technician), Jenn (29, postal service employee), and James (29, barista). They had been living together for eighteen months. Heather was the sole owner of the Flickr account and several of her roommates are featured in many photos in it. She had approximately 2500 photos in her five-year-old archive at the start of the study.

Household 3 (H3) consisted of Samuel (35, insurance salesman) and Shelly (34, legal clerk), a couple who had been living together in the same apartment for nearly two years. Samuel was the sole owner of his six-year-old Flickr account. He had approximately 3000 photos in it at the start of the study.

Participants owning the Flickr accounts used in this study all reported similar shifts in interaction with that service over time. Initially, they had been active members in the Flickr community, using the service to support social relationships, and as an outlet

for self-expression (these trends in behavior match findings from prior research on Flickr (Van Djick, 2010). However, over the past several years all account owners had become much less active in the Flickr community. At the time of this study, participants' primary use of their Flickr accounts was as storage for their digital photo collections (approximately between five to sixty photos were uploaded each month). Consequently, the participant pool helped support my goal of exploring how people might more meaningfully re-visit their photo archive on a general level.

I recruited participants with large Flickr photo archives for a few key reasons. First, these large archives would enable us to provide participants with glimpses into past experiences that stretched over several years. During preliminary research, I found many people's locally-stored photo archives were fragmented across various hard drives and physical media (e.g., DVDs). As a result, I decided against using locally stored digital photographs, as the effort required to make these archives cohesive would have complicated the goal to easily introduce a prototype into the home. Second, at the time the Photobox prototypes were created (2010-2012), the Flickr API emerged as the most flexible and robust option for the .NET application that was developed to enact Photobox's behavior.

I aimed to collect rich accounts from participants about the rhythms and activities of the home through semi-structured interviews that took place bi-monthly. This interview schedule included an introductory interview when installing the Photobox and a final interview at the end of the deployment. During my initial home visit (which lasted 2-3 hours), the research team aimed to develop an understanding of members' everyday lives, common domestic activities, perceptions of their photo collections, and technology-usage trends. Household members gave us a home tour and decided where the Photobox should be installed (all Photoboxes were installed in or near living rooms). I deliberately gave brief descriptions of the Photobox, noting it will occasionally print a photo from the owner's Flickr archive. I wanted participants to develop their own interpretations over time. I did not explicitly encourage participants to interact with the prototype and all were aware they could drop out of the study at any time.

The printer embedded in the prototypes was limited to holding ten pieces of paper, requiring us to visit each household bi-monthly to re-load each Photobox. These sessions were advantageous for us to probe and record household members' unfolding experiences with the Photobox in a reasonably structured, yet informal manner. These sessions typically lasted 60-90 minutes. At the conclusion of the study, I visited each household to collect the prototype and conduct in depth interviews with participants (these sessions lasted 2-4 hours). I commonly referenced prior field notes and recordings capturing participants' earlier experiences to explore possible changes in attitudes toward the Photobox, and to better understand changes in experience with it over time. I also paid attention to possible changes in attitude toward Flickr archives, emergent interpretations of the prototype, and how it potentially affected domestic practices.

All interview sessions over this fourteen month period were audio recorded, producing 40+ hours of content. Relevant segments of recordings were transcribed. Researchers also took field notes and documentary photographs during each interview. Field notes were reviewed immediately following each interview, and tentative insights were noted in reflective field memos (Miles and Huberman, 1994). I held weekly meetings to discuss emergent findings. Analysis of the data was an ongoing process. After each home visit, I conducted preliminary analysis, searching for emergent (and shifting) patterns across recordings field notes and photos to draw out underlying themes (Glaser and Strauss, 1967). I coded raw data documents with these themes. I also created conceptual models and affinity diagrams to reveal unexpected connections and differences among households. I present several descriptions and examples taken from field observations that help illustrate the themes.



Figure 3. Significant challenges had to be overcome in the field when deploying and servicing Photoboxes in the field throughout the duration of the study.

8.2 Findings

Despite the relative simplicity of the Photobox, it provoked a range of reactions across households—many of which were characterized by initial frustration and disappointment, which slowly shifted towards acceptance, and pleasurable anticipation. In what follows, I first describe how this *trajectory of appreciation* (Gaver et al., 2006) unfolded across the three households, with particular attention to when the transition from disappointment to acceptance occurred. I then describe ways in which the Photobox shaped participants' perceptions of their digital photo collections. Finally, I detail insights into participants' reflections on living with slow technology.

8.2.1 Experiences over time: from frustration to acceptance

Gaver et al. (2006) describe acceptance of new technology prototypes as moving across a *trajectory of appreciation*. A new technology may initially be embraced with excitement because it is novel. As novelty wears off and expectations are potentially unmet, people may become frustrated or disillusioned. Over time, the technology will normalize into a state of understanding—it is either abandoned or accepted. If accepted, people's experiences with it may improve as they develop ways to work around the difficulties they faced, and eventually the technology can integrate into everyday life.



Figure 4. H1's Photobox after the laptop was moved under a living room couch (in month six of the study).

While individual trajectories understandably varied, all three households followed a similar path: a period of initial excitement in the first few weeks, followed by tensions that emerged around a lack of control over the prototype, and, eventually key moments of acceptance as the Photobox settled into everyday life. In what follows, I briefly describe these stages.



Figure 5. H2's Photobox kept alongside many electronics and entertainment technologies.



Figure 5. H3's Photobox kept near the kitchen and living room.

The first four to eight weeks were characterized by excitement that tended to overshadow disappointment. While participants were aware the Photobox would only occasionally print a photo, it was common for them to check the box everyday (often several times). For example, Britt-H1 reflects on her experience during this period of the study:

“It’s this new thing here [points to dining room]. It looks interesting, kind of antique. It’s lovely. And, the photos it’s popping out, we haven’t seen most of them in so long. ...it’s intriguing when we get one. But, it does make me want to have another one and another one. ...I guess I don’t mind too much not being able to push a button and make it pop another one out. I am peeking in on it all the time. Sometimes there won’t be one for a week! Or longer!”

The optimism and creeping tension voiced in Britt’s reflection is exemplary of discussions with households in the first two months of the study. Between months three to six tensions continued to surface, often leaving participants conflicted. They were usually delighted to receive a new photo, but struggled to come to terms with a

lack of control over the Photobox's slowness. During the final interview, Samuel (H3) reflects on his experience in month four:

“At the time I think I didn’t even realize how many images wash over me everyday. I’m so used to seeing photos on the internet, just clicking through them rapid fire [makes rapid clicking sound], it became hard to wait. ... When it did [print] I’d get excited but also well I’d get kind of tense. I’d be like ‘When’s the next one coming? What’s it gonna be? When should I look next? Why is it doing this to me?’”

In another case, Heather (H2) reported confronting her roommates about taking her photos as a way of rationalizing why they were not appearing as frequently as she initially desired:

“At that point, I think I was projecting my craving to see more little bits of my life onto my roommates.”

In general, as a matter of coping with these struggles, this period of the study was characterized by participants' efforts to 'make sense' of the prototype and, in some cases, the study as a whole. Accordingly, during this period, I encountered a range of speculations from participants about the Photobox. Tim (H1) appeared briefly convinced his Photobox would only print photos of people wearing hats, while Heather (H2) considered her Photobox may be predicting her love life after a photo of her ex-lover was consecutively followed by one of her current boyfriend. Interestingly, Samuel (H3) became temporarily skeptical of the study, mentioning he had at one point considered that the prototype was actually designed to track his movements through the house. Collectively, these descriptions help illustrate a period in which participants attempted to make sense of the device and, in some cases, balance their expectations with its slowness.

However, as the study progressed, I observed these tensions began to fade across households in different ways. During the final interview, Britt and Tim (H1) reflect on an important decision they made in month six: “

Britt: At first we were excited to show it to people and get the photos. Then, it became kind of a drag because, you know, we want to use it, but we can’t do anything. I’d be walking through into the kitchen and be thinking ‘When is the next one coming?’ ... Then we moved the computer under a [living room] couch. ... That made it [Photobox] less like a focal point in the dining room. ... it became a lot easier to not worry about it but also not forget about it. Tim: Yea after the laptop was gone I didn’t have to come and see the little lights on it and wonder what it’s doing. ... It eased things up. It became a lot more comfortable for us.”

While members in H2 and H3 made no material changes to their Photoboxes, they did note shifts in perception. Samuel describes how returning from a two week vacation in month seven caused him to critically rethink his perspective:

“The surprise of getting a photo was great but I had this, I don’t know, sense that I should have some ability to make it print. ... Sometimes I’d have these thoughts like why am I not telling it when

to? I guess it's what I'm used to doing. ...When we got back [from vacation]. ...I opened it up and found three photos, one was of a different trip, [from] back when we first met. That's when I felt like I 'got it.' It's going to do its thing. It can take care of itself. That way of thinking about it changed things for me. I don't have other things that do stuff on their own. From then on, it started to take on a personality. It's independent and takes its time, but it's going to print something for me."

Somewhat similarly, Heather (H2) discusses how her perception of Photobox as a "technology" had to change before it could be completely integrated into her life:

*"Even though it's using a laptop and getting on my Flickr, I had to let go of any idea that it's like our other gadgets. ...[laughs] it's not too typical that I have to **wait** for technology. That took time to get used to. Zack: But it's also not asking you for anything. Heather: Yes you're exactly right and I think that's one reason why it's cool. ...why I want to keep it."*

Collectively, these reflections illustrate how participants' perceptions of the Photobox changed over time as it transitioned from a perplexing and, at times frustrating, device, to one that was eventually understood and integrated into the home. In the next section I describe how the Photobox facilitated interactions with households' Flickr archives. All of the remaining observations and reflections are taken from interviews after these points of transition had occurred.

8.2.2 Anticipating re-encounters with the archive

While households were initially frustrated by the slow rate of photos being printed, over time they appreciated how this pace created time to reflect on an individual image and the memories it triggers. The photos printed by the Photobox served as resources for reflecting on past life events and celebrating (or letting go of) aspects of earlier life stages. In the final exit interviews, participants reflected on their earlier experiences and how perceptions of the Photobox changed over time. For example, Samuel (H3) describes his experience during the final six months of the study:

"I'd take some time, a few minutes, and think about the people or the place in the picture. And I'd be focusing on the other stuff not in it too. ...What was going on in my life then, where I was at."

Samuel later compared his experiences with the Photobox and his photo albums:

"I think I started to understand why it didn't print many [photos]. ...Made them more special but also more easy to take in, in passing. ...[It's] kinda similar and kinda different to [looking at] a photo album. ...With [my photo albums], I have to make time and get absorbed in them. I get a lot out of it. But, realistically I don't do it much. ...The box created that same sort of feeling but without having to prepare to get too deep. I could look in, think for a minute then go about my day. ...since I never knew what was coming, there's no way I could prepare and now that I think about it, that's one reason it kept being exciting. ...It has certainly reinvigorated my [Flickr] account."

Similarly, Heather and Jenn reflected on how the Photobox provoked curiosity among members in Household 2:

“Heather: *Eventually, the whole not knowing when it would print or what it would print made me curious for sure. It made me realize how I lose track of what’s up there [on Flickr], even though I uploaded it at some point. That got me pretty interested about what might be coming next.*

Jenn: *We were all a little curious ...wondering who might be in the next photo. Sometimes we’d all be here and looking at the photos and asking her about them. Like, why one of us was in one but someone else wasn’t? I think we learned a great deal about her past. Maybe more than she wanted us to!*

Heather: *That’s probably true! ...Overall it’s been an interesting experience. We’d never be sitting around my tiny laptop laughing about my photos like we did.”*

More generally, the randomized, non-linear approach to re-visiting Flickr photos appeared well accepted across households. For example, Britt (H1) draws a comparison between the randomization and her own experience of remembering:

“*We’ll get a photo of a concert we went to and that’ll make me think of a person I went with, and then I’m thinking about something else we did together. ...so I remember experiences but not always in the order they happened. I like how this had that going on.”*

Randomization was also commonly described as a key quality contributing to the building of anticipation. Following Britt’s reflection in this same interview, Tim’s remark characterizes a sentiment I encountered across participants:

“*It could’ve printed anything from seven years ago to last month. There’s a lot that happened in that span of time, so we were usually surprised at what we’d find.”*

Collectively, these reflections help illustrate how, over time, the Photobox supported experiences of anticipation, reflection, and meaningful interactions with participants’ Flickr archives. However, occasionally participants encountered photos representing memories they wanted to forget; they were typically unaware these photos were still in their archive. While these examples included things such as images of now stolen possessions (e.g. bicycle, musical instruments); the two most compelling examples involved Samuel (H3) and Heather (H2) receiving photos of previous lovers, which they both they discarded the printed photo and deleted these images from their Flickr archives.

8.2.3 Transitioning the online archive from digital to material

A core aspect of Photobox’s design is its ability to make two by three inch material copies of Flickr photographs. I wanted to explore how participants might react to the transition from the digital to material, and explore any differences in perception between the two. In general, participants highly valued the material affordances of the paper copies, particularly in terms of (i) how a sense of age could be more richly captured over time as well as (ii) how they could be more easily integrated into

everyday life. For example, Heather (H2) describes the material wear occurring on a subset of photos kept in her wallet and, at times, under her pillow (see Figure 5):

“Some of them [prints] represented special moments in my life. When I’d get one of those, I’d think ‘this is a good omen.’ Sometimes I’d slip one under my pillow at night. ...I’m not exactly going to put my laptop under my pillow! [laughs] ...They started to crease and bend from the humidity and me jumbling them around. ...It’s part of their history. That’s something I’m obviously not going to get with the photos in my [Flickr] account.”

In reflecting on the physical prints received from Photobox, Britt and Tim (H1) noted a re-emergence of their practice of curating photos on the fridge:

“Britt: Back when we developed our photographs, we’d have a rotating group of them on the fridge, like a lot of people did. When the change to digital came, we stopped printing them out almost entirely...”

Tim: Yeah so if you remember our fridge before, it didn’t have many photos on it. Maybe a few from wedding invitations and some postcards. That’s pretty much it. ...Having [material] copies got us back into it. We change them around as more come in and decide our favorites. ...It opened up a familiar way of using photos but kind of updated to our [Flickr] collection.”

Interestingly, Samuel describes how the Photobox was able to support a richer way of re-visiting his digital photo collection, without compromising the value of online redundancy:

“It is extremely important to me. That’s one reason I still use Flickr, to back it up. If our apartment burned down or flooded, god forbid, it would be saved. ...It took some getting used to, but I liked how it [Photobox] gave me little reminders about what’s in there. Every once in a while I’d go back to check out some of the other photos online from around that time period or call a friend I hadn’t seen in a long time that was in one of them that printed. ...It was the best of both worlds. I knew all of them were backed up [online], but I also had some right here. I didn’t have to deal with trying to organize them better. Or, even figure out where to start [re-visiting them].”



Figure 7. Left, a valued selection of photos, some of which Heather kept under her pillow from time to time. Right, a rotating curation of Flickr prints on Britt and Tim’s refrigerator.

These reflections help illustrate how, in different ways, Photobox enabled participants to have richer interactions with the photographs in their Flickr archive.

These ranged from supporting material wear over time to the re-emergence of everyday photo curation in the home. Samuel's reflection provided insights into how the device supported a need for ensuring the redundant backup of his archive as well as his desire for richer, less overwhelming experiences with his digital photo collection.

8.2.4 Living with slow technology

Beyond experiences with the printed photos, households discussed living with the device itself. Drawing from the final bi-monthly and closing interviews, I briefly describe how the long-term experience of living with Photobox provoked participants to critically think about the role of technology in their everyday lives.

During these discussions some participants described how, over time, the relative slowness of the prototype provoked them to consider the rate at which other domestic technologies operate. Tim (H1) describes how undemanding it was compared to other devices in his home:

“Sometimes I am overrun. ...the sound of the TV and my phone, texts and notifications. Things to do and people to get back to on it [motions to iPad]. ...it's creative in getting away from all this. ...I like how it's a technology but it does stuff in a simple way. ...[it] wasn't yelling at me.”

Similarly, Heather critically considers her technological habits and describes a recent change in her routine:

“It made me think about how quickly things are moving these days. Like I check Facebook four or five times a day, clicking through all kinds of stuff. Like what's all that information doing to my brain?? ...I thought about changing things up some. ...I took a break from Facebook recently. Don't know how long it'll last [laughs] but I thought why not try it out.”

Interestingly, Samuel (H3) makes a comparison between his experience of reading a Sunday newspaper and Photobox:

“I let my subscription to the Times expire a few years ago. Now I read everything online. I jump around [from] site to site on Google News. I'll have [Google] chat going too. It's fun, don't get me wrong, but it does feel different than when I was reading the paper. ...It's a calm feeling. I didn't expect it [Photobox] to make me think about that, but every once in a while it did. ...Finding a few photos, looking at them in an involved but laid back way reminded me of it.”

Participants also described how the background nature of the Photobox contrasted with other domestic technologies. For example, Britt (H1) likens the presence of Photobox to other material artifacts in her home:

“[It's] in the backdrop of our life, not distracting, just there. ...like many of the things we keep out on the mantle or put up on the wall.”

Collectively, these reflections help illustrate how the Photobox provoked some participants to critically consider the role of technology in their everyday lives and, in Heather's case, make a subtle change to her routine. They also highlight how participants, such as Samuel and Britt, drew on experiences and metaphors in which digital technology was conspicuously absent to describe their interactions with and perceptions of Photobox.

8.3 Discussion and Implications

It is clear that photographs hold a significant place in people's lives. However, the transition of photo collections from physical to digital brings new complications as they grow to increasingly unmanageable sizes and become more difficult to curate. A key contribution of this study is to reveal how technology might open up new opportunities for engaging with large and growing digital photo collections by making them more material and by building in support for re-visitation of the past through slower interaction.

Experiences of living with slow technology provoked participants to broadly reflect on the role of technology in their everyday lives. The Photobox was ultimately successful at opening up new experiences for participants with their photo collections, and in some cases, older photo curation practices re-emerged. These findings highlight the complexity bound to designing for reflection, re-visitation, and anticipation, and the challenge of enabling meaningful experiences with domestic technology that overrides user control. In what follows, I articulate several research and design considerations for the HCI community that emerged from this work.

8.3.1 Designing for Anticipation

A core goal of this study was to explore how a design might build anticipation. It appeared the combined design choices of slow pacing and *layered randomness* were effective. Participants could not easily develop expectations about how many photos the device would print each month, when they would print, and what glimpses into their life they might provide. While these aspects of the Photobox design ultimately led to valued experiences, they were also the source of much frustration as participants struggled to recalibrate their expectations of living with a potentially worthwhile technology they had little control over. This highlights the complexity of designing for anticipation: people's desire to be in control and the enjoyment that can emerge if control is ceded to the system in a meaningful way. Balancing these two concerns harmoniously is difficult and unpredictable.

However, I found the Photobox provoked anticipation around receiving new photos, and that people generally connected these prints to three main themes: a person or social relationship, a specific life stage, and even an interpreted thematic sequence (e.g., Heather's past and current romantic relationships). Each of these themes

suggest interesting spaces for designers to explore in the future when considering metrics to mine and re-present elements in valued digital archives.

More generally, the topic of anticipation has been described in prior HCI research as an important thread of felt experience (McCarthy and Wright, 2004). However, little work has directly explored how these notions could be applied to the design of new technologies for reflection on the past. This study contributes to this small but potentially important area of future HCI research. In particular, developing more meaningful ways to support the experience of ceding control to an interactive system in the context of re-experiencing one’s digital content marks a clear space for future research in the HCI community. Prior research on the relationship between autonomy and reflection (Gaver et al., 2007; Helmes et al. 2010; Woodruff et al. 2007) could be leveraged in support of this direction.

8.3.2 Designing for Re-Visitation and Reflection

The study has also highlighted how making digital photos materially present in the home played an important role in supporting re-visitation and reflection around this personal content. Printing the photos enabled participants to better incorporate material versions of their digital photos into their everyday lives. In some cases, this led to ritualized uses of the print outs (e.g., Heather putting ‘good omen’ photos under her pillow at night) as well as the re-emergence of prior practices of curating photos in the home (e.g., Tim and Britt’s refrigerator). Interestingly, Samuel described how receiving material copies of his Flickr photos enabled him to “have the best of both worlds”, where he simultaneously experienced the comfort of cloud-based storage and redundancy along with the manipulability and intimacy of physical photos. Clearly there are opportunities for increasing the presence of digital photos through new digital display technology. However, Samuel’s reaction subtly highlights how people may not currently be experiencing the richness of combining physical form with the placeless, reproducible qualities that digital archives can provide.

These findings suggest a future opportunity for the HCI community to explore more diverse ways that new technologies might re-present different elements of people’s ever growing—and increasingly online—collections of personal content. This approach could be applied across different kinds of archives and potentially clustered around digital histories of social relationships or events. For example, new interactive systems could be designed that create databases composed of electronic messages, photos, and location histories shared between two friends or those that characterize a specific life stage. Elements from such archives could be made present in everyday life to support reflection on these past experiences. Further, new systems could directly gather feedback from people to explore the extent to which different combinations of digital content are likely (and unlikely) to evoke aesthetic, meaningful experiences over time. This direction could provide a step toward enabling interactions with systems that subtly influence their behavior without

ceding control to the user. Nonetheless, in some cases participants did have negative experiences as they re-visited old photographs, which they had materially (and psychologically) expunged from their everyday lives. This marks an important implication to consider in the design of new systems aimed at support re-visitation of past experiences.

The Photobox successfully opened up new opportunities for participants to experience their expansive Flickr archives in slower, more succinct and meaningful ways. However, it is important to acknowledge that if left for six months or a year, the Photobox prototype itself could easily create a proliferation of digital prints that could induce overwhelming experiences. Importantly, in the aim and ambition of technology probes (Hutchinson et al., 2003), my goal was not to engineer a solution to the problem of digital content proliferation. Instead, I hoped to further develop the design space for future exploration by HCI researchers and practitioners.

8.3.3 Slow Technology Research Considerations

Another goal of this study was to explore people's experiences living with slow technology over an extended period of time. While participants initially struggled with the unfamiliar pacing and (in)action of the prototype, over time they began to embrace these constraints and accept the Photobox as they reconfigured their perceptions of how this device played a role in their home.

The Photobox provoked participants to critically consider the role of technology in their everyday lives and, in Heather's case, prompted a subtle, if not temporary, change in her routine. These findings illustrate how the pacing of the interaction not only opened a space for reflection on participants' pasts, but also on their current domestic technological practices. Photobox was eventually accepted as a *background technology*—one that could be closed up and fade away, not demanding nor requiring the owners' attention. Building on recent values-oriented calls for design initiatives that help constrain people's choices (Sengers, 2011), this study suggests an opportunity for future research to explore how new technologies could be created that similarly embrace unfamiliar constraints, operate on their own, and potentially enable people to make sense of (and draw on as resources) in their own time, when desired.

However, it is important to point out that the slow technology design space poses several practical and methodological challenges. For example, it is unclear how long deployments ought to last. Fourteen months was an appropriate scaling for this study considering the rate at which the Photobox created new photos. However, the amount of time and resources required for such a study may not always be at a research team's disposal.

The slow technology design space presents an under-engaged yet fruitful opportunity area for future research in the HCI community. The study described in this chapter

provided a glimpse into how long term deployments of slow technologies can open unique opportunities to explore designing for anticipation, mindfulness and reflection. It has clear links to ongoing initiatives exploring how more enduring forms of technology can be designed and how this might shape people's (or future generations') experience over time (e.g., Friedman and Nathan, 2010; Karapanos et al., 2009; Odom et al. 2012; Odom et al. 2009). On a broader level, this study provides a case building on and expanding prior research (e.g., Blythe et al., 2002; Gaver and Martin, 2000; Gaver et al. 2007; Grosse-Hering et al. 2013; Hallnas and Redstrom, 2001; Leshed and Sengers, 2011; Maze and Redstrom, 2005; Sengers et al., 2005) articulating how embracing values alternative to the more dominant focus of efficiency and usability can critically nurture and expand future research in the HCI. It is my hope that this work will inspire the HCI and interaction design communities to explore designing slow technology in the future as they increasingly focus on the intimate contexts of everyday life.

8.4 Broader Contributions of this Study

On a broader level, the Photobox project produced several contributions in support of this dissertation.

First, several key findings from my prior projects suggested that designing slower interactions with cherished virtual possessions represented a compelling design opportunity area. In the Teen Bedroom User Enactments project (described in chapter 4) I unexpectedly found that teens valued the slow pace of the 'postcards from the past' concept, and reflected on how this slowness could be applied more generally to how virtual possessions could become emergent and eventually present within their bedroom. These reflections often directly contrasted the overwhelming presence of the 12-screen display in the prototyped bedroom. Additionally, across the Technology Heirlooms project (described in chapter 7), the ability to put one's cherished digital collections away with similar cherished material possessions in the service of having slower, longer-term interactions with these things strongly resonated with participants. However, in part due to the generative, exploratory nature of these projects, they did not include participants' own personal data within the prototypes, and in neither case did participants 'live' with them over time. Albeit small in scope in terms of the number of households Photobox was deployed with, the eventual acceptance and widespread positive reactions to this slow technology provides promising evidence that this design opportunity area is beneficial and worth continued future explorations. Beyond supporting findings in my earlier work, the Photobox study was extremely well received by the CHI community, earning a best paper award, which helps demonstrate this opportunity area's potential to inspire and provoke future work around designing slow or alternative interaction patterns with cherished virtual archives.

Second, the Photobox project illustrates the virtues of using prototypes to explore potential future interactions with virtual possessions over a relatively long period of

time. As I have argued in this dissertation, much like material things, virtual possessions play important roles in people's lives, but due to their immaterial nature fundamental differences emerge in terms of how people experience them. For example, the fact that a digital device typically must be used to make virtual possessions present often leaves people with two options: either directly interacting with an archive of virtual possessions or not directly interacting with it (in the later case, it is likely not present, persisting somewhere on a hard drive, server or device). Currently, there is little space for virtual archives to exist between these binary possibilities. A key characteristic of a cherished material possession is its ability to function as "a companion in the life experience" (Turkle, 2007, p. 5). What Turkle points to in this quote, and what has also been widely investigated in consumer behavior literature, is that the enduring presence of our cherished things around us play highly significant roles in developing deeper meaning with and attachment to them. They can exist in the background of our everyday lives, not necessarily grabbing our attention while still remaining present and re-affirming who we are through one's occasional glance or through deep contemplation and interaction with it. Once accepted, the Photobox was successful at functioning as a "background technology", helping to bring experiences with digital photo archives a step closer to this middle space that virtual possessions have such a difficult time occupying. The embodied, aesthetic form of Photobox combined with the slower interaction pace emerged as a productive way to achieve this balance and to enable the device and the printed photos to become sedimented within people's everyday lives and practices. Over time, the presence and expression of the Photobox became an incorporated part of the participants' households and, ultimately, their *lifeworld* (Hallnas & Redstrom, 2002).

Third, participants' experiences with Photobox (and the printed photos) over time illustrated how it, to some extent, broke down boundaries between the virtual and the material. The hybridity that Photobox offered in terms of its cohesive, highly resolved integration of analog and digital components emerged as a highly valued quality of the design. In reflecting on the experience of his Flickr photo archive through Photobox, one participant remarked, it offered "the best of both worlds." In this quote the participant references how his Photobox provided the safety and reassurance of the entire digital photo collection being backed up remotely across redundant locations in the Cloud, while also offering the immediacy, tangibility and even fragility that make material photographs so unique and valued. One of the experiential qualities of a virtual possession when kept in the Cloud can be characterized as *placelessness*—it can be easily reproduced across material environments simultaneously in valued ways. But, this quality can also paradoxically make it more difficult to know where a particular virtual thing 'is' at any given time or who has it. The Photobox helped mitigate these complications by, in essence, reinstating a sense of *placefulness* through its capacity to produce material photographs in an anchored physical location (i.e. the embodied prototype in a familiar place in the home).

The Photobox study provided a worthwhile example of how leveraging different inherent experiential qualities of virtual and material things can open up new opportunities for people to construct value and meaning with their personal digital collections. However, little work exists to help provide a broader understanding of what virtual possessions are as a class of artifacts, how they are experienced, and how these experiences differ from material possessions. In the next chapter, I will critically revisit and synthesize findings from my prior fieldwork projects to tackle these issues and to propose a novel conceptualization of a set of qualities that help characterize the experience of virtual possessions.

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

Despite there being an ongoing interest in people's practices with their digital content and archives in the HCI and interaction design communities, little work currently exists to help guide the design of new, novel and potentially more valuable experiences with virtual possessions. One reason for this is that the experience of virtual possessions can exhibit key differences compared to material things. My prior fieldwork studies uncovered some of these differences to varying extents. However, the way in which the findings from these studies were framed understandably emphasized how virtual possessions related to and shaped the particular concerns, values and practices of the respective populations I was studying with an eye toward developing new design strategies to better support value construction activities with their virtual possessions.

In this chapter¹³, I will adopt a broader perspective to synthesize and reflect on findings from five fieldwork studies I 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 I adopt in this chapter allows me to surface key thematic qualities that help characterize how people experience virtual possessions, to explore how these experiences are similar to and difference from material possessions, and to relate these themes to existing research in the HCI community. I see this as another step toward developing an understanding of factors shaping the experience of virtual possessions. 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.

¹³ This chapter is adapted from a paper published in the proceedings of the DIS 2014 conference in Vancouver, Canada (Odom, Zimmerman, Forlizzi, 2014). All of the fieldwork studies that I conducted that are described in this chapter have been previously published in the proceedings of past CHI or DIS conferences (and each are cited accordingly, although not all appear as chapters in this dissertation).

This research described in this chapter 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: *placelessness*, *spacelessness* and *formlessness*. Second, it draws on the proposed qualities as lenses to help frame design opportunities to better support value construction activities with virtual possessions. My overarching goal is to nurture the HCI and interaction design communities' interests in virtual possessions as a research topic, and to take a step toward advancing it beyond a nascent level of understanding.¹⁴

9.1 Summary of Field Studies

In this section, I give a brief overview of my prior studies not previously discussed in this dissertation. In addition to the following studies, I draw on the teen study (Chapter 3), the cloud study (Chapter 5), and the young adult study (Chapter 6).

Bereavement Study: Understanding Bereavement in the context of Interactive Technologies. In collaboration with colleagues in the Socio-Digital Systems group at Microsoft Research Cambridge¹⁵, I conducted in depth in-home interviews with 11 bereaved participants across the United Kingdom in 2009 (Odom, Harper, Sellen, Kirk, Banks, 2010). I wanted to understand how emerging technological trends are requiring people to confront a range of new issues, such as dealing with and curating locally stored or online digital archives and accounts inherited from departed loved ones. I anticipated many of these concerns owe to the fact there are few mechanisms in place that help people deal with the proliferation of their digital data and accounts on larger time scales, in and beyond their own life span.

Divorce Study: Divorced Families and Interactive Systems. In collaboration with my advisors at Carnegie Mellon University, I conducted in depth in-home observations and qualitative interviews with 13 divorced families with joint custody during 2009-2010 in a large Midwestern city in the United States (Odom, Zimmerman, Forlizzi, 2010). A total of 13 parents and 46 children (ages ranging from 10-17) were interviewed. One strand I focused on was teens' experiences of transitioning between two domestic environments that were often very different on social and material levels. I paid particular attention to the possessions teens drew on as coping mechanisms in these circumstances.

¹⁴ See Edmonson and MacManus' (2007) 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 (p. 1158).

¹⁵ This fieldwork was conducted during an internship at Microsoft Research Cambridge where I worked with Abigail Sellen, Richard Harper, Richard Banks and David Kirk (then at University of Nottingham).

9.2 Experiential Qualities of Virtual Possessions

In what follows, I draw on findings across the aforementioned studies to unpack three thematic qualities to help characterize aspects of people's experiences with their virtual possessions. Similar to Löwgren and Stolterman's (2004) discussion of *use qualities* of interactive artifacts, I 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.

These qualities emerged in part from ongoing reflection and analysis on findings across all five studies. As a part of this process, I reviewed prior transcribed data, photographs, field notes and textual documents coded with themes specific to individual studies. I also created new textual documents coded with overarching themes, and conceptual models and affinity diagrams to help structure emerging themes and connections. Additionally, I critically considered technological trends that in part opened up possibilities for what I observed in the field to occur. This chapter provides a space to conceptually consider findings across my five studies from a higher-level perspective. For each quality, I 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.

9.2.1 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 kept 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, this quality 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.

9.2.1.1 Placelessness and value construction activities

I 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 my 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 cohesive sense of a 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 I 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 (Shklovski and Mainwaring, 2005). Interestingly, in the Divorce and Teen Studies the trends of creating placelessness through mobilizing and carrying large virtual archives as well as 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.”

9.2.1.2 Complications and workaround 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, I 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 I 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's 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.

9.2.2 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 in part be linked to the proliferation of increasingly affordable hard drives and appliances offering massive amounts of storage space. In particular, it appears that 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.

9.2.2.1 Experiencing spaceless virtual archives and possessions

Across many studies it was clear that people valued the experiential 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 and books, 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 being one's first job after college, many participants were in transitional situations and connected the value of spacelessness 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.

9.2.2.2 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 phenomenon that has since been documented elsewhere (e.g., Massimi and Baecker, 2010)).

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, I 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.

9.2.3 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* (2003, 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.

9.2.3.1 Formlessness and value construction activities

Across several of my studies, the metadata that could be applied to a virtual possession surfaced as a resource for people to manipulate, re-shape and personalize their virtual possessions. In the Teen study, there were several instances in which teens described giving and receiving musical playlists as gifts, several of which had 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. Several other teens used this practice to, for example, 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, I encountered a range of instances in which participants created virtual copies of cherished material possessions that were typically constrained to particular physical locations. What I 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 the 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 the 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.

9.2.3.2 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 the 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.

9.2.4 Discussion and Implications

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 perceive and experience virtual possessions can differ substantially from their experiences with material possessions. I 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, these qualities are 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 (Hekkert, Snelders, Wieringen, 2003). 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 critical reflection and discussion, I describe future research and design opportunities for investigating how metadata might positively address some of the shortcomings that people experienced with placelessness, spacelessness and formlessness.

9.2.4.1 Placelessness

Across studies, people's experiences of placelessness supported value construction activities with virtual possessions, particularly in terms of enabling people 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 the potential of being meddled with by unknown entities or suddenly lost. 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 and defined digital place that people keep and 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 I encountered in the 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 largely preserve the beneficial aspects of placelessness, while reinstating a deeper sense of awareness of one's distributed collections, and while providing 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 through applications, devices and appliances.

9.2.4.2 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 same benefit also caused archives to become increasingly unfiltered as they invisibly grew larger, hindering people's ability to meaningfully curate them over time. In contrast to Belk's discussion of material collections as being characterized by their ability to become finite and complete (Belk, 2004), virtual collections seemed boundless, producing often-unresolved immediate and long-term consequences.

These issues echo broader concerns that critically question a 'total capture' lifelogging perspective within the DIS and HCI communities (e.g., Petrelli and Whittaker, 2010; Sellen and Whittaker, 2010), and demonstrate clear need for designers to develop new opportunities to support the curation of virtual archives. In many cases, I found people used largely ineffective approaches for sorting their virtual possessions, such as by their name, 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 (Feinberg, 2013). As the community begins to look toward longer-term implications of multi-generational interactions with virtual archives (Freidman and Nathan 2010), 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, there exist opportunities for future research to explore designing new interactive systems that might rigidly embrace storage space limitations to effectively 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. (2013) suggesting digital photos that decay over time provides a radically different way of achieving this same outcome. On a broader level, 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, this approach offers little help for the problem of existing large archives

and could compromise the inherent value of spacelessness that people have grown accustomed to.

9.2.4.3 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 and particular histories. The manipulability that formlessness affords could support the creation of highly personalized virtual possessions and even assemblies of related 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, across studies people struggled to create more unique or idiosyncratic virtual possessions reflective of their life story and 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 game could be combined along with social media comments, video, information about the people present, as well as that day's weather report and ticket purchase information. New interactive applications and toolkits could be developed to support the construction and manipulation 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 (2013) 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.

9.3 Conclusion

I have reflected on and synthesized findings across five field studies I conducted that investigated people's practices with and perceptions of their virtual possessions. A core goal of the research described in this chapter 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. I proposed *placelessness*, *spacelessness* and *formlessness* as a set of interrelated and paradoxical qualities that shape people's experiences with their virtual possessions. These experiential qualities can be used as constructive lenses 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 aimed at enabling more valuable conceptions of virtual things.

As noted earlier in the chapter, the aim and ambition of this work is to constructively open up a set of experiential qualities; however, they are not exclusive and it is likely others will exist. This initial set of qualities provides an emerging vocabulary to catalyze further critical inquires exploring what virtual possession are as a class of artifacts, and what they could become in the future. There is clearly more fascinating work to be done as the community's knowledge of this area transitions beyond a nascent level of understanding.

While not an experiential quality *per se*, the ability to accrue machine and human generated metadata is another unique characteristic of virtual possessions. In the future, I intend to expand this research by critically examining metadata and unpacking the similarities and differences it introduces when comparing material and virtual possessions. From the patina acquired through years of use or annotations attached to (or inscribed in) an object, material possessions too can have 'metadata', albeit in quite different ways. Future research in this area will help articulate what metadata is on both practical and theoretical levels in the context of virtual possessions, and, importantly, how it can be used as a design material in future interaction design inquires and initiatives.

Additionally, the issues of timelessness and temporality are and will continue to become important areas of research as the interaction design and HCI communities critically consider the role of virtual possessions in people's lives with a critical eye to the future. The immaterial nature of virtual possessions can enable them to appear

‘timeless’ in the sense that they do not acquire patina or convey age in the same way as material things. Issues of technological failure, changes in file format, and storage maintenance aside, virtual possessions have the ability to remain persistent, enduring and seemingly unflinching records of the past and can, in theory, remain unchanged over long time periods. Indeed, this introduces many benefits, such as the capability to capture decades worth of personal life experiences and, perhaps, over time, centuries worth of multi-generational digital family histories.

However, this kind of persistence paired with people’s accrual of increasingly larger and more diverse amounts of virtual possessions can also introduce possible unintended consequences. As I have touched on earlier in this dissertation, virtual possessions offer the potential to create exacting histories of people’s lives, which could make it more difficult to let go of painful or embarrassing experiences from the past. The problems with the computer model of “memory”, its embodiment in the many everyday computational technologies, and the breakdowns that can result as people encounter digital content representing experiences long forgotten in the material world has been an increasing issue of concern in and outside the HCI community (e.g., Bannon, 2006; Mayer-Schoenberger, 2011; Sellen & Whittaker, 2010). As I described in chapters 5 and 6, this can become all the more complicated when virtual possessions are introduced into the Cloud, the boundaries of ownership and possession become blurred, and one may lose control over virtual things or archives representing experiences they wish to leave behind. Balancing the intrinsic benefits of a virtual archive’s ability to remain persistent and potentially unchanged over time, while mitigating the complex tensions that this introduces marks a complex and unresolved area for future research.

Finally, it is important to acknowledge that in my development of an initial vocabulary to describe experiential qualities of virtual possessions and, especially, in the articulation of how they can be used as resources for design, there is an implicit notion that supporting people in being able to better ‘possess’ their virtual things is the ultimate desired future state. While this may be true in many cases, it may not always be the case. Technologies such as Cloud and Mobile computing transform virtual possessions in such complex ways that the notion of owning or possessing them can completely breakdown. Understanding situations in which ‘possessability’ of digital content might not be the most optimal future state to achieve is an important area for future research to explore as people continue to struggle with what ‘to possess’ means in an ever more networked, connected world.

Ultimately, the work described in this chapter provides an important contribution in taking an initial step toward understanding, in quite fundamental ways, what virtual possessions are, and speculating on what they could be in the future. As they become more pervasive, and archives continue to grow ever larger, it is a crucial time to consider factors shaping people’s experiences their virtual possessions and how they can become more meaningful parts of our lives and our selves.

10 Conclusions, Contributions and Future Directions

In Chapter 1, I introduced my goals to (i) open up virtual possessions as a research topic for the HCI community and (ii) to contribute new knowledge on how virtual possessions can be designed in radically different and potentially more meaningful ways in the future. When I began my dissertation, I drew heavily on theories of material possessions and attachment from the social sciences and humanities as a foundation to ground inquiries into virtual possessions. While this theory was a useful starting point (or counterpoint), it was often not very predictive of what I encountered in terms of people's perceptions of their virtual possessions compared to material things.

At the time I began my doctoral research, the field of HCI had been exploring people's interactions with personal or familial digital content over the past several years. These investigations had largely focused on two main themes: (i) how specific types of digital content were intersecting with people's everyday social practices and how richer interactions could be supported (e.g., Kirk et al.'s (2006) project on Photowork is exemplary here) or (ii) how digital content was intersecting with particular points in one's life stage (e.g., the processes through which digital files were bequeathed to the bereaved (e.g., Massimi and Baecker's (2010) project on digital inheritance). These thematic bodies of research are crucially important and there is still much work to be done in each. However, the relatively specific focus required for these types of investigations yielded few concrete insights into what virtual possessions *are* and what they could be in the future. This prompted me to take a step back to critically consider questions, such as: What are virtual possessions if conceived of as a class of artifacts? What types of things construct this class? How do people perceive and experience these things, and how do they differ from material possessions?

Also, at this time, the field of HCI had begun creating and evaluating new prototypes to explore people's interactions with their virtual possessions. Most of these projects adopted fairly standard user-centered design approaches that produced useful outcomes (e.g., Ames and Naaman, 2007; Tang et al. 2008; Kristensson et al. 2008). However, here emphasis largely centered on improving usability as opposed to radically re-visioning how people might experience virtual

possessions in the future.¹⁶ New design-oriented approaches and projects were needed to support the development and structuring of the virtual possession design space. How can the form, presentation and behavior of virtual possessions be radically transformed to open up new and potentially more meaningful interactions with them over time? Clearly, there is no single answer to this question, making the generative and constructive nature of design-oriented research a well-suited approach to pursue this complex question.¹⁷

10.1 How has the dissertation achieved its proposed goals?

My two contributions areas are constituted by complimentary, yet distinct types of investigations: one, to conduct descriptive, qualitative fieldwork studies to understand and begin to unpack what virtual possessions are as a class of artifacts for HCI research, and two, to study new design artifacts, prototypes, and environments to produce new insights into what virtual possessions could, or should, be in the future (not to mention areas that ought to be avoided when designing in this emerging space). The findings from the first area in different ways informed the second; however, the corpus of work associated with each contribution area stands on its own as novel and substantial. I describe how each chapter contributes its particular area of emphasis and the overall contribution of this dissertation.

The first contribution area is primarily addressed through in depth qualitative field research exploring people's relationships with their virtual possessions. As I have argued throughout this dissertation, considering the paucity of work on virtual possessions when I began my doctoral research, a rich, descriptive approach was required to first establish a core understanding of both the phenomenon at hand (what are virtual possessions?) and what are and will be salient issues for future research as the field's knowledge in this area matures.¹⁸

Chapters 3 (teen study), 5 (cloud study), 6 (young adults study), and 9 (experiential qualities framework) present and interpret findings from qualitative fieldwork in

¹⁶ The Family Archive (Kirk et al. 2010; Kirk et al. 2012) and the FM Radio (Petrelli et al. 2010) are clear outliers here; both represent novel and radical approaches to how people might experience virtual possessions that hold sentimental or reminiscent value in the future.

¹⁷ Gaver (2012) offers an in depth description of research-through-design's generative nature and it's orientation toward embodying ideas of what-might-be through prototypes and design artifacts. More generally, also see Koskinen, Zimmerman, Binder and Redstrom's (2011) characterization of constructive design research as a diverse, yet established form of research where design is the central activity.

¹⁸ See Edmonson and MacManus' (2007) discussion of methodological fit to field research for a more in depth account on making appropriate methodological commitments shaped by the relative state of knowledge in a domain area.

support of achieving these goals. In Chapter 3, I describe findings from a fieldwork project with teenagers in their bedrooms at sites in the United States. This chapter does the work of both describing teenagers' specific practices, workarounds and experiences with their virtual possessions in the context of teen life, as well as articulating what virtual possessions are and the substantial design issues and opportunities this emerging research space suggests for the HCI community.

The fieldwork with teenagers revealed a variety of ways cloud computing was intersecting with virtual possessions. In Chapter 5, I describe findings from fieldwork with participants of various life stages and occupations in the United Kingdom that specifically explored their experiences and interactions with virtual possessions in the cloud. This chapter makes clear the paradoxical situations that cloud computing environments create—they provide the unique ability to make virtual possessions present in and across multiple environments simultaneously, while at the same time compromising people's awareness of and control over these things. This research also helped draw attention to more fundamental questions of what it means to 'possess' something in the cloud, and frame and structure future initiatives for the field that might enable people to retain a higher degree of control over their virtual possessions without compromising the inherent value that comes with the cloud.

While the research described in the teen and cloud studies played instrumental roles in beginning to unpack virtual possessions as a program of research for the HCI community, the fieldwork supporting this articulation remained somewhat limited in its scope and scale. In Chapter 6, I describe findings from a much larger fieldwork initiative conducted with 48 participants across sites in South Korea, Spain and the United States. Findings from this fieldwork project helped substantiate many themes described in Chapters 3 and 5, and also provided insights into new issues and opportunities for future research on virtual possessions.

The studies described in Chapters 3, 5, and 6 each provided important contributions in terms of better understanding and unpacking virtual possessions and guiding future research, yet they existed largely in isolation. In Chapter 9, I describe my work to synthesize and critically reflect on findings across these studies and two prior fieldwork studies (which are not included as exclusive chapters in this dissertation). The higher-level perspective that I adopt in this chapter enabled me to surface a broader set of experiential qualities of virtual possessions. While by no means conclusive, this initial set provides some of the first theoretical insights, from an HCI perspective, on what virtual possessions are and ways in which they fundamentally differ from material possessions. Importantly, this vocabulary provides a foundation that can be developed through future research and practice initiatives. These initiatives could include future empirical investigations that incorporate mixed-methods or purely quantitative approaches and also future additional theoretical and philosophical inquiries (which I will describe in more detail later in this chapter).

It is important to acknowledge that the trajectory of research described in this dissertation was conducted over the course of five years. Over this time interactive technologies and systems evolved and so did social practices related to them. At the beginning of my doctoral research companies that offered social media accounts to people, such as Facebook or Flickr, had not widely considered the fact that the owners of these account will pass away one day and there will need to be some mechanisms in place to handle these delicate situations. Now social media services are augmenting their technical architectures to enable people to create memorial sites and also to have preemptive clauses to transfer the ownership of an account to a loved one.¹⁹

More generally, when I began this research cloud computing services and applications existed, but were not yet in level of widespread use as they are now. As my research progressed over the years it became apparent that participants' perception and uses of cloud computing services varied quite a bit across generations. My research with teenagers revealed that they were very comfortable with the cloud and there was a strong, overarching desire to keep their virtual possessions in cloud-based services and places. An interesting and unexpected example of this was one teen's speculation that he will need less, not more, memory on his iPod touch because his virtual possessions will all be stored online in the near future. On a general level this trend could owe to a few different reasons. First, teens (especially my youngest participants) are now growing up in a world where cloud computing services have nearly always been available, making it a familiar, and perhaps trustworthy, thing. Second, teens described a heavy desire to be connected to their virtual possessions across the environments and social contexts they inhabited and moved between on a daily basis. This could also be due to the fact that teens are growing up in a world where they have nearly always had a growing collection of virtual possessions. All other age groups I interviewed had more conflicted perceptions of cloud computing environments throughout the course of my doctoral research. While these reactions understandably varied, in general people experienced anxiety over ceding the control to a largely unknown and unseen third party to ensure the safety and longevity of their cherished virtual possessions.

Another interesting and unexpected theme emerged in the multi-country study of young adults where I expected to see many more cultural differences when it came to how people perceived and related to their virtual possessions. While there were some key and important differences, in general I observed many of the same

¹⁹ In collaboration with colleagues at Microsoft Research Cambridge, I published one of the first qualitative accounts of people's complicated and at times troubling experiences of bereavement in the context of interactive technology, where there was an especial emphasis on these issues (see Odom et al. 2010). In next few years after this study, I continued to encounter similar issues across my fieldwork (often these instances highlight how starkly different virtual possessions were compared to material things). Very recent studies indicate that, in the case of Facebook, new technical changes have begun to better support the processes of bequeathing an account and stewardship of its content (see Brubaker et al. 2014).

complications, issues and workarounds. One possible explanation of this is that young adults are in general going through a transitional time in their life in ways that are relatively similar across South Korea, Spain and the United States. Another possible explanation is that interactive devices and systems are designed for a global marketplace and these technologies may enforce an organizational structure on virtual possessions in ways that makes it more difficult craft and make present diverse assemblies of them. Technical advances offer the potential to enable virtual possessions to be more flexibly and fluidly combined, organized and re-structured. It remains an interesting and open question as to whether people from different cultural groups would develop radically diverse and unique kinds of virtual possessions.

The second major contribution area of this dissertation is primarily addressed through three design-oriented research projects. Beyond understanding the current state of the world, research-through-design aims to generate new artifacts, prototypes or environments that articulate what the future could or should be. The design-oriented projects described in this dissertation in Chapters 4 (user enactments with in a teen bedroom), 7 (technology heirlooms), and 8 (Photobox) investigate people's reactions to radically new representations of what virtual possessions could be in the future and also, in varying ways, uncover areas best avoided by the researchers and practitioners when working in this emerging space.

In Chapter 4, I described a study I conducted using the speed dating user enactments design research method. In this project, I prototyped a high fidelity teen bedroom, which five design concepts were situated within. Building findings from my fieldwork, each concept explored how the form and/or behavior of virtual possessions could be radically altered to investigate how teens would react to these new instantiations. This project revealed that teens desired new tools to reflect on and develop social relationships that they have with specific people (as opposed to their entire social network), and that, to our surprise, they valued and desired digital materials to support reminiscence and reflection on the past. These findings helped focus our attention on these parts of the design space, and move away from areas concerning, for instance, enhancing virtual possessions with new behaviors, such as auto-redecoration controlled by social audiences present in the bedroom. While beyond the scope of this dissertation, this project also provoked myself and the research team to critically reflect on the user enactments method, and to produce an additional scholarly work that detailed how to use the method and its contribution to interdisciplinary HCI research or design teams.²⁰ Ultimately, the teen bedroom user enactments project helped move beyond fieldwork findings and revealed several new

²⁰ This research (Odom, Zimmerman, Davidoff, Forlizzi, Dey, Lee, 2012) appeared in the proceedings of the 2012 Designing Interactive Systems conference where it received a best paper award. The method and images from the teen bedroom user enactment study also appeared in the *Universal Methods of Design* book (Martin and Harrington, 2011).

insights that helped develop the design space and guide future research and design initiatives.

In Chapter 7, I described a study in which I used three ‘technology heirlooms’ prototypes, each of which represented different potential future ways families could experience and pass down their growing digital legacies. Exploring this design space posed a complex paradox: virtual possessions are increasingly intersecting with and complicated people’s practices to pass them down along with their family’s heirlooms and material possessions. However, adopting a ‘traditional’ HCI approach of deploying and evaluating a new prototype to ‘solve’ this problem would have taken decades, as the prototype accumulated content was (or was not) passed down across generations. As a result, I developed a methodology in which I used the technology heirloom prototypes to mediate and provoke conversations with (and among) family members. They critically considered how each design artifact might fit within their lives, the potential benefits and tensions it might raise, and explored ideas that were inspired beyond the technology heirloom devices themselves. This design-oriented methodological approach provided highly effective and has since been adopted elsewhere.²¹ Specifically, the Technology Heirlooms study produced new a range of new insights from the notion of designing technologies specifically to be put away when considering interactions with virtual possessions over long periods of time, to several design opportunities for better supporting the various social roles and identities implicated in curating, experiencing and passing down a multi-generational family archive.

While the research described in Chapters 4 and 7, played crucial roles in developing the emerging virtual possession design space, they were limited in that they used stock digital content in the prototypes as opposed to people’s own virtual possessions and archives. More generally, at this time, little work had explored how people’s perceptions of their virtual archives might change over time if embodied in a radically different way through a new a novel system, device or appliance. In Chapter 8, I describe the design, implementation and long-term deployment of the Photobox prototype. This project represented one of the longest field deployments of a technology probe in HCI research and illustrated the value of understanding how people’s perceptions of new technology can change over time as they struggle with whether it will be accepted within the home. Specifically, this study resulted in several new insights on how supporting anticipation through designing slower interaction patterns with one’s virtual archives can open up opportunities for new value construction activities in support of reflection and reminiscence. This project also demonstrated the value in drawing on the slow technology design philosophy in creating new interactive domestic technologies to support experiences of anticipation and reflection. More generally, this project contributed to a growing body of

²¹ The same design methodology was used in a subsequent project on digital legacy by Gulotta, Odom, Faste, Forlizzi (2013), which received enthusiastic reviews and received a best paper nomination at the CHI 2013 conference.

research that illustrate how embracing values alternative to the more dominant focus of efficiency (or even usability!) can critically nurture and expand future research in HCI as the community increasingly focuses on designing for the intimate contexts of everyday life.

Taken together, these constructive design research projects illustrate three distinctly different types of studies and methodologies. The teen bedroom user enactments project aims to understand where opportunities are in radically re-thinking and advancing the presence, form and behavior of virtual possessions in the context of teen life. At the time of this project, virtual possessions as a research topic was just beginning to be opened up and required a broad future-looking investigation to better understand the design space as a whole, and also where possible tensions could emerge in it. Through the process of bringing teens into the user enactments bedroom set and having them rapidly experience a range of potential technological futures, I was able to develop new insights into how virtual possessions could be designed to better support teens' practices and desires and, ultimately, open up new value construction opportunities.

The Technology Heirlooms project also aimed to critically explore different potential technological futures through constructive design research. It differed from the teen bedroom project in that it had to more directly confront issues of time and temporality. The core set of concerns I explored centered on how people might inherit, experience and pass down virtual possessions and collections over time and, potentially, across generations. Clearly, it would not be possible to 'deploy' the Technology Heirloom prototypes within a family over the course of decades and evaluate how they are experienced. However, bringing the three fully functional prototypes into families' homes created a situation where household members had to confront the actual material realities of these technologies against the backdrop of their own possessions and each other. Despite not including any of the participants' actual virtual possessions within the prototypes, this approach proved highly effective at opening dialogues with family members and provoking speculations on and beyond the concepts embodied by each device. The choice to use of three, highly resolved design artifacts in this study proved to be extremely beneficial in that it (i) surfaced insights germane to the issues and questions that each specific device materially articulated, and (ii) it generated a rich, deeply textured understanding of opportunities and issues in this complex and emerging design space. This same methodology was implemented in a project the following year that involved three fully functioning design artifacts targeting how individuals themselves could more mindfully craft their digital legacies (see Gulotta et al. 2013). Similar to the Technology Heirlooms project, this approach produced rich insights to guide future work and was enthusiastically received by the HCI research community.

Finally, the Photobox project emphasizes a much longer-term study of a design artifact in the context of people's everyday lives. While the slow technology design

philosophy (Hallnas & Redstrom, 2001) had emerged over a decade prior to this project and had become widely influential in terms of its theoretical contribution, little work had explored how people would react to living with a slow technology over a long period of time. In addition to explore a new mode for digital photo consumption, the Photobox project aimed to understand how people would react to living with a slow technology that was embedded in their everyday life over the course of fourteen months—a duration of time uncharacteristic of field studies in HCI. This choice was partly motivated by the fact that Photobox enacts its behavior infrequently, but also, and more importantly, it was motivated by my desire to see constructive design research taken more seriously and to deeply unpack what people’s lived experiences were with this design artifact. In comparison to my prior constructive projects, this was a much more focused investigation. It transitioned beyond my earlier projects that aimed to develop a deeper understanding of what the design space is, toward targeting a key set of issues in the design space and empirically investigating them in nuanced and rigorous ways.

The three types of research projects described here provide different illustrations of how constructive design research can be used to critically explore potential technological futures. In the HCI community there is arguably a great deal of empirical research of people’s everyday lives and practices, which is then used to inform the design of a new system that is subsequently evaluated. There is a conspicuous lack of research projects that open up dialogue and discussion about opportunities, issues and potential unintended consequences in the emerging design spaces that the HCI so often operates in. As form givers to interactive technologies and devices it is the responsibility of the HCI community to keep in mind and actively explore the potential effects of the things we create. It is my hope that, albeit modestly, the constructive design research projects I detail and unpack in this dissertation provide examples of practical and rich approaches that can better support future research and practice in the HCI community aimed at critically investigating emerging design spaces, and the possible future they might suggest.

10.2 What is the impact of this dissertation?

This dissertation contributes primarily toward scholarly development in the Human-Computer Interaction and interaction design communities. Judging the impact of a cohesive body of scholarly work as it is emerging as a dissertation can be a contentious task. In the context of this dissertation, its impact can be demonstrated by two related points: (i). its success in terms of publication and recognition and (ii) the subsequent uptake of this research by other scholars in the HCI and interaction design communities, and beyond.

Over the past five years during my time at Carnegie Mellon, my body of work on virtual possessions (a large sample of which is described in this dissertation) has resulted in two book chapters and eighteen peer-reviewed, archival publications at

top-tier HCI and interaction design conferences. This work has received three best paper awards (CHI 2011, DIS 2012, CHI 2014) and two best paper nominations (CHI 2010, CHI 2013). While these publications and awards are not a demonstration of impact *per se*, they do indicate the academic community's eagerness to embrace this emerging program of research and, one side effect of this recognition has been the wider appearance of my research in several news and media outlets around the world.

While my research is not the origin of scholarship on people's interactions with and perceptions of their personal digital content and archives, I have established myself as a researcher on the vanguard of the virtual possession research space with my body of work having been cited nearly seven hundred times at the completion of this dissertation.²² The virtual possessions research space is vast, with much fantastic research being produced by scholars such as Abigail Sellen, Richard Harper, Sian Lindley, David Kirk, Melanie Feinberg, Dan Cosley, Jofish Kaye, Corinna Sas and Steve Whittaker, Russell Belk, and many more too numerous to mention here. It is an exciting time with much more to do be done.

10.3 What comes next?

One of the most exciting parts of engaging in the writing of a dissertation is exploring the new ideas for future research that emerge out of it. Throughout this dissertation I have explicitly and implicitly suggested new areas for future research and practice initiatives in the HCI community. In what follows, I will describe some areas for future research following from this dissertation.

There are clear opportunities for future research to build on and expand the initial vocabulary I developed to characterize experiential qualities of virtual possessions. As noted in Chapter 9, further critiquing and developing this emerging vocabulary can help unpack fundamental ways in which virtual possessions are experienced compared to material things, what they are as a class of artifacts, and what they could be in the future. To prescribe a single methodological approach in pursuit of this research direction would be misguided. As with all socio-technical artifacts, people's perceptions of and relationships with virtual possessions will continue to change over time. As such, empirical (qualitative, mixed-methods, and quantitative), philosophical, and design-oriented inquires all have important parts to play in developing the HCI and interaction design community's understanding of virtual possessions. Also noted in this chapter as issues, such as: 1. the role metadata can and should play in opening up new value construction activities with virtual possessions, 2. the benefits and potential unintended consequences of the 'timeless' nature of virtual possessions, and 3. the extent to which 'possessability' is a desired

²² This number is calculated via Google Scholar:

<http://scholar.google.com/citations?user=LT9zh4sAAAAJ&hl=en&oi=ao>

state for virtual possessions (especially those kept in the cloud), all mark clear areas for future research I intend to investigate.

There is a direct opportunity to help transition the HCI and interaction design communities' knowledge on virtual possessions beyond a nascent level of understanding through quantitatively-oriented empirical research. As I have argued in this dissertation, a rich, descriptive foundation of qualitative research was required to first establish important relationships among phenomena, structure the research space, and critically guide future investigations. Now that a modest, yet constructive foundation has been developed, it is an optimal time to begin incorporating additional methodological approaches. I am currently working on a project with colleagues at Carnegie Mellon University and KAIST University that aims to build on and challenge design implications emerging from my prior work through a large scale survey of people's perceptions of value across several scenarios in which material possessions, virtual possessions and future instantiations of virtual possessions augmented with metadata are embedded. Specifically, we are looking at similarities and differences in how people rate and compare these three different categories of objects. One of our hypotheses is that while people will highly value unique and personal material artifacts like a handwritten recipe or an annotated analog photograph, the virtual counterparts to these things are often undervalued and new value could be produced if they were augmented with various kinds of metadata. The early results of this study are interesting and encouraging. This work will help provide a broader perspective on how people's perceptions of value of material and virtual possessions differ, and, importantly, how the form and presentation of virtual possessions could be augmented to open them up to more valuable interactions in the future.

Another area I plan to investigate in my most immediate next steps is the how co-owned possessions are acquired, recognized and created by couples that live together. The act of creating co-owned possessions play important roles in the development and signification of social relationships between people, and, especially, those that are romantically involved. In this, I will investigate how the processes of developing, interacting and living with co-owned material possessions unfold, and how these practices are similar and different to virtual possessions. As I speculated on in Chapters 5 and 6, the manner in which digital technology and systems are currently designed often makes it difficult to 'share' one's virtual possessions without ceding complete control to someone else. By probing more deeply into how couples develop shared or co-owned virtual possessions, and where potential breakdowns and workarounds occur, new insights can be generated into what virtual possessions are, how practices like co-ownership and sharing could be better supported in the future, and the extent which ideas of ownership or possession as people understand them in the material world can be supported with virtual possessions.

Finally, in this dissertation I have described several design-oriented projects (particularly those in Chapters 4 and 7) which, in different ways, engaged people in experiencing and interacting with interactive prototypes and environments in the service of opening a critical dialogue about the technological futures embodied by, and beyond, them. These research-through-design investigations were effective in generating novel insights that helped develop and structure the virtual possession design space, which was dramatically underdeveloped at the time. They aimed to draw people into socially situated future scenarios of potential new technologies to develop knowledge not only on opportunities for the research and design communities to pursue, but also, quite crucially, areas that are best avoided. In a sense, this kind of generative, future-looking approach sits in a less common space for HCI research—it is outside empirical studies of people’s current technological orientations and practices as well as field trials of interactive systems aimed at evaluating how effective they were at achieving their intended goal (e.g., how well they supported completing of a task everyday life). As the HCI community increasingly moves into emerging design and research territories that are by their very nature new, complex and unstructured, this kind of generative design-oriented approach could become increasingly important to reduce the risk associated with pursuing initiatives constructing a critical foundation to guide work in them. In the future, I will more draw on the teen bedroom user enactments and technology heirlooms projects as case studies to discuss and unpack the viability of and need for this kind of work within the HCI and interaction design communities. Through this future scholarship, I hope to open up this style of research to other researchers and practitioners, and to demonstrate how valuable it can be.

While this set of projects forms a reasonably extensive research program, all of these ideas, while varied in content, have a conceptual orientation similar to this dissertation: an emphasis on understanding what virtual possessions are on theoretical, empirical, and practical levels, and the pursuit of radical design-oriented methods and design artifacts that help gain a firmer grasp on what the future could—or ought to—hold. In the slightly longer-term future, with these complementary, yet distinct trajectories of research in place, I would like to work towards writing a book on virtual possessions. I believe I can establish a research career that is simultaneously diverse and coherent, and that will be of enduring value to the HCI and interaction design communities.

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Appendix

Appendix I

materials from interviews with
teenagers

INTRO QUESTIONS

- How old are you?
- When you look around your bedroom, what are your most favorite possessions? Why? What kind of story do they tell about you?
- Do you have any souvenirs? What do they remind you of?
- Do you have collections of anything?
 - If there was a fire, and you could take only a few things, what would you take?
- How much time would you guess you spend in your bedroom? (e.g. 3 hours a day..)
 - What did you do in your room yesterday?
 - Over the past week has it generally been the same kinds of things?
- Do your friends ever come over? (Do you ever have sleepovers?)
 - Do you spend time in your room then?
 - What kinds of things do you do together?
 - [what objects are used in the activities?]
 - Do you keep in touch with your friends when they aren't over (e.g. through Facebook or any other technologies)?
- Can you describe the things on the walls? Who put them up?
- What kinds of technologies do you use?
 - (e.g. mobile phone, computers, digital camera)
 - How often do you use your mobile phone? Whom do you call? Do you use it more when you're at Mom's or Dad's home?
 - Do you own/use a digital camera?
 - What kinds of pictures do you take?
 - Where do you put them?
 - Are they on a/your computer?
 - What kinds of stories do they tell about you?
 - Do you take them with you when you go places (e.g. Dad's)
 - Do you share them with your friends? How?
 - Do you ever put them on display in your room?
 - Do you own a computer?
 - Where is it?
 - Do you take it outside of the house?
 - What would you say you use it most for?
 - Do you have a Facebook page?
 - If so, how often do you use it? Who do you contact?
Do you use it any more often at Mom's house than at

Dad's house?

- Do you use any other websites often? [to keep in touch with friends or otherwise]
 - What are they? Which is your favorite? How often would you say you go on them?
- In general, how much time would you say you spend using the internet everyday? (e.g. 2 hours)
 - Does it depend on the day, for example do you use websites and the internet more on some days than others? Why?
 - Do you use the internet more at one parent's house than the other? Why?
- What other kinds of things do you have on your computer that are important or special to you?
 - (e.g. photos, emails, diary, blog, music)
- Do you carry any of this content with you outside of home?
 - Would you like to if you could?
- Do you own an ipod or another kind of mp3 player?
 - Does it feel like it's yours? How is it unique to you?
- Do you bring your mobile phone with you outside of home?
 - Does it go everywhere with you?
 - Who do you call most often on it?
- Do these technologies usually travel with you across outside of home frequently?

ADDITIONAL QUESTIONS

Do you think of your VPs as the same as your material possessions?

- How do they differ?
- How are they the same?
- How do they change?
- Which will be around longer?
 - → Is accessibility more important than quality? Why?

Comparisons of physical vs. virtual possessions

- How would you compare your precious physical possessions and precious virtual possessions (e.g. wall posts, digital photo collections, digital music collections, metadata)?
 - Does one 'represent' you more than another?
 - Does one feel like it will be around longer than the other?
- Do you think your virtual possessions gain value over time?

- (e.g. do you Facebook photos get new value through comments over time?)
- How do these kinds of VPs differ from your material things?
 - e.g. is a FB photo with comments the same and that regular digital photo?
 - Would you want to keep the comments (i.e. metadata)?

Capture

- Do you use your cell phone to take pictures or record notes or txt messages?
 - how do you transfer this information off?
 - where does it go?
 - do you use your phone for FB?
 - what kinds of things do you access on it?
- When you take pictures on your phone or camera, where do you store them?
 - Do you instantly upload them to FB or another site online?
 - Any problems? Can you describe the process?
- Do you view your phone and computer more as a portal to your things online?
 - Do you interact more with files stored locally on your computer, or things you access over the Internet?
- Do you ever email digital files to yourself so you can find them later?
 - What kinds of things? (e.g. music files, photos, HW)
 - Do you have any problems managing or accessing your files online?
- When you're searching through information on your computer or online on Facebook, how do you know when something is a virtual possession worth keeping?

Use of VPs

Virtual-Made-Material

- Do you ever print out digital photos or other things on your computer and post them around your room?
 - (or in your locker or elsewhere in your life?)
 - if so, do you want to have the metadata that goes along with it?
- Do you leave your computer monitor or mobile device on and logged into social media sites online?
 - Are these prominent displays in your room?
- Have you ever burned a CD for someone and given them music files + playlist in person?
- Have you ever made anything else that's 'virtual' into something physical?
 - e.g. chat logs, FB photos, etc..
 - what kinds of things do you print from your computer?

Material-Made-Virtual

- Have you ever taken a picture of a physical thing and put it online?
 - → On Facebook to get a new comment?
 - → emailed to yourself to make it accessible?

- Are there any other instances that you want to make a physical thing a virtual thing or have a virtual copy of it?
 - e.g. similar to how you put other photos on Facebook, would you want to put other “things” online to get people to comment on them?
 - Why?
- Do you carry VPs with you?
 - on phone? on flash drive? on iPod?
- Are there VPs you only use in your room?
- How do you find the digital photos (or other VPs) that are most important to you when they’re spread out in large archives?
 - (e.g. separate the significant from the trivial)

Deletion as important part of experimentation with self

- Do you ever delete your VPs? (stored locally or online)
 - Why?
- Do you ever get rid of material possessions that ‘represent’ you?
 - Why?

VPs & Presentation of Multiple Aspects of Self

Are there any examples of things you’ve customized to be more ‘you’?

- physical object? settings on a player, etc..
- how do these things reflect you?

Do you change different photos on your devices and online sites?

- e.g. desktop background, mobile phone background, laptop/mobile phone skin, FB profile pic online, profile information
 - How often do you make these kinds of changes?
 - What do they reflect about you?

How would you compare your use of FB to reflect changes in your identity to how your room is setup?

- In your room, have you ever had to take something down your parents didn’t like?
 - Have you ever had to do this in Facebook?
 - Does it feel like the first ‘place’ you have total ownership of?

Other FB (SNS) behaviors

Do you ever tag or untag yourself in photos online?

- why? do you feel like photos on FB are going to be online forever?
- where are they? [stored]

Do you use privacy settings on FB to restrict access for some people to your account?

- for who? why?
 - how do these restrictions shape how people understand who you are?
- → have any problems emerged for you on FB when someone saw things about that you didn’t intend for them to see?
- Have you ever had a problem where a person came across a *physical* object that reflected something about you that wasn’t intended for them to see?

- Have you ever had someone comment on your wall and then deleted it or changed profile picture?
- Have you ever attended an event with your friends, posted photos of it online and then collectively commented on it?
 - Do you feel like this is a more authentic representation of the event?
 - Would you want to keep all these photos and metadata?
 - were they all stored together in one album or across several?
 - How quickly did this manifest? (over a day, week, months?)
- What VPs (photos, HW, playlists, music files, etc...?) do you feel most represent you?

VPs & New Value

Do you 'share' digital files online?

- e.g. (video, music, photos, online music playlists)
- do they acquire some kind of metadata?
- where are they stored?
- would you like to be able to access them in the future?

Do you have extensive digital music collection?

- how big is it?
- do you have music you no longer listen to?
 - why? does it reflect a former taste or preference you had?
- do you go to lengths to get album art into saved into your digital music files? do you put other metadata into them? (e.g. artist, song title, etc..)

Have there ever been any instances in which you discovered some digital files became more valuable over time?

- e.g. a collection of music files you no longer listen to, but are associated with a past stage of your life (and good for reflection on that period of your life)

Themes

Where do they exist?

- computer, thumb drive, digital device, cloud, etc..

What is their purpose?

- what do they do? (i.e. what is the nature of the attachment, is it purely just because of what the thing represents and/or is it used for some functional purpose?)
- how are they currently used?
- has the purpose or use changed over time? how does it differ historically?

Who created it? How was it obtained?

- did the owner create it?
- did they receive it from some external source independently?
- was it given to them?
 - if so, by whom, when and how does that shape how it is related to?

What is its lifespan?

- how long has it been around?
- where has it been?
- has it always been stored where it is currently?
- has the owner always been the sole owner?

How actively is it used?

- when? why?
- are there passive forms of use? (e.g. desktop background image, etc..)

What is the boundary of ownership?

- is it intentionally put on display to convey something about the participant's identity?
- is it intentionally shared with others?
 - if so, what social groups? why?
- is it deeply private? is the owner the only one that uses it? why?

What are the practices and tools used to manage the possession?

- how are they sorted?
- what is the hierarchical structure? (can you sketch it)
- what do these suggest about how specific virtual possessions (or groups of them) are related to?
- are there clear distinctions between *management* and *use* practices?

Are any precious physical possessions digitized and made mobile?

- do participants carry virtual possessions with them outside of the bedroom?
 - what are they? why? what are they stored on?

What kinds of virtual possessions do participants duplicate?

- why? where are they stored?
- are they perceived to be any more or less precious due to this practice?

Do participants trust their virtual possessions will outlive their physical things?

- which ones? why?
- do tensions arise in the ways in which they're stored?
 - (e.g. on display on mantle piece vs. stored on hard drive)

Other areas to consider:

Game related virtual possessions

- e.g.: online trophies, stats, game achievements, Farmville possessions on FaceBook, Neopets, Club penguin, etc.. (and more generally gift/gifting on Facebook)

What is the scope and depth of participants' lists?

- Skype address book, buddy list (via different chat programs), FB friend list, email contact list, etc.. totality
- How many are trapped on a device? How many are on the cloud?

What things are regarded as private or sacred?

What things do participants keep but never use?

- Where are they kept?

What possessions do participants have a resistance to having in the cloud?

How old are your oldest emails and why do you have them?

- photos? (where are your photos?)
- what is the oldest virtual possession they have? what is its associated history?

How bad would it be if data was erased, lost forever? In relation to other possessions?

Appendix II

materials from user enactments
project with teenagers

Virtual Possessions Script.

PREP

1. Decorations appropriate to gender: makeup, bulletin board
2. Foam core phone with text messages (dark orange- boy, light yellow- girl).
3. Foam core 'MOM button'
4. Romeo and Juliet book on bed with notes/notebook of notes
5. Screen Projector: Scene 1 'default screen' displayed
6. Laundry basket by table for "Mom"
7. Music playing on laptop for background music.

ROLES

Only need 2 people to run these studies.

1. Researcher (Will)
 - Clicks through slideshow (Hajin, Steph?)
 - Doubles as the Parent (Hajin, Steph?)
 - Interviewer- ask questions
2. Research Assistant (Angela)
 - Explains scenarios and screens
 - Acts as the Friend.

Introduction

Dialogue: Intro.

Inside the Bedroom

- Welcome to the Bedroom!
- Role- You are acting as if this is your room.
- Integrate room décor into participant's role- You are into the Goo Goo Dolls. You like Toy Story 3. You like sports.
- Here are the screens. This is all your texts, emails, and calls. There's Goo Goo Dolls. Photos from Facebook.
- Scenarios- We'll prep you for each scenario and tell you what you are acting out. Do what you would do if this was YOUR bedroom.
- Try to reflect and think about how these things would fit into your life. After each scene, we'll ask some questions.
- No right or wrong answers. We want to see what you think.
- Questions?
- Cell phone- turn off and keep on table.
- In return, here is a new phone for you. To read texts, just peel off post-its. Here is a "Mom" remote for the screens. If you want to change the screens to something more mom-friendly, press this button.
- So! Let's start our first scene!

Walk out of the Bedroom.

1. Socially Reactive Bedroom

1a. Default screen / Personal Notifications

Scene 1 Background Explanation.

- You have a test on Romeo and Juliet on Friday.
- Your friend, who will be played by me, is coming over really soon.
- Right now, you're at dinner with your parents. 2 buzzes on your phone- can't check it now. Dinner over- going back to your room.
- Go study!!!

<Screen with text notifications already up>

Participant enters Bedroom alone.

< After participant checks each message, fade screens>

1b. Similarities / Differences among friends (friend confederate enters room)

"Friend" knocks. Enters.

- Hi! Hope you finished the reading. We have so much to study!

< Slowly update screens to friends. Sequentially change.>

- Oh! It's me now!
- What's that? [communication visualization]
- Wow, we talked about EMILY/JOE that much? And Romeo and Juliet. I'll be happy when this test is over.
- Remember when we watched that? So fun.
- Halloween! Wow, that's when we didn't even know each other!
- That party last month was SO fun! But I hope your mom doesn't find out about that...
- That girl's pretty hot. / Nice abs on that guy.

1c. Parent button (mom/dad enters room)

< Parent knocks. Parent is played by computer monitor.>

- PARENT: [Name]! I have your laundry! Can I come in?
- FRIEND: (Wait to see if Participant will go to the remote.) Quick! Get the remote! Change the screens!

<When Participant presses button, change to Mom screen.>

- MOM: I'm coming in now... So how's studying going?
- Okay, have fun studying, you two.

Mom walks out.

- Okay! That's the end of Scene 1! I have some questions for you.

<While asking questions, Research Assistant plug in bed projector. Prep Quilt image.>

<Can also wait for Researcher to do it while Research Assistant explains the scenario.>

Scene 1 Post-Questions.

- How comfortable were you with having your information on the screens when you came back from dinner?
 - Is there anything you wouldn't want other people to see?
 - Was there anything you would have liked to see?
 - What would you MOST like to see? LEAST like to see?
- How do you feel about the screens changing when your friend came in?
 - Would you like more control over what gets changed and when?
 - Was there anything inappropriate or uncomfortable?
 - What did you think of seeing the pattern of communication between you and your friend? What if it was a relative?
 - What do you feel about seeing places you and your friend went to together? (movies)
 - How did you feel about seeing pictures of you and your friend when you didn't know each other yet? How do you feel about the screens pulling things from that far back?
- When your "mom" came in and you switched the screens, how did you feel?
- Would you prefer to have more control about what changes or would you like it to change automatically?

2. Bedroom Quilt

PREP

1. Switch computer projector cable to Bed Projector.
2. Show Quilt Screen 1.

Walk into Bedroom

Dialogue: Tour

- Quilt
 - o Fabric itself changes colors.
 - o Bars show status updates. Texts, photos, Facebook, email.
 - o Changes depending on how many unread items you have.

Dialogue: Explain Scene.

- **Scene:** You just got home and are going to bed.
- When you enter, kick off your shoes, turn the light off.
- Then you can get into bed and pretend you're going to sleep.
- In the morning, "Mom" will wake you up to get ready for school.

Participant walks into Bedroom alone.

<After Participant gets into bed, update Quilt bars.>

<"Mom" knocks.>

- "[NAME], get ready for school! You're gonna miss the bus!"

Participant gets up and sees new screen. Turns lights on, puts on shoes, runs out.

- Great! Good job. Let's talk about that Scene.

Scene 2 Post-Questions.

- How does having this information surrounding you in your room feel?
 - o Is it useful? Why or why not?
 - o Is there any other kind of information you'd like?
 - o What do you think about having this projected in your room? What do you think about other people seeing it?
 - o Would there be a better place to put this?

<Research assistant can plug in other projector while Researcher is interviewing.

OR Can change projectors when Research Assistant explains the scenario.>

Prep Gift-giving screen. Have Black-Eyed Peas songs ready on iTunes.

3. Gift Giving

PREP

1. Project Gift-Giving screen.
2. Have songs ready.

Walk into Bedroom

Dialogue: Tour

- These screens are when you are listening to music.
- You can see what's "Now Playing".
- A friend gave you this playlist as a gift. They specifically put these pictures and comments in for you.
- These are other playlists from friends. You can see shared songs and playlists between you and your friend.
- This corner is album artwork and word clouds of the song. And this corner is all your other normal playlists.
- Any questions?

Dialogue: Explain Scene

- **Scene:** You're about to go to a sports game with your parents in 15 minutes. Your friend's going to join you soon.
- So now you can go into your room and listen to music!

Participant enters room.

<Start music and have Gift-Giving screen 1 up.>

<Friend knocks and walks in.>

Dialogue:

- Hey! Sorry I'm a little late. Your parents said we could wait a few more minutes. They'll call us when it's time to go.
- Oh, I love this song!
- I forgot how fun that trip to Kennywood was! What's this? I didn't tag these [map, weather].

<Wait another 30 sec. Mom knocks.>

- Okay guys! Time to go!

Everyone walks out.

Scene 3 Post-Questions.

- How do you feel about having photos and comments associated with a gifted song show up while you're listening to it?
- How did you feel about the screens pulling up other information like weather?
- Does this playlist feel like a gift even though it's not in a physical form? If you had something like this, do you think it would feel different from other songs/playlists in your library? In what ways? Why?
- Are there other things that you would (or wouldn't) want to include in making gifted playlists? Would you want to share your gifted playlists with others?
- Would you make these kinds of gifted playlists and send to another friend? How do you feel about sending the gift digitally instead of in a physical form?

<Get postcards ready.>

4. Postcards

PREP

1. Power down both projectors
2. Get postcards together, along with other mail

Outside Bedroom

Dialogue: Scene

- You're going to get some postcards that will be automatically generated from your computer and mailed to you.
- It will have a summary of your activity and a picture.
- Your Mom is going to drop off some mail. Just sort through those and look at them.
- So now you can go into your room and read a book.

Participant enters room.

- Mom: Here's your mail. Make sure you don't throw anything important away...

<Wait for Participant to look at postcards>

- Okay, great! That's the end of that Scene.

Scene 4 Post-Questions.

- How do you feel about a computer system automatically generating summaries of your past behaviors and experiences and mailing them to you?
- Is there information that you wouldn't want to be tracked and presented in postcards?
 - How do you feel about it being publicly mailed?
 - What kind of information is 'ok' to be made public and what isn't? (E.g. information about where you've been and with whom; everyday computer usage patterns, etc..)
 - To what extent do you (or do you not) feel like these postcards help you to reflect on the past?
- Is there anything else you would want to put in the cards?
 - Would you prefer to send yourself messages in the future?
 - Would you like to make and send these kinds of postcards to friends or family?
- How do you feel about receiving physical copies of this information in the mail?
 - Would you prefer to receive it in a different form (i.e. securely sent digitally)
 - Does it feel they are more valuable in physical form compared to virtually on a screen?

VP Enactments- Appendix Material

- Is there any other kind of information from the other enactments that you think would be valuable to have in physical form (as opposed to being displayed on the screen)?
- Where would you put these postcards in your room?
 - Would you put them on display? Would you hide them?
 - Do they feel like something you would keep? Why/Why not?

<Turn on 12-screen Projector. Get Multiple Self-Presentation screen ready.>

5. Multiple Self Presentations

PREP

1. Ready 12-screen projector- Multiple Self-Presentation screen
2. Foam core phone - text messages

Inside Bedroom

Dialogue: Tour

- Screens
 - These four screens are four profiles you have on Facebook. Each is an aspect of who you are.
 - So this corner is your sports team and these are the photos, comments, etc. that your teammates can see.
 - This one is for your family. This one is for your social group and this one is for school.
 - The screens update when you change things online.
- When you receive any texts or email, the screens will let you know.
 - You can actually check your phone by peeling off a Post-It for the next message.
 - You can also check your laptop.

Dialogue: Explain Scene

- You're going to be reading in your room.
- You might receive some texts or emails. When you do, you can just check them. How do you do that again?
- Okay, great. Go ahead!

Participant enters room.

<Trigger incoming text sound. Change screen to text alert.>

<Once Participant checks it, go back to default screen- swoop into text visualization.>

<Trigger another text. Change to text alert. Back to default screen when participant checks.>

Scene 4 Post-Questions.

- Do you think having multiple profiles like this is helpful in managing different social groups?
 - Would you like to have more control over how your digital self is presented to different groups?
- Does it feel like there are any drawbacks to this kind of system?
 - Do you think you would become engrossed in managing your self to these different audiences?
- What do you think about this system helping you feel closer to the people in these different groups? Why?
 - Do you think these screens would create new obligations? Why/why not?
- How do you feel about the presence of the information on these screens in your room?

Virtual Possessions Project

The Process of Building a Teen's Bedroom

Fall 2010

Human-Computer Interaction Institute

Carnegie Mellon University

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/ Project Overview

We live in a world increasingly filled with virtual possessions. We characterize virtual possessions to include the many objects that are losing their lasting material form, such as books, music, photos, plane tickets, and money. In addition, we also consider them to include things that never traditionally had a material form, such as video game avatars; electronic messages including email, SMS, IM and status updates; social networking profiles; personal behavior logs, such as purchase histories; visited locations from services such as brightkite.com; and a listing of activities, such as jogging routes from MapMyRun.com. It appears that the convergence of social and cloud computing, along with the growing presence of mobile media players and networked mobile phones/computers has produced a new world in which people both carry and ubiquitously access large collections of virtual possessions.

HCI researchers and practitioners have focused on how the digital can improve performance in terms of efficiency and effectiveness, however little work has investigated how the form and presentation of an immaterial thing might modify its value. This research project takes a step towards better understanding (i) ways in which technologies might enable people with richer opportunities to construct value with their virtual possessions, (ii) how virtual possession might be more meaningfully materialized in people's everyday lives, and, importantly, (iii) the potential social appropriateness and acceptability of these kinds of technologies as we look toward near future design opportunities.

We focused on teenagers as an initial group to begin exploration in this emerging space for 3 primary reasons. They are deeply occupied with the process of constructing their identities; they are heavily engaged in digital media, online communication, and use of interactive technologies; and they are on the vanguard of social and cloud computing, embracing these emerging technologies and actively defining the behavior and social mores of these products. In what follows, we describe the process through which a teenager bedroom was constructed, as well as the script and attendant screens for the enactments we engaged teenage participants in.

/ Environment

1. Bedroom Setup

In order to observe teenagers' natural interactions with technology in their bedrooms, we sought to design a "singular" bedroom that is not generic. We aimed to create a specific, detailed bedroom that evokes the feel of the teenagers' real bedrooms back home. Our choices are based off of photographs obtained from prior research in teenagers' actual rooms.

A challenge we immediately encountered was the sterile and utilitarian atmosphere of the academic building we were using for our study. To mask this, we hung bamboo blinds to section off a corner of the room and made a white-paneled closet door out of foam-core. It made a significant difference.

We intentionally selected mismatching and old furniture. We decided to steer clear of Ikea-style furniture in favor of clunky, robust furniture that looked like they have been around for many years. We purchased lamps to give the room warm, natural lighting instead of the cold fluorescent bulbs of the office.



2. Décor

Posters lent immediate characterization to the room. However, they were also the most tricky to pick out. Decorating the room for a specific age range is challenging. Teenagers are very sensitive to how they appear. Artifacts in the room could not be too juvenile or too mature.

We decided that the Black Eyed Peas were relevant to 14 year olds as well as 17 year olds. Most teenagers are interested in music bands. They are also usually interested in movies, though Avatar may be for a slightly older crowd. However, we are confident with our choices in posters. One participant mentioned that she loved Toy Story 3.

The process of decorating the environment evolved hand-in-hand with the direction of our study. We could not design our scenarios without the space but we also could not design the space without the scenario. For example, the bedspread is white because we decided to project an image onto it and a pattern or any other color would make it difficult to view.





We had to decorate the Bedroom to be suitable for both female and male participants.

With this in mind, we made decisions based on what both genders would find appropriate. Therefore, we chose a poster of the Black-Eyed Peas instead of Justin Bieber.

To support specific genders, we had items in a concentrated location to easily remove for a different gender participant.

For males, we had a war strategy computer game on the desk and a bulletin board designated for boys. For females, we had makeup and jewelry with a bulletin board designated for girls.

We also purchased used dolls, birthday cards and random trinkets from Goodwill to give the impression that an actual person lived there.

And for the finishing and unifying touch, we scattered crumpled papers around the room because most teenager's room is messy.

/ Script & Roles

Our process of running participants is far from a controlled, formal experiment. We are attempting to draw out the nuances and inarticulated reactions to technology in potential futures. We value qualitative data. Therefore, our script is intentionally flexible to allow for spontaneity. The dialog and sequence within the script is a guideline. It has been a convenient order of events but straying from it is acceptable and even encouraged.

To run the study, we found that a minimum of two people are needed. Each person plays two separate roles. The main researcher will be the interviewer as well as the "Mom" or "Dad." The research assistant explains the scenarios and environment and also plays the "Confederate."

The Confederate acts as the participant's friend in a few scenarios. Her role is to set an example for the participant in acting out imaginative roles. More than adhering to the script or an experimenter's role, the Confederate should put

the participant at ease. Hopefully, candidness will encourage the participant to follow suit and begin visualizing the scenario as her own.

Most of the enactments depend on the participant. There are some teenagers who are creative and will elaborate on a scenario with their own interpretations. Others are very quiet and will not be as descriptive and comfortable with acting out their role. Regardless, our study has yielded interesting results.

DIALOGUE: BEDROOM TOUR

- Welcome to the Bedroom!
- Role: You are acting as if this is your room.
- Integrate room décor into participant's role: You are into the Goo Goo Dolls. You like Toy Story 3. You like sports.
- Here are the screens. This is all your texts, emails, and calls. There's Goo Goo Dolls. Photos from Facebook.
- Scenarios: We'll prep you for each scenario and tell you what you are acting out. Do what you would do if this was *your* bedroom.
- Try to reflect and think about how these things would

- fit into your life. After each scene, we'll ask some questions.
- No right or wrong answers. We want to see what you think.
- Questions?
- Turn off your cell phone and keep it on table.
- In return, here is a new phone for you. To read texts, just peel off post-its. Here is a "Mom Button" for the screens. If you want to change the screens to something more mom-friendly, press this button.
- So! Let's start our first scene!



The study begins with greeting participants, giving a tour of the bedroom (dialogue above), and handing them props used in the study—a cell phone and "Mom Button" made out of foam-core.

/ Scenes

1. Socially Reactive Bedroom

For many teens, their interests and experiences are captured in the form of virtual data—music, photos, messages exchanged with friends, etc. In this enactment, such data is presented on the wall screens in the bedroom and changes depending on the context. We broke the scenario into three parts to establish various contexts: when the participant is alone in the room, when a friend visits, and when mom (or dad) enters the room. The goal was to understand 1) if the data displayed on the wall is perceived differently than when it only exists online and is accessed through mobile devices or computers, and 2) what kinds and how much of the data participants feel comfortable being displayed for others to see or keeping private.

Script

DIALOGUE: EXPLAIN SCENE

- You have a test on Romeo and Juliet on Friday.
- Your friend, who will be played by me, is coming over really soon.
- Right now, you're at dinner with your parents. 2 buzzes on your phone- can't check it now. Dinner over- going back to your room.
- Go study!!!

IN THE SCENE

1-1. Default Screen and Personal Notifications

- Screen with text notifications already up.
- Participant enters bedroom alone.
- After participant checks each message, fade screens.

1-2. Similarities / Differences among Friends

- "Friend" knocks. Enters.
"Hi! Hope you finished the reading. We have so much to study!"
- Slowly update screens to friends. Sequentially change.
- "Friend" looks at the display.
"Oh! It's me now!"

"What's that? [communication visualization]"

"Wow, we talked about EMILY/JOE that much? And Romeo and Juliet. I'll be happy when this test is over."

"Remember when we watched that? So fun."

"Halloween! Wow, that's when we didn't even know each other!"

"That party last month was SO fun! But I hope your mom doesn't find out about that..."

"That girl's pretty hot. / Nice abs on that guy."

1-3. Parent Button

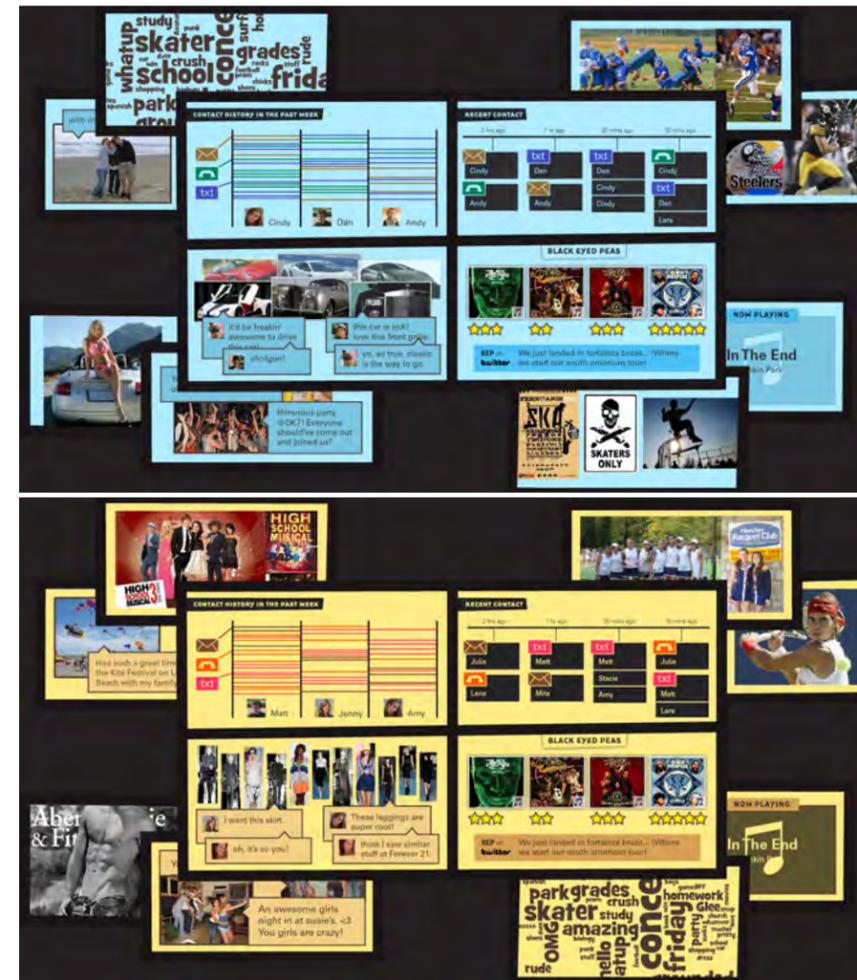
- "Mom" (or "Dad") knocks.
"[Name]! I have your laundry! Can I come in?"
- Friend waits to see if participant will go to the remote.
"Quick! Get the remote! Change the screens!"
- When Participant presses button, change to "Parent Screen".
- "Mom" (or "Dad") enters.
"I'm coming in now... So how's studying going?"
- "Okay, have fun studying, you two."
- "Mom" (or "Dad") walks out.

1-1. Default Screen and Personal Notifications



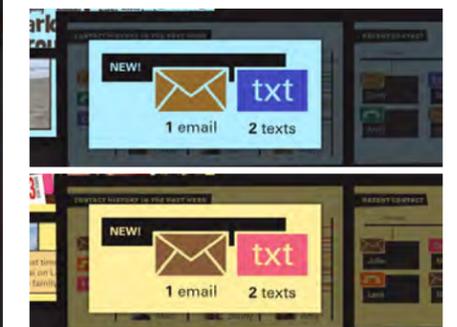
For the first part of the scene, the participant enters the room alone, checks the text messages and is given a chance to look at the screens. By creating a context where they have an exam to study for, we intended that the screens would not draw her full attention, but rather existing as an ambient fixture just like other furniture or posters on the wall.

Screen Design: Boy's (top), Girl's (bottom)

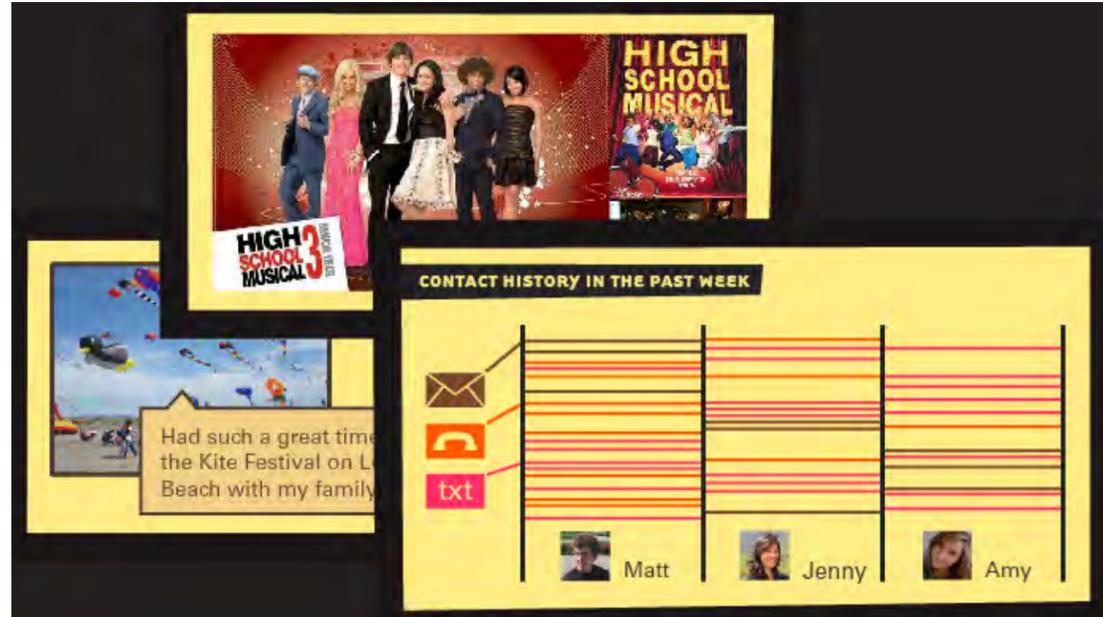
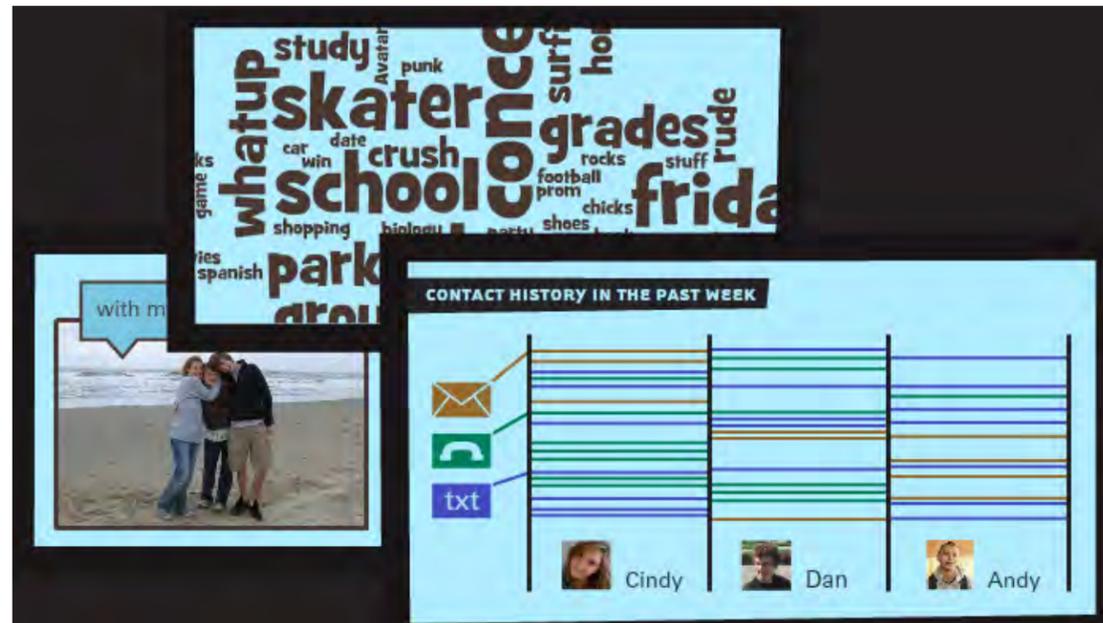


Most of the design is identical for boy and girl participants except for the color scheme and some content that fits one gender but not the other.

We observed the participant in the room and had the message notifications (images below) disappear after she checked the messages.

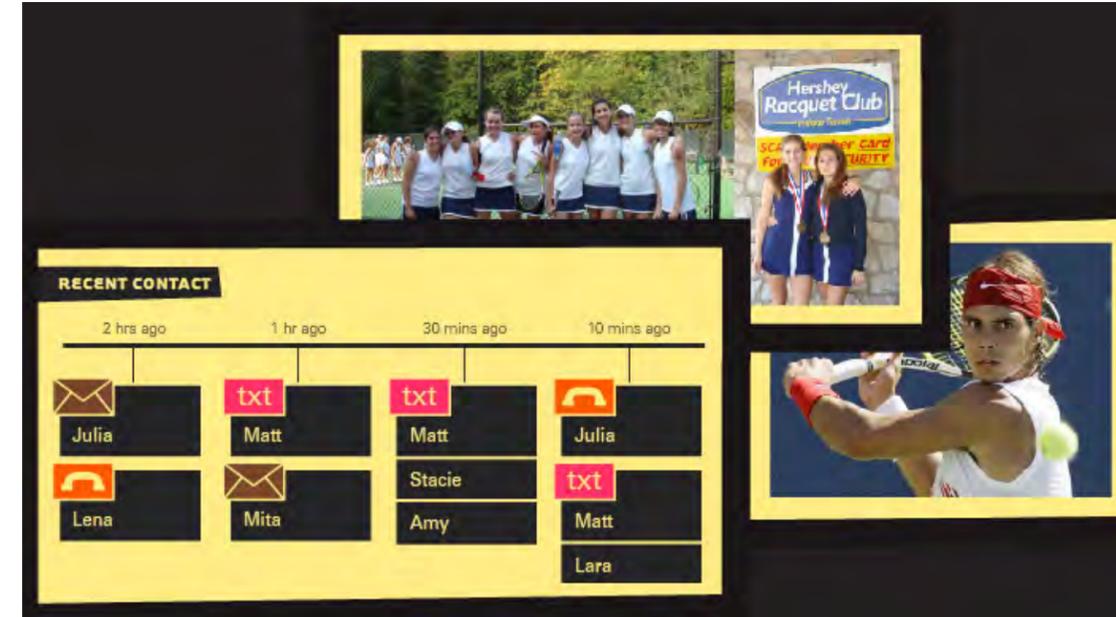


Screen Design: Boy's (top), Girl's (bottom)



The screen at the top most layer shows the contact history between friends. It is rather abstract to give participants a feel for how the system could provide the information that they might not be aware of: the frequency and the pattern

of their communication with friends. Other screens show the photos and posters from a TV show popular among teen girls, and the word clouds of frequently used words in participant's text and email messages with friends.

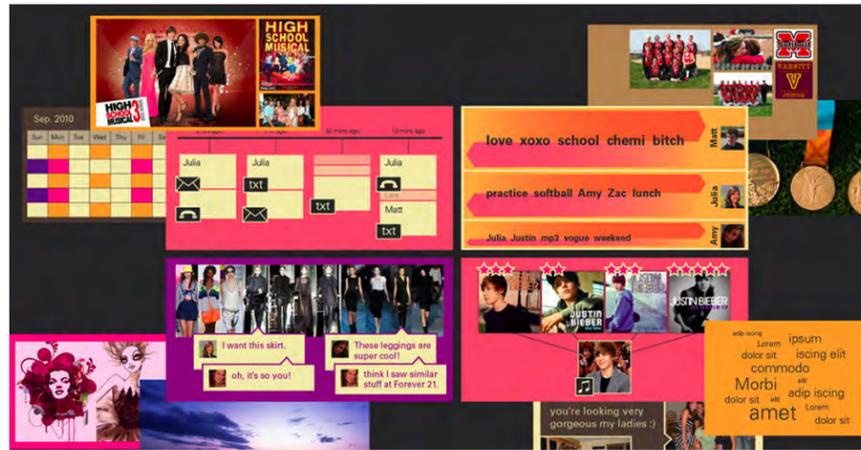


This top right portion of the wall screen displays the recent contact information: sender's name, message type, and received time. Similar to the contact history screen on its left side, this reveals the participant's communication pattern. The icons and simple timeline were

used to help participants quickly grasp the gist of the concept on this screen without having to spend a long time reading it, which would interfere with the flow of the scene.

The bottom layer screens display the photos of participant's sport activities. Without any captions or comments, these photos meant to sit back in the background as the photos in the physical photo frames do in many teens' bedroom.

Initial Sketches



The calendar in the left most screen was intended to remind participants of events and activities and help them with scheduling. However, the previous research revealed that teens rarely have a systemized way of managing their schedules. This made this content irrelevant. As a result, this screen was changed to display family photos.

The contact history was displayed in the top right corner screen at the top layer. It

contained frequently used words placed on top of the lines whose thickness denoted the amount of communication. In this design, the clarity of information seemed to be sacrificed in favor of keeping the screen simple and abstract. To solve the problem, label and icons were added in the final design.

The top right corner showed the participants' the sport activities. It was changed from softball to tennis to be

consistent with the scenes used in the scenario 5, "Multiple Self Presentations."

The look and feel of the word cloud in the bottom left corner was not *real* enough—only slight changes in font size and a monotonous layout. Later, using "Wordle" (<http://www.wordle.net/>) allowed us to generate a more plausible design with little effort and time.



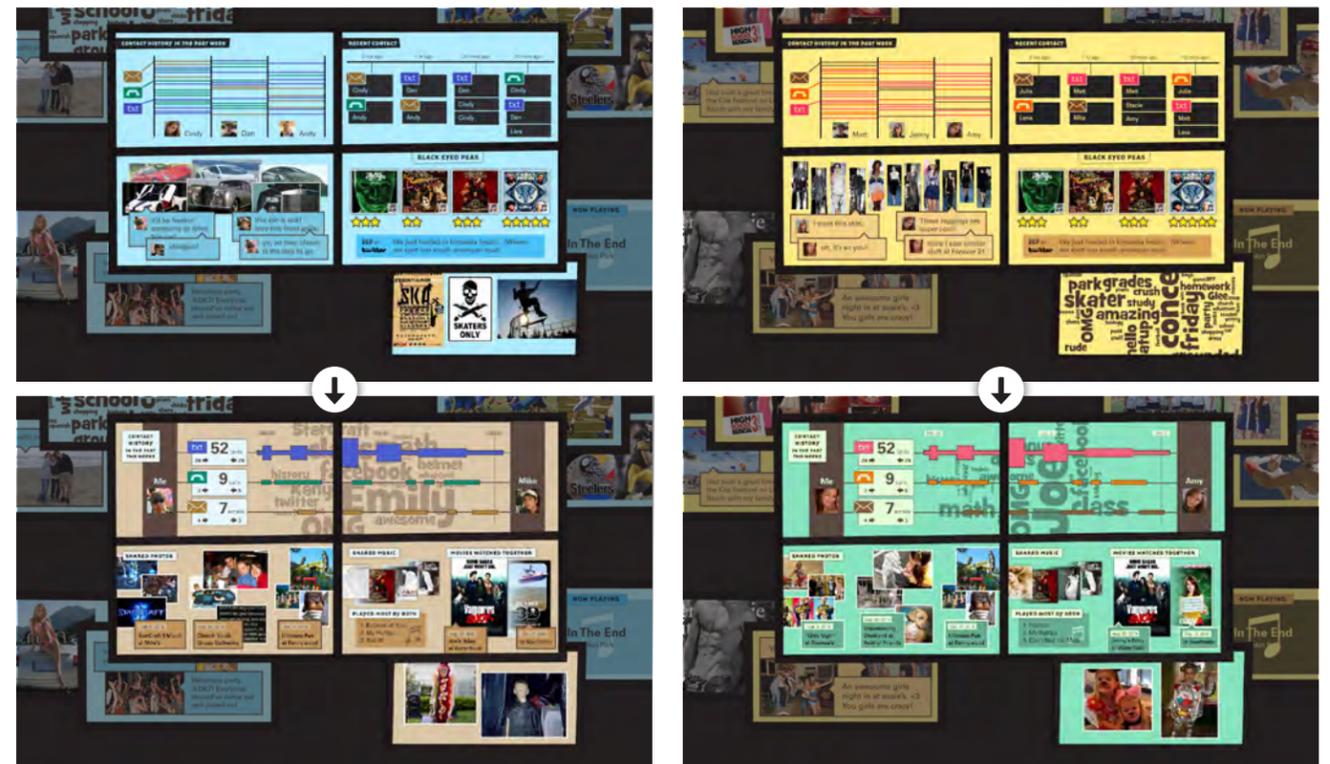
Each set of screens (left: boy's, right: girl's) used two different background colors. This seemed to distract the viewers and take the focus away from the changes in content that happened at

each time a new scene was introduced. The final design reduced such a visual noise by applying one background color to all screens.

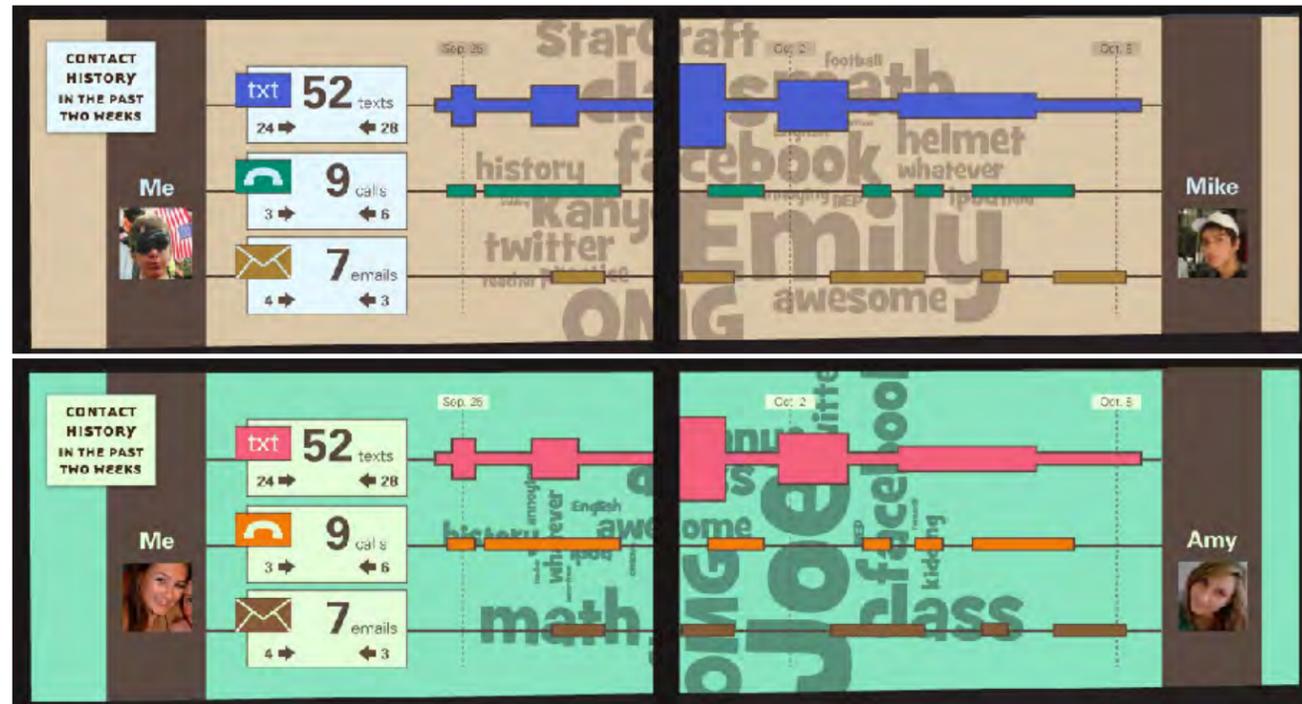
1-2. Similarities and Differences Among Friends



In this scene, when the friend enters the bedroom, the wall screens transition to the content about the contact history and the shared experiences between the two. As the images below show (right: boy's, left: girl's), most of the peripheral screens remain the same and the center ones and the one in the bottom right corner change. To differentiate these screens from the ones that stay, a different background color is applied.



Screen Design: Boy's (top), Girl's (bottom)



In the contact history section, the frequency of communication is visualized in an abstract form and the word cloud of frequently used words is displayed in the background. The icons and the color

scheme are carried from the default screens for consistency. This aims to surface the communication pattern the two friends may not be aware of, helping them reflect on their relationship.

Screen Design: Boy's (top), Girl's (bottom)

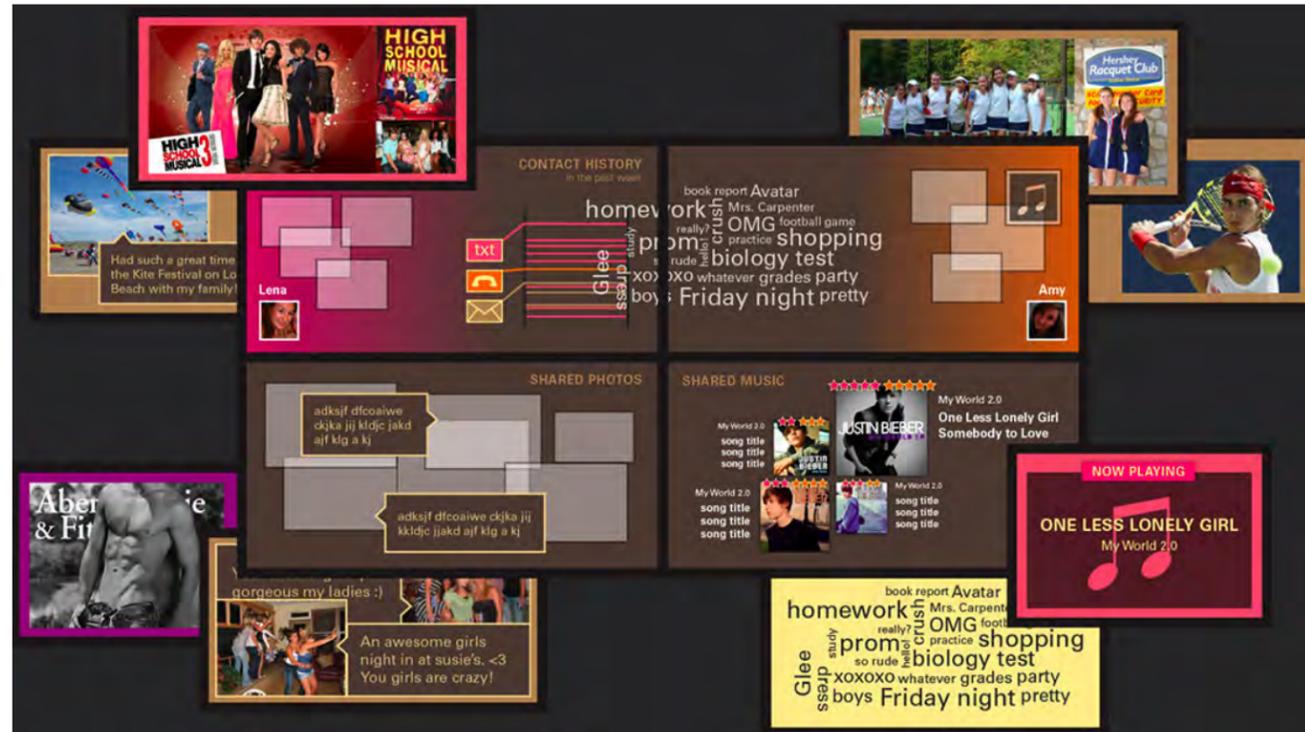


The top two screens contain photos and images that remind the two friends of the experiences and interests they share with each other. Most of the content is associated with a specific event as a reminiscence of their past and a trigger for a conversation.

The bottom screen displays the photos from the past when the friends did not know each other. This aims to find out if teens would feel comfortable with and see values in the idea of system's digging the data from their past and displaying, and if so, how far back would be appropriate.

The design of these screens, consistently with other ones in this scene, takes a form of simple photo frames laid out like a collage.

Initial Sketch



In the initial design, the screens for this scene (friend's visit) did not make a clear visual distinction from the rest. This seemed to scatter viewers' attention. Even within the screens containing the contact history, the lack of clear hierarchy added to this visual clutter.

The shared photos section was changed so they are event based instead of a collage of random photos.

The selection of the artist, Justin Bieber, was changed in the final design because it did not seem to appropriately reflect

the interest of the teens who were in the age range we targeted in this study, 14–17.

1-3. Parent Button

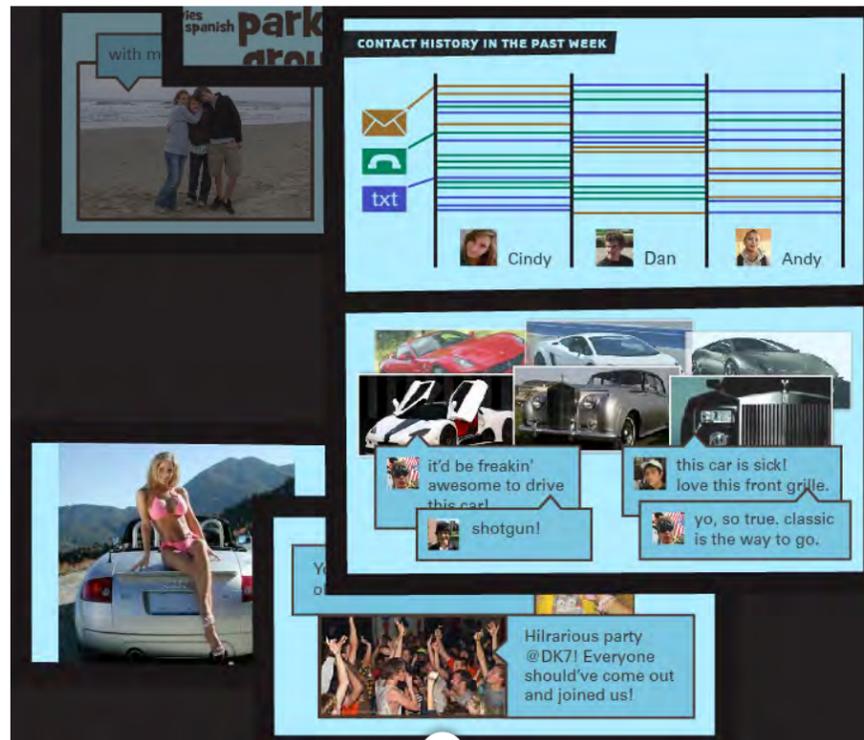


In this scene, while the friend is with the participant, mom (or dad) knocks on the door to drop the laundry. The friend hints at using the "Parent Button" to switch some of the content the participant may not want her parents to see.

Some screens switch back to default and others, as the image below highlights (right: boy's, left: girl's), change to display the content more appropriate for parents.



Screen Design: Boy's



This transition of the screen is meant to display the content that is "ok" for parents to see; the contact history is replaced by family photos; the church group activity photos replace the party photos and are promoted to the top layer screen; the image with a girl in bikini was replaced by a car poster.



Screen Design: Girl's



Like the boy's screens in the previous page, the content on the girl's screens changes in the presence of parents; the contact history is replaced by family photos; the volunteering activity photos replace the party photos and are promoted to the top layer screen; the image with a shirtless guy was replaced by the two girly illustrations.



2. Bedroom Quilt

This concept tests the idea of aggregating a teen’s social information in an abstract heat map embedded in their quilt. The quilt would reflect information in real time, which might include new photos or wall posts on Facebook, text messages and emails. We were trying to understand boundaries and values of having your personal information wrapped around you and always present while you were sleeping.

Script

PREP

- Switch computer projector cable to bed projector.
- Project quilt screen on bed spread.

DIALOGUE: BEDROOM TOUR

- Bed spread fabric itself changes colors.
- Bars show status updates (texts, photos, Facebook, emails) and change depending on how many unread items you have.

DIALOGUE: EXPLAIN SCENE

- You just got home and are going to bed.
- When you enter, kick off your shoes, turn the light off.

- Then get into bed and pretend you’re going to sleep.
- In the morning, “Mom” will wake you up to get ready for school.

IN THE SCENE

- Participant walks into bedroom alone.
- After Participant gets into bed, update quilt bars.
- Mom knocks. “[NAME], get ready for school! You’re gonna miss the bus!”
- Participant gets up and sees new screen. Turns lights on, puts on shoes, runs out.

This enactment takes place in the evening after dinner. Teen participants turn off the lights and go to bed. The enactment only lasts for about five minutes, during which time the bedspread gradually grows brighter to reflect incoming information.

This enactment has not produced much reaction as we would have hoped. We hypothesize that this could be for a variety of reasons. First of all, we were trying to simulate dynamic graphics that would be embedded in the fabric of the bed. Because we projected it from above, the light source was very intense and thus perhaps felt too present. The goal was for the information to be subtle. Additionally, projecting information on a bedspread might not have been the best location.



Bedsread Design



The final design is a simple bar chart with large type. Using bars as a pattern maintains the feel of a real quilt that might be found on a teen’s bed. Adding labels to each bar in a large type size adds playfulness, but also aids in ex-

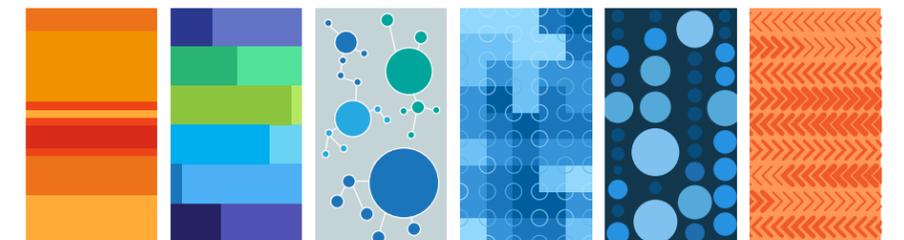
plaining the content and context should the participant forget while in the middle of an enactment.

The graphics begin as dark, subtle pattern, suggesting no new content. Over

time, three of the bars grow bright and vary in height. The final state of conveys that the teen has new content on her wall, new photos and new email.

Initial Sketches

The design needed to be gender neutral and teenager appropriate. In other words, not too child-like yet simple and graphic to convey dynamic information. I explored a variety of techniques for showing emphasis and change including color, scale and weight. Some of my inspiration was Marimekko patterns



3. Gift Giving

This enactment aims to find out how teens perceive the value of virtual music playlist gifted from friends when it is made present in their physical environment; the playlist is displayed on the wall screen with associated data curated by the gift giver that reminds the experience shared between friends.

Script

PREP

- Project gift-giving screen.
- Have songs ready.

DIALOGUE: BEDROOM TOUR

- These screens are when you are listening to music.
- You can see what's "Now Playing".
- A friend gave you this playlist as a gift. They specifically put these pictures and comments in for you.
- These are other playlists from friends. You can see shared songs and playlists between you and your friend.
- This corner is album artwork and word clouds of the song. And this corner is all your other normal playlists.

DIALOGUE: EXPLAIN SCENE

- You're about to go to a sports game with your parents and your friend's going to join you soon.
- So now you can go into your room and listen to music!

IN THE SCENE

- Start music as participant enters room.
- Friend knocks and walks in.
 - “Sorry, I’m a little late. Your parents said we could wait a few more minutes. They’ll call us when it’s time to go.”
 - “Oh, I love this song!”
 - “I forgot how fun that trip to Kennywood was! What’s this? I didn’t tag these [map, weather].”
- Wait another 30 sec. Mom knocks.
 - “Okay guys! Time to go!”



Screen Design



The overall color scheme and the choice of musician, Black Eyed Peas, intended to be gender neutral. Along with gifted playlists from friends, other music-related contents such as album arts and word cloud of lyrics are displayed.

In the scene, one song from the gifted playlist is playing. This primary part of interface shows what is currently playing, "I Gotta Feeling," and the content that reminds the shared experience with the gift giver. Some are curated by the gift giver such as photos and comments, and others are generated by the system such as weather and location information and lyrics word cloud.

In an attempt to avoid being rigid or monotonous, the design uses a radiating form of layout. This helps portray the human touch put into creating the playlist for a friend.



The top right corner of the interface is devoted to displaying “My Playlists” and a word cloud of lyrics from one of the songs. As secondary content, its design intends not to interfere with the main part of the display—the song currently playing and the associated content.



The three screens on the top left portion of the wall display shows the images related to the currently playing song. This includes album arts, concert posters and other photos of the artist.



In the bottom left corner are “Playlists from Friends” and a simple information graphic that compares gift giver’s and my playlists—how many songs and playlists each has and how many are shared.

As the purpose of the study is to test the boundary of acceptance of new ideas, the content and the exact way it is displayed per se is not meant to be evaluated. The simple design here gives a enough feel for participants to see how the screens might look, steering them away from getting caught in the details.

4. Postcards

In this enactment, the teen participant is hanging out in her room and her mom brings her some mail, which includes two Virtual Possessions postcards.

The postcards help to remember the past by gathering information from the web about a participant’s past. The postcards include photos, facts, quotes and stats both positive and negative.

Our goal was to understand the concept of making the virtual, tangible, which was a finding from past research about teens printing out photos or conversations. We were also trying to understand the value of metadata automatically constructed by a computer versus information that is personally collected and curated by the user. We were curious to learn if the computer generated postcard felt creepy like Big Brother, or if it provided useful and nostalgic information.

Script

PREP

- Power down both projectors.
- Get postcards together, along with other mail.

DIALOGUE: EXPLAIN SCENE

- You’re going to get some postcards that will be automatically generated from your computer and mailed to you.
- It will have a summary of your activity and a picture.

- Your Mom is going to drop off some mail. Sort through those and look at them.
- Now you can go into your room and read a book.

IN THE SCENE

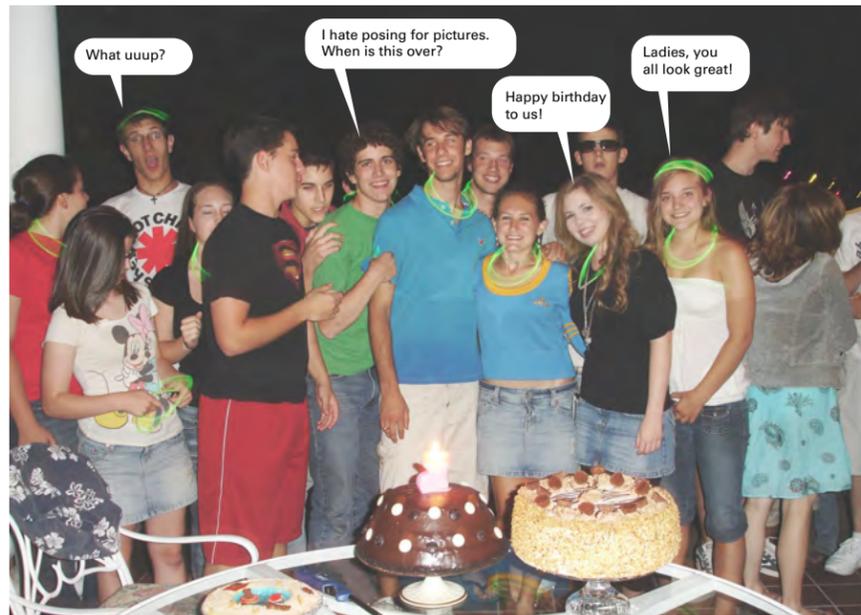
- Participant enters room.
- Mom enters.
“Here’s your mail. Make sure you don’t throw anything important away...”
- Wait for Participant to look at postcards.



Postcard Design

The voice of the postcards are conversational yet high level enough to make it believable that it was pulled off the internet by a computer.

Two postcards are used in the enactment. The event on each postcard is a positive memory. However we made a negative postcard about an event that was rained out and included negative comments. That postcard was introduced during the debrief to compare it against the positive postcards.



Postcard #1

The idea for this postcard was to feel similar to the tagging device in Facebook. Adding quotes from the kids in the photo would be a layered piece of metadata and also add to the nostalgia of the specific event.

The back of the postcard was intended to feel like similar to a baseball card with quick statistics about the teen which could be scraped together from the internet.

IN 2009...

You listened to the **Black Eyed Peas** 1034 times.

You had **145 friends** in your social networks.

You tagged **78 people** in photos.

You were tagged in **38 photos**.

You untagged yourself from **9 photos**.

You 'liked' **Steven Miller's profile contents** the most often.

You sent the most emails to **Samantha Davis**.

You responded the least frequently to **Ben Smith**.

To: _____



Postcard #2

The second postcard was intended to be a negative memory where the teen's event was rained out, hence the dreary photo on the front. During the process we decided to make this postcard a positive experience instead. During the enactment we give the teen just one of the postcards and then show the opposite postcard during the debriefing.

One thing we might consider moving forward would be to match the positive experience with a positive photo rather than a rainy scene.

On October 12, 2008 you:
Went to Cedar Point amusement park.

You invited 8 friends.

3 friends attended:
Kelly Johnson, Jill Medvez, Kim Glassman

The weather was:
Thunderstorm; 65F

You commented:
"Hey sorry for the bad weather. Maybe we can go again next year."

Your friends commented:
"Rain sucks." "Are we doing this again next year?" "We should've gone to the Steelers game"

Other events happening on November 12 2008:
Pittsburgh Steelers vs. Cleveland Browns; Pennsylvania Chili cook off; Downtown Arts & Culture fare

On November 12, 2008 you:
Went to Cedar Point amusement park.

You invited 8 friends.
5 friends attended:
Kelly Johnson, Jill Medvez, Kim Glassman, Nathan Gilbert, Jeff Smith

The weather was:
Partly Cloudy, 75F

You commented:
"Hey what an awesome time. Remember how scared Kim was at the top of all the coasters!?! LOL. Lets go again next year!"

Your friends commented:
"Are we doing this again next year?? Will Kim come LOL!" "I'll come but never to the top of some of those rides again!" "The funnel cakes were sooo good... next time I'll try not to drop mine on Jeff!"

Other events happening on November 12, 2008:
Pittsburgh Steelers vs. Cleveland Browns; Pennsylvania Chili cook off, Downtown Arts & Culture fare

Other friends visiting Cedar Point amusement park in 2008:
Jenny Davis, Sam Jenkins, Marlow Conway, Winston Matthews,

Celebrities visiting Cedar Point amusement park in 2008:
Ben Rothelsberger, Justin Beiber, Brittany Spears, Kings of Leon

To: _____

negative memories

positive memories

5. Multiple Self Presentations

Teens often project different selves to various groups of people in their lives. When currently manifested on Facebook, teens censor their comments and expression for all groups even though in person they may act differently. For this enactment, we were exploring how a teen's multiple selves would look if they were all visible in one place.

Script

PREP

- Project multiple self presentations screen.
- Foam core phone for text messages.

DIALOGUE: BEDROOM TOUR

- These four screens are four profiles you have on Facebook. Each is an aspect of who you are.
- So this corner is your sports team and these are the photos, comments, etc. that your teammates can see.
- This one is for your family. This one is for your social group and this one is for school.
- The screens update when you change things online.
- When you receive any texts or email, the screens will let you know.
- You can check your phone by peeling off a Post-It for the next message or check your laptop.

DIALOGUE: EXPLAIN SCENE

- You're going to be reading in your room.
- You might receive some texts or emails. When you do, you can just check them. How do you do that again?
- Okay, great. Go ahead!

IN THE SCENE

- Participant enters room.
- Trigger incoming text sound. Change screen to text alert.
- Once Participant checks it, go back to default screen—swoop into text visualization.
- Trigger another text. Change to text alert. Back to default screen when participant checks.



Screen Design



The wall display includes four personas, each with three screens. Each persona is differentiated by color, labels, content, and profile picture. The different personas—represented by four photos of the

same teen—are symbolically unified in a circle at the center of the display. Although each quadrant incorporates persona-specific content, the overall display is intended to feel messy yet

curated. Some parts should feel like a bulletin board and other parts feel like posters.



Content that appears on the wall display is not specifically defined, but might be pulled from digital devices and the web. For example, text messages might be aggregated into a tag cloud or upcoming events would appear.

The displays also suggest hierarchy based on time. Content in the fore-

ground is newer than content in the background. Also, the smaller displays on the periphery of the display do not contain time-sensitive information.

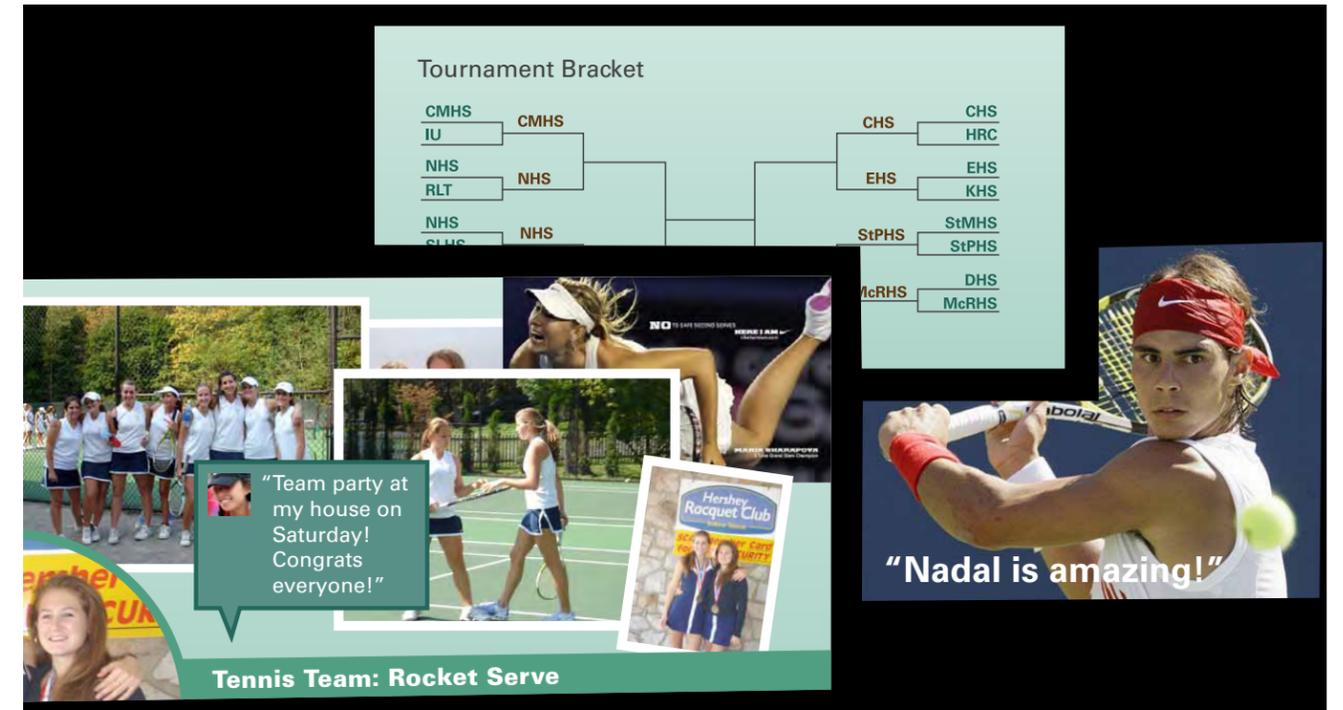
Additionally if a student has incoming text messages or email, the quadrant specific to the sender will highlight.

During the enactment, the teen receives a text message from two different friends. Receiving a message will highlight that quadrant in yellow and dim out the other quadrants. This device reinforces the idea of four different personas

Screen Design: Girl's



This is the family persona. It includes content that is safe even for grandma to look at. The photos chosen were happy and sunny. In considering the imagery a teen might want to see about her family and her history, we included a photo of an old house. We wanted the family section to allow for reflection and pride about where you come from and what it means to be a family.

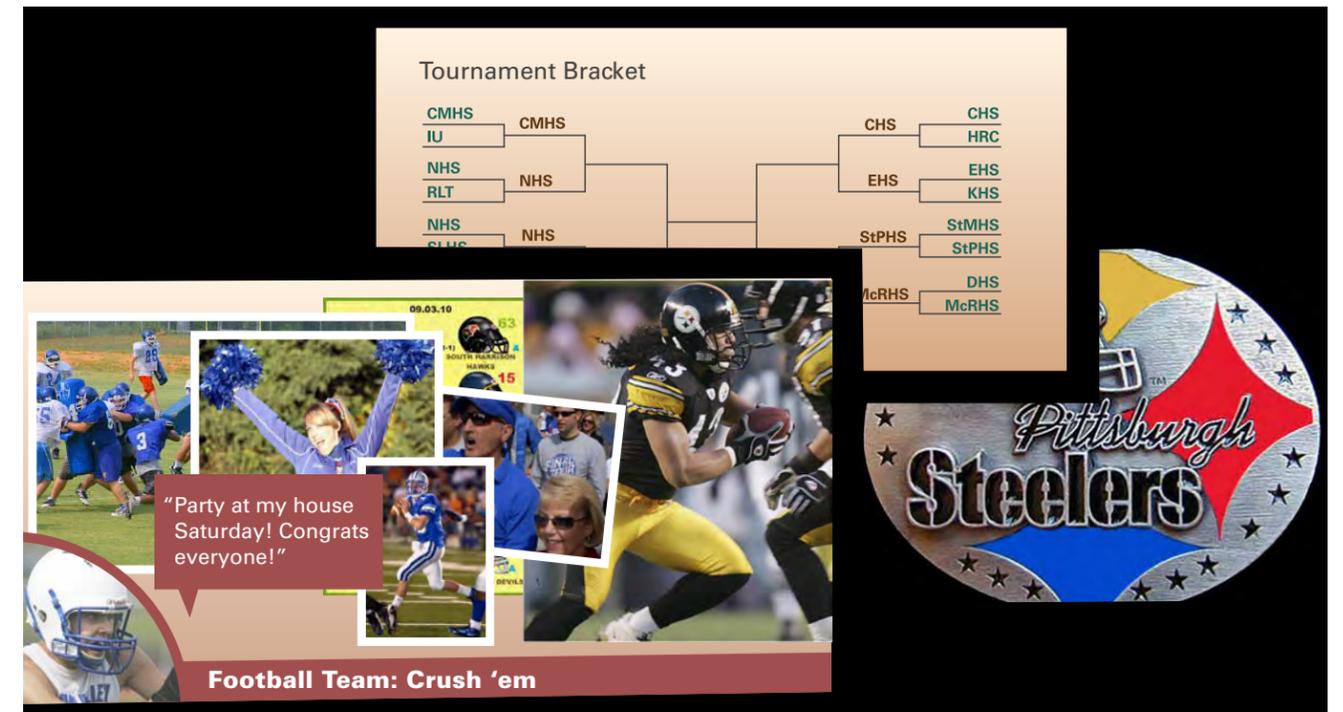


This is the sport section. The teenage girl is obsessed with tennis. The larger panel focuses on current events and the teen featured as an athlete. In addition to photos, we included other current information such as a tournament bracket which might help the teen keep track of her standing. Last, to round out the passion for tennis, we included more commercial photos of famous tennis players. This section is not only about the teen playing tennis but also the athletes she looks up to or admires.

Screen Design: Boy's



This is the family section for the boy persona. In contrast to the girl's family section, the boy is depicted with an outdoorsy family. They are always going on an adventure and eating together is an important family tradition. All four color backgrounds vary to support the idea of multiple selves. Color backgrounds for the boy are deeper jewel tones that feel more masculine. In this case, the straw color background was meant to feel like fall, warm and vibrant.



This is the sport section for the boy. He is a obsessed with the Steelers and plays football himself. The images are active and tense. They feature him at practice, but he also has his own cheering crowd of parents and cheerleaders. The color is a jewel-toned red which is more masculine and contrasts the blue jerseys of his football team. Also as a contrast to the active large section, the Steelers logo is meant to resemble a poster on your wall.

Appendix III

materials from cloud possession
study

General Speculations Framing the Study

Creating the capacity for digital things to be 'possessed' or 'demonstrate possession' could lead to some new innovation; it could also help better understand where problems are happening and why.

How is possession demonstrated? And, where does the grammar breakdown? Why?

Are there tensions about 'possessing' something that's immaterial.

Is the focus on that you have to *demonstrate* possession?

Are there distinctions between *possession* and *ownership*?

Is the Internet still thought of as a place where you have to 'copy' things to?

Do people still retain 'original' copies on their hard drive?

Perceived *shareability* can also expose issues related to breakdowns in possession (i.e. if you own something, you have the right to give it to someone)

****Bring paper and pens, and ask people to sketch out where a photo goes when it is placed online and where possession/ownership lies? Similarly sketch out where ownership lies when they attribute metadata to a photo online that they don't own.**

- The metaphors of ownership and possession of digital materials, particularly in online places, are conceptualized and implemented in problematic ways.
- As people's things have migrated to online places, new opportunities have emerged that enable people to share and extend these things to other social affiliations. However, these shifts have to some extent complicated how digital 'ownership' and 'possession.'
- Recent work has described how people are constructing value with their *virtual possessions*. However, little research has explored how people perceive and experience notions of *ownership* (and indeed *possession*) of their digital objects and collections.
- We speculate that developing deeper knowledge of how people perceive 'possession' of their digital materials and, importantly, where complications emerge, will be lead to better ways of designing interactive systems through which people store, present, and dispossess their digital things, and perhaps inspire design possibilities beyond these concerns.

A sketch of interview topics and questions

Begin interview by aiming to get participant comfortable with being interviewed, and establishing an understanding of her/his life and significant material things. If it is a teenager participant, this could occur in her/his room, with an older participant this could occur in a particular room of significance, or during a tour throughout the home. In either case, the interview could begin with asking the participant to give a tour of some of their favourite material possessions, one's they have a strong sense of ownership over and plan to retain possession of.

This portion of the interview will also explicitly cover *dispossession*; this is done to setup a later comparison of 'dispossession' with digital things. The questions for this part are generally framed as follows:

- We've been talking about different possessions that are important to you and that you've held onto for a lot of different reasons. Now let's shift for a moment and talk about some things that you've gotten rid of.
 - For example, have you ever gotten rid of anything that reminded you of a bad memory that you no longer wanted to relive?
 - Or an object that reminded you of a past relationship you didn't want to relive?
 - Can you describe what they are?
 - Can you describe where they went—how did you *dispossess* them?
 - In reflecting on those experiences, do you now feel it was regrettable getting rid of those things, or has it been beneficial for you? How? Why?

Probing perceptions of 'ownership' through distinctions among personal (i) material things, (ii) locally stored digital things and (iii) digital things stored in online places (e.g. Facebook)

When you think back over the past year, does anything come to mind that you owned for a while, but got rid of?

What about over the past month?

What motivated you to get rid of it?

What comes to mind when you think about digital things you own—say things on your computer hard drive or your mobile phone?

- How would you compare them to the physical things you mentioned?
- Do you use/think about them in similar or different ways? How? Why?
- Does it feel like you own them in the same way you 'own' your physical things?
- Is there anything about them (the digital things) that makes you feel like you own them?
 - I.E., is there any representation of ownership? Are there any ways these digital artifacts *express their possessiveness*?

- Is the perception of ownership in any way tied to access permissions to storage location?

- If your digital files are stored locally on your computer and no one else has access to them, do they feel like you own them?
 - What if they were stored on someone else's computer (e.g., a shared family computer)?

 - Would they feel more, less or the same like you 'owned' them if they were protected with a password?

What comes to mind when you think about digital things that you that you put online (e.g. content uploaded to Facebook)? Does it feel like you 'own' this content?

- How does it feel similar or different to the other digital things you own that are stored locally on your hard drive (or other personal devices)?

- What about compared to the physical things you mentioned?

Further exploring perceptions of ownership of things stored in different online places

I'd like to ask a few more questions exploring your thoughts on the things you have online and your online accounts.

Places only "I" have access to (e.g. email)

- What comes to mind when you think about online places that hold some of your digital things that no one else can see or has access to?
 - For example, email might be one of these kinds of things?

 - Do you feel a sense of ownership of your personal email account?
 - Can you describe how they feel different or similar to your physical things? What about the digital things you have stored on your computer/devices locally?

- Do these digital things seem like something you would want to keep?
 - If 'Yes', then: Where will they go? Who will you give them to when they're gone?
 - If 'No', then: How will you eventually get rid of (i.e. dispossess) them?
- Has anyone ever 'assumed' possession of your account? Did it shape the way you perceived your ownership of it?

Places other people might have permission to access to (e.g., home /office network?)

- Does any place come to mind that you store digital things, but others might have permission to access it? (e.g., shared folders on a home network? Or, on a shared network in the office place?)
- If so, does having these things stored in this kind of online place change the way you think about owning them? Perhaps compared to your personal email account (which only you have access to)? Can you describe how they feel similar or different? ...as compared with the physical things?
- Do these digital things seem like something you would want to keep? Do you feel like there are any barriers to do so?
 - If 'Yes', then: Where will they go? Who will you give them to when they're gone?
 - If 'No', then: How will you eventually get rid of (i.e. dispossess) them?

Places "I" post things about me that other people can see (e.g. Facebook)

- Do you use any social networking sites (e.g. Facebook, etc..)? How often do you use it?
- Can you describe the kinds of things you store/post on Facebook? (e.g., photos, etc..)
 - What motivates you to post these things on Facebook? And, how often do you?
 - Once you have uploaded these things to Facebook, do you retain the original copies (e.g. photos stored locally on the hard drive)? Why?

- Does having these things stored in this kind of online place change the way you think about owning them?

- If a photo you put online receives 'comments' or 'likes' from other people, does this change the way you think about the photo? How so?
 - Does it shape the way you think about who 'owns' the photo?
 - (is there a sense of 'co-ownership')

 - Do you feel like you possess the photo after it has been commented on?
 - If you were to save or archive the photo somewhere else, would you want to keep these metadata with it?
 - Does the metadata feel like 'part' of the photo once comments have been left on it?

 - Does this change the way you think about who is entitled to possession of the photo and/or metadata?

- Do these digital things seem like something you would want to keep? Do you feel like there are any barriers to do so?
 - If 'Yes', then: Where will they go? Who will you give them to when they're gone?

 - If 'No', then: How will you eventually get rid of (i.e. dispossess) them?

- On the other hand, if you post things like comments on another person's photo (perhaps one that you're tagged in), would you want to be able to have access to those things in the future?
 - What if the original photo posted online is delete by the 'owner'?

 - This would mean that your comments are by default deleted? Does this shape your perception of ownership of the comments? What about the photo itself?

Places other people post things about me, but it is unclear that I 'own' them (or will have 'permission' to access them in the future)

- Do people in your social network on Facebook ever post content related to you (e.g. tag you in a photo or wall post)?

- Can you describe what kinds of things they post related to you?
 - (e.g., photos, wall comments, comments on photos, lightweight social metadata (i.e. 'likes')

- If someone posts something about you like these things, do you feel a sense of possession or ownership over them?
 - Do you feel like you should be entitled to some sense of ownership?

 - Can you compare the kind of ownership/possession you're imagining to how you think about material things?

 - Would you want access to these kinds of digital materials beyond the online site they are stored on? Why/Why Not?

- To think about it another way, to what extent do you feel you have (or should have) *permission* to own these kinds of things?
 - In the case of a photo that you are tagged in, but did not upload, how are you able to assert control in some sense over these things?

 - E.g., do you ever 'untag' yourself from these things, or report them as inappropriate (if applicable)?

 - Do you wish you had more freedom or control to do so?

How do 'I' dispossess digital things

Probing experiences of Dispossessing Locally Stored Digital Things

- Now turning back to the discussion we had previously about things that you've gotten rid of and why, do any objects or collections come to mind when you think about digital things that you've gotten rid of so as to forget a painful experience or relationship?
 - Did this motivation ever lead you to delete anything from your local hard drive? (e.g. word/text document, digital photos, ...other content)
 - What about on a mobile device, like your phone? (e.g. photos, diary entry, text messages)
 - Can you describe these things?
 - In retrospect, do you regret deleting these things? Has the experience felt regrettable or beneficial? Why?

Probing experiences of dispossessing Online Stored Digital Things

- Now lets shift to talking about things that you have stored online. When you think about the content that you have stored online in the services you use (e.g. Facebook, Flickr, Picasa, Twitter...), have you ever explicitly tried to get rid of something that you had uploaded?
 - What were they? What motivated you do this?
 - Do you feel like they've been 'permanently' dispossessed like your physical things? Why/why not?
 - Do you ever have concerns about these things continuing to exist somewhere else digitally?
- Have you ever experienced any instances in which someone else has posted content about you that you didn't like and wanted to get rid of it (e.g. on Facebook or elsewhere)?
 - How did you deal with this situation?
 - Were you able to get dispossess or otherwise get rid of them to an extent you were satisfied with? How? Why?
 - If only in the case of 'un-tagging', then : Do you feel like they are 'dispossessed', similar to your other discussions of your physical and digital things?

Probing reasons / experiences with abandonment of content in online digital services

- Have you ever used any online services (e.g. Flickr, Picasa, MySpace, Facebook) in which you uploaded personal content to your page, but ultimately abandoned the site at a later date?
- Why?
- Do you feel this content was adequately disposed of, or dispossessed?

Sundries

Probing perceptions of the longevity of digital materials online vs. through local storage

- When you consider the digital content that you find valuable, do you think you'll still have it in ten or twenty years?
- Are there any distinctions between the things you have online, and the things you have stored locally?
 - What feels like it will be around longer? Where will it go?

Probing other perceptions and experiences related to perceptions of ownership of digital things

This portion of the interview would explore how the origin and currently storage location of different kinds of digital things (online or offline) may shape the degree to which they are 'possessed' or 'owned.' Specifically, categories of digital artefacts to be explored are: (i) Bought, (ii) Downloaded (legally or illegally), (iii) Made by self, (iv) Composed by self from pre-existing digital materials, (v) Made by others and received as gift (or in some kind of exchange).

Bought

- When thinking about your digital stuff, what comes to mind when you think of things that you purchased?
- What kinds of things were these? (e.g. music, movies, etc..)
- Where do you keep them? (i.e. where are they stored)?
- What do they mean to you? What do they represent about you?
- Do you feel like you 'own' them?
 - How is it different or similar to a physical thing?
- How long do you think you will own it/them?
- Will you give it to anyone when you no longer want it?
- Where will it go? How will you get rid of it? (i.e. relinquish ownership)

- Will it 'feel' the same of getting rid of physical thing? Why/why not?

Downloaded (legally or illegally)

- When thinking about your digital stuff, what comes to mind when you think of things that you purchased?
- What kinds of things were these? (e.g. music, movies, etc..)
- Where do you keep them? (i.e. where are they stored)?
- What do they mean to you? What do they represent about you?
- Do you feel like you 'own' them?
 - How is it different or similar to a physical thing?
 - What kinds of things shape how you think about 'ownership' of these things?
- How long do you think you will own it/them?
- Will you give it to anyone when you no longer want it?
- Where will it go? How will you get rid of it? (i.e. relinquish ownership)
- Will it 'feel' the same of getting rid of physical thing? Why/why not?

Made by self

- When thinking about your digital stuff, what comes to mind when you think of things that you purchased?
- What kinds of things were these? (e.g. music, movies, etc..)
- Where do you keep them? (i.e. where are they stored)?
- What do they mean to you? What do they represent about you?
- Do you feel like you 'own' them?
 - How is it different or similar to a physical thing?
 - What kinds of things shape how you think about 'ownership' of these things?
- How long do you think you will own it/them?
- Will you give it to anyone when you no longer want it?
- Where will it go? How will you get rid of it? (i.e. relinquish ownership)
- Will it 'feel' the same of getting rid of physical thing? Why/why not?

Composed by self from pre-existing digital materials (i.e. ownership out of curation)

- When thinking about your digital stuff, what comes to mind when you think of things that you purchased?

What kinds of things were these? (e.g. music, movies, etc..)

- Where do you keep them? (i.e. where are they stored)?
- What do they mean to you? What do they represent about you?
- Do you feel like you 'own' them?
 - How is it different or similar to a physical thing?
 - What kinds of things shape how you think about 'ownership' of these things?
- How long do you think you will own it/them?
- Will you give it to anyone when you no longer want it?
- Where will it go? How will you get rid of it? (i.e. relinquish ownership)
- Will it 'feel' the same of getting rid of physical thing? Why/why not?

Made by others and received as a gift

- When thinking about your digital stuff, what comes to mind when you think of things that you purchased?
- What kinds of things were these? (e.g. music, movies, etc..)
- Where do you keep them? (i.e. where are they stored)?
- What do they mean to you? What do they represent about you?
- Do you feel like you 'own' them?
 - How is it different or similar to a physical thing?
 - What kinds of things shape how you think about 'ownership' of these things?
- How long do you think you will own it/them?
- Will you give it to anyone when you no longer want it?
- Where will it go? How will you get rid of it? (i.e. relinquish ownership)
- Will it 'feel' the same of getting rid of physical thing? Why/why not?

Appendix IV

materials from young adult study

General Overview, Approach and Aim for interviews with Couples

Aim: The aim of the interview is to uncover couple's individual and collective relationships with their digital things, both stored locally and in the cloud—and, similarities and differences when compared to their material things. We also want to uncover how couples construct a 'sense of home' with their material and digital things, and how these things reflect aspects of their identity, values and aspirations within domestic space. In particular, we want to understand how couples differentiate their individual and shared digital things (i.e. **from what's "mine" and what's "ours"**), and how this relates to or differs from their material things.

Notes on the Interview Protocol: Interview questions consist of trigger questions, general questions, and detail questions. Trigger questions are for attracting natural participation from interviewees. Interviewees may explain stories by using the trigger questions. General questions deal with the most important facts related to material possessions and virtual things that we have to discover. Detail questions contain optional examples that we can ask to interviewees. Also a checklist is provided to prevent interviewers from neglecting core questions. Depending on the proceeding of the interviewer, interviewers can modify or add more questions.

[Amended] Approach: For couples, please conduct the interview with each member of the couple separately. We originally had couples being interviewed together, however, this proved far too difficult to appropriately document data from each of the couples (e.g., it was hard to take notes, and photos when one researcher had to be paired off with one member of the couple). It was also difficult to split couples up as there were only so many rooms they could go into that the other member of the couples wasn't in. In this amended approach, please conduct an interview with one member of the couple and then review that data. Afterward, schedule and conduct the additional interview with a member of the couple with the data from the 1st member of the couple in mind. This will help provide context for the interview, and also will help reveal differences in perspectives on the curation of 'personal' and 'shared' places in the home (among other things).

This general approach is to establish an understanding of material things members of the couple individually and collectively find important, how they become attached to them, where they're kept in the home, and why. We can then use these insights to understand their perceptions of and relationships with their digital things, whether stored locally on devices in their home or stored in the Cloud (but accessed through devices in the home). The following questions are guidelines to uncover these understandings—you may not need to use all of them, but most will need to be covered.

A few things to keep in mind: The interview can last up to 90 minutes, you will likely need to use all of this time. You also need to create an inventory of participant's digital things. This will require you to go through the digital things of the participants with them. You are compensating them \$75 for this interview, so, within reason, you should not be shy in asking people to directly show you their stuff, digital or otherwise. Finally, remember that we are interviewing people about their material things in order to move onto their digital things. Please make sure to manage time appropriately so you are able to capture the full range of digital things people have (i.e., if it feels like the interview is dragging on with respect to people's material things, make it clear that you politely need to move on). Please also make sure to make clear that we may contact them in the future for a few follow up questions.

1. Demographic Questions

How old are you?

What is your current occupation? How many hours do you spend at work each week?

What are your goals for this year?

How is life different now than it was five years ago?

What do you think your occupation will be in five years?

Do you have siblings? If so, how many?

How have your relationships with your family changed in the past year? In the past five years?

How frequently do you visit family members in person each week? Did visit any family members in person last week?

How long have you lived in this house?

How long do you think you will continue living here?

How long have you lived with your partner?

Do you own a car? If so, can you show it to use and tell us what you keep in it?

2. Material possessions & Domestic Spaces

General questions about possessions

Now we are going to ask you some questions related to the your material possessions. We'll also ask you some questions about where you keep them in your home.

Goal: Determine how meaning emerged with object / nature of the attachment

2.1 Trigger questions

Depending on the proceeding of the interviewer, interviewers can choose some of questions to start interview.

- Imagine your house is opened for the public to exhibit your history and life like Shakespeare's birthplace. What do you want to exhibit among your material possessions?
- If you are able to store some of your material possessions at Swiss safe bank, what would you store?
- Among your material possessions, is there anything that you want to hand down as an heirloom from generation to generation?
- When you think about your most cherished material possessions, what comes to mind?
- If your house was burning down, what would be some of the most cherished things that you would desire to grab?

2.2 General Questions that can be asked:

- What is it?
- Can you describe it?
- How did you acquire it? (e.g., did you make it? Did someone give it to you? Did you make it?)
- Where is it kept?
- Why is it in this room?
- What kind of story do they tell about you?
- What does it mean to you?
- What does it say about you?
- How does this thing represent you?
- What has motivated you to hold onto it?
- How much longer do you think you'll have possession of it?

2.3 Checklist and Detail Questions

		Check	(Optional) Detail questions
a. Types of possessions			•
b. Stories about possessions	i. Created		• How did you acquire them? (e.g., did you make them? Did someone give them to you? Did you make them?)
	ii. Used		•
	iii. Trashed		• Are there objects that once were in the home, but have now been disposed?
c. People	i. Ownership		• About shared possessions of a couple, who is the person that cares about the shared possession?
	ii. Identity		•
	iii. Social relationship		•
	iii. (Lifestyle) Transition to early adulthood life		• Are there material possessions that you gained or trashed by the change of your lifestyle? • Are there material possessions that you had 5 years ago, but not anymore?
d. Things	i. Time		•
	ii. Spatial relationship		•
	iii. contents		•
e. Future wishes/desires			• How will you keep and store them? • How do you want to manage material possessions that are meaningful now but will lose the meaning as time goes by?

Script: We are interested in where you keep these things in the home, and in general other material things that you keep in your home and how you relate to them.

General description of what should happen: Now the participant will be asked to give a tour their private spaces and/or where they keep their personal possessions in the home. The aim is that a sense of connection could be (or start to be) established between the researchers and participant in the initial object discussion, before moving on to the tour of different rooms of the home. Questions will aim to understand the significance of specific material possessions, their organization (or 'curation') and relationship to domestic space). The idea is that the questions that immediately follow could be asked multiple times as the focus of the interview changes from different domestic objects and spaces. Naturally, the order and structure of these questions would not have to be followed methodically, and could fluidly change depending on the specific participant and conditions.

Goal: Understand how their perception of material things relates to (and helps curate) domestic space.

Questions that could be used to investigate relationships with material things in different rooms in the home:

Can you describe this room?

Is it a shared space? Who do you share it with?

What things do you have out on display?

What motivated you to put them on display?

Can you describe what some of the most meaningful things are that you have them this room?

What does it mean to you? What kind of story does this thing they tell about you?

Has its meaning changed over time? Why? How?

What has motivated you to hold onto it?

How much longer do you think you'll have possession of it?

Are the things that you have on display related to each other in some way? For example, if they had to collectively tell a story about you, or say something about you, what would it be?

Why did you choose to put these objects in this room, compared to another room? Would they be just as appropriate to be in another room? Why/Why Not?

How often do you rearrange them?

How often do you put new objects out on display?

What motivates you to do this?

Do you ever take objects away from being on display in the room? Why? Where do they go?

Questions for couples that explore shared ownership:

- What kinds of things come to mind when you think of things that you 'share' with you partner? (e.g., houseplants, pets, furniture, etc...)
- What kinds of things come to mind when you think of things that you and your partner both own in the home?
- What kinds of things come to mind when you think of things that you and your partner have made?
- What do these things mean to you? How would it change your home if you no longer had them?

Questions about cherished objects not on display.

Goal: Understand relationships with material things not on display, or in 'deep storage'

Do you have any material possessions or collections that are deeply meaningful, but not out on display? (e.g. in closet, shoebox under the bed, in a chest)

Can you describe what they mean to you? Why do you continue to hold onto them?

How long have you had them? How long do you think you'll continue to have them? Where will they go after you're gone?

Is it important that they are kept together?

Why did you chose to keep them in this room rather than in another room?

Are there any other things that you want to keep, but that you don't want to see or have on display?

Questions about objects that once were in the home, but have now been disposed.

Goal: Understand how and why people get rid of personal things to later compare to digital things.

Can you reflect on whether you ever possessed something that was meaningful, but you got rid of because it longer represented you, or reminded you of memories you no longer wished to think about? (e.g. a letter from a former lover, music from a band no longer liked)

How long did you have it?

How did you get rid of it?

Did you make this decision together? How did you decide?

3. Digital/Virtual Possessions

Goal: Understand perceptions of digital things compared and contrasted to material possessions. We want to get a sense for how social relationships are expanded, understood, and supported through the digital things or places.

Script: Now we would like to ask you some questions about your digital possessions. First, however, we'd like to ask you some general questions about your technology use.

3.1 Trigger Questions

Depending on the proceeding of the interviewer, interviewers can choose some of questions to start interview

- What things come to mind when you think about your most treasured or important digital things (e.g. diary, photos, music, etc..)?
- Can we take a tour of your other digital possessions? For example, do you keep digital photos on your phone? On your computer?

3.2 General questions

- What comes to mind when you think about a digital thing that's important to you?
- Where is it stored?
- How do you access it? (e.g., computer, mobile phone, etc.)
- Why is it in this room?
- What kind of story do they tell about you?
- What does it mean to you?
- What does it say about you?
- How does this thing represent you?
- What has motivated you to hold onto it?
- How much longer do you think you'll have possession of it?
- Has its meaning changed over time? Why? How?
- Why and how did you get rid of it?
- Have you ever shared it with others or given to other?
- What will be the future of the possessions that you mentioned as meaningful thing?
- (About Cloud-based virtual things) do you access it in different rooms? Why?

3.3 Checklist and Detail Questions

		Check	(Optional) Detail questions
a. Types of possessions			•
b. Stories about possessions	i. Created		•
	ii. Used		<ul style="list-style-type: none"> • What kind of (messages) do you send? What do you communicate to people you frequently send messages to? • How often do you modify your (phone)? Do you change the background images of your phone, or customize it in any other way? What motivates you to customize your phone? What does it say about you? • Do you ever look at data associated with your (music collection)? For example, the amount of times you've listen to a song, or the top songs you've listened to, etc.? What does this mean to you?
	iii. Trashed		<ul style="list-style-type: none"> • Do you have (music) that you no longer listen to? Why do you keep it? • Have you ever intentionally deleted any files on your devices because they reminded you of something you no longer wanted to remember? How did you delete them? Where did they go? Are they 'gone'? • Would you be upset if you lost your (Facebook account)? If so, Why? What about it feels valuable?
c. People	i. Ownership		•
	ii. Identity		•
	iii. Social relationship		• Do you edit things on your (Facebook account) so that only certain people can see them? Why?
	iii. (Lifestyle) Transition to early adulthood life		• Are there material possessions that you gained or trashed by the change of your lifestyle
d. Things	i. Time		•
	ii. Spatial relationship		•
	iii. contents		•
e. Future wishes/desires			<ul style="list-style-type: none"> • How will you keep and store them? • How do you want to manage material possessions that are meaningful now but will lose the meaning as time goes by?

Technology Usage Questions

Do you have wifi in your home?

How frequently do you send SMS messages? Each day? Per week? How long have you been using SMS? (e.g., how many years?)

Who do you frequently send SMS messages to? (e.g. friend, family members, partner)

What kind of messages do you send? What do you communicate to people you frequently send messages to?

When you think about the bulk of SMS messages you've sent to a specific person (you frequently text), what kind of story would it tell about your relationship with them?

Are there any SMS messages that you've wanted to hold onto or preserve?

Why were they special? Where did you put them? How did you preserve them?

Can we now take a tour of your other digital possessions? For example, do you keep digital photos on your phone?

How many photos do you have on your phone?

What are they of?

When do you look at them?

What is the oldest photo on your phone?

Do you produce new photos directly through your phone?

How often do you modify your phone? Do you change the background images of your phone, or customize it in any other way? What motivates you to customize your phone? What does it say about you?

Do you use your phone to 'view' or use your digital possessions, like photos, in your home? Where and when? Why do you use it as opposed to your computer? Are there particular places you or times you prefer to use your phone to view your digital things in your home?

What other devices do you have that you have your digital things stored on? (e.g. desktop, laptop, mp3 player, iPad or tablet computer, digital camera, etc.)

Questions related to digital content/things stored locally on devices

Note: the questions that immediately follow could be adapted to explore each of the aforementioned possible devices

Can you describe where you use these different devices in your home? (i.e. living room, bedroom, etc.)

Where do you keep your collection of digital photos (locally, i.e. on the computer)? Can you show us? How did you decide to organize them? How do you view them? Do you produce physical photographs from them (i.e. print them or send them to be printed)?

How often do you produce or acquire new digital photographs?

How would you compare or contrast digital photos to physical analog photos? Do you use digital photos in any ways different to physical ones?

How important are your digital photos to you? What kind of stories do they tell about you? Do you share them with others? How?

Where do you view your digital photos in your home? (i.e. in your home office, in your living room, in your bedroom)? Why do you chose these locations? Is there a location that would feel more appropriate?

Do you use your photos or any other digital materials to customize your computer? For example, how did you select the background image on your computer? What does it say about you? How often do you change it? When you change it, what do you do with the old images?

What is your current screen saver set to? How did you make this decision? What does it represent about you?

Are there any other ways you've modified your computer to be more representative of 'you'?

Where do you keep your digital music collection? How many songs are in it? How important is it to you? How long have you had it? What is the oldest song? What is the newest song? What does your digital music collection say about you?

Do you have music that you no longer listen to? Why do you keep it?

Do you ever look at data associated with your music collection (for example, the amount of times you've listen to a song, or the top songs you've listened to, etc.)? What does this mean to you?

Have you changed the album art of a song in your music collection? What do you change it to? What motivated you to do this? What does the new image mean to you? Did you change it again?

Have you given music to anyone? How? What motivated you to do this? What did it mean?

Does you digital music feel different in any way than physical music (e.g. vinyl, tapes)?

Can you give us a tour of any other things that you have on your computer that you consider to be meaningful? Or, things that you desire to hold onto? What are they? How long have you had them?

Have you ever intentionally deleted any files on your devices because they reminded you of something you no longer wanted to remember? How did you delete them? Where did they go? Are they 'gone'?

Questions exploring Virtual Possessions online or in the Cloud

How long have you been using email? Do you have multiple email accounts? If so, how many? Why?

What other kinds of online services do you use?

How frequently do you access Facebook? (multiple times per day? Once a day? Every few days?) Yesterday how often did you access it?

How frequently do you access Facebook from your home?

How long have you been using Facebook? (e.g., how many years?)

What does your Facebook account say about 'you'? What kind of story does it tell about you?

Do you edit things on your Facebook account (photos, for example) so that only certain people can see them? Why?

Do you send status updates out that are only viewable to certain people?

Would you be upset if you lost your Facebook account? If so, Why? What about it feels valuable?

Have you ever printed anything out from Facebook (e.g. photos)?

Have any of your photos acquired comments or 'likes' from other people?

Did this change the way you think about them? Why? How so?

After a photo acquires a comment or 'like' does it change the way you think about it compared to the original photo? For example, is it 'the same'? If it does change, how so? Are the comments something you would want to keep? How would you keep them?

What about comments or posts people leave on your 'wall'? What kind of meaning or story do they have for you? Would you want to hold onto some of them to look back on in the future? All of them?

Have you ever left any of your devices open and logged in to your Facebook account to monitor what is activity occurring on it?

Do you use any other social networking or social media services (e.g. Twitter, MySpace, MapMyRun, FourSquare, Brightkite.com)? **(these may vary by location)**

4. Relationship between material possessions and virtual things

Goal: Explore any experiences of transitioning things between material and digital forms

General questions

- Have you ever transformed digital contents into material things or the other way around?
- Why and how did you transform it?
- After the transformation, how do you use the original one and the replica?
- What do they mean to you? Are there difference?
- How much longer do you think you'll have possession of it?

4.3. Detail questions

- Have you ever printed anything out from (Facebook) (e.g. photos)?
- Do you feel different between (digital music) and (physical music such as records, cds or cassette tapes)?

5. Questions exploring boundaries around shared/individual digital things

Do you have your own 'personal' devices or do you share all of your devices?

Do you have personal and shared collections of digital things in your home?

What are they?

Can you show us?

How do you make decisions about what is 'yours' and what is 'ours' when you think about your digital stuff?

Are there any digital things that you would like to share with each other that you currently cannot?

General Overview, Approach and Aim for interviews with Singles

Aim: The aim of the interview is to uncover people's relationships with their digital things, both stored locally and in the cloud—and, similarities and differences when compared to their material things. We also want to uncover how people construct a 'sense of home' with their material and digital things, and how these things reflect aspects of their identity, values and aspirations within domestic space.

Notes on the Interview Protocol: Interview questions consist of trigger questions, general questions, and detail questions. Trigger questions are for attracting natural participation from interviewees. Interviewees may explain stories by using the trigger questions. General questions deal with the most important facts related to material possessions and virtual things that we have to discover. Detail questions contain optional examples that we can ask to interviewees. Also a checklist is provided to prevent interviewers from neglecting core questions. Depending on the proceeding of the interviewer, interviewers can modify or add more questions.

Approach: The general approach is to establish an understanding of material things people find important, how they become attached to them, where they're kept in the home, and why. We can then use these insights to understand their perceptions of and relationships with their digital things, whether stored locally on devices in their home or stored in the Cloud (but accessed through devices in the home). The following questions are guidelines to uncover these understandings—you may not need to use all of them, but most will need to be covered.

A few things to keep in mind: The interview can last up to 90 minutes, you will likely need to use all of this time. You also need to create an inventory of participant's digital things. This will require you to go through the digital things of the participants with them. You are compensating them \$75 for this interview, so, within reason, you should not be shy in asking people to directly show you their stuff, digital or otherwise. Finally, remember that we are interviewing people about their material things in order to move onto their digital things. Please make sure to manage time appropriately so you are able to capture the full range of digital things people have (i.e., if it feels like the interview is dragging on with respect to people's material things, make it clear that you politely need to move on). Please also make sure to make clear that we may contact them in the future for a few follow up questions.

1. Demographic Questions

How old are you?

What is your current occupation? How many hours do you spend at work each week?

What are your goals for this year?

How is life different now than it was five years ago?

What do you think your occupation will be in five years?

Do you have siblings? If so, how many?

How have your relationships with your family changed in the past year? In the past five years?

How frequently do you visit family members in person each week? Did visit any family members in person last week?

How long have you lived in this house?

How long do you think you will continue living here?

Do you own a car? If so, can you show it to use and tell us what you keep in it?

2. Material possessions & Domestic Spaces

General questions about possessions

Now we are going to ask you some questions related to the your material possessions. We'll also ask you some questions about where you keep them in your home.

Goal: Determine how meaning emerged with object / nature of the attachment

2.1 Trigger questions

Depending on the proceeding of the interviewer, interviewers can choose some of questions to start interview.

- Imagine your house is opened for the public to exhibit your history and life like Shakespeare's birthplace. What do you want to exhibit among your material possessions?
- If you are able to store some of your material possessions at Swiss safe bank, what would you store?
- Among your material possessions, is there anything that you want to hand down as an heirloom from generation to generation?
- When you think about your most cherished material possessions, what comes to mind?
- If your house was burning down, what would be some of the most cherished things that you would desire to grab?

2.2 General Questions that can be asked:

- What is it?
- Can you describe it?
- How did you acquire it? (e.g., did you make it? Did someone give it to you? Did you make it?)
- Where is it kept?
- Why is it in this room?
- What kind of story do they tell about you?
- What does it mean to you?
- What does it say about you?
- How does this thing represent you?

- What has motivated you to hold onto it?
- How much longer do you think you'll have possession of it

2.3 Checklist and Detail Questions

		Check	(Optional) Detail questions
a. Types of possessions			•
b. Stories about possessions	i. Created		• How did you acquire them? (e.g., did you make them? Did someone give them to you? Did you make them?)
	ii. Used		•
	iii. Trashed		• Are there objects that once were in the home, but have now been disposed?
c. People	i. Ownership		• About shared possessions of a couple, who is the person that cares about the shared possession?
	ii. Identity		•
	iii. Social relationship		•
	iii. (Lifestyle) Transition to early adulthood life		• Are there material possessions that you gained or trashed by the change of your lifestyle? • Are there material possessions that you had 5 years ago, but not anymore?
d. Things	i. Time		•
	ii. Spatial relationship		•
	iii. contents		•
e. Future wishes/desires			• How will you keep and store them? • How do you want to manage material possessions that are meaningful now but will lose the meaning as time goes by?

Script: We are interested in where you keep these things in the home, and in general other material things that you keep in your home and how you relate to them.

General description of what should happen: Now each participant will give a tour their private spaces and/or where they keep their personal possessions in the home. The aim is that a sense of connection could be (or start to be) established between the researchers and participant in the initial object discussion, before moving on to the tour of different rooms of the home. Questions will aim to understand the significance of specific material possessions, their organization (or 'curation') and relationship to domestic space). The idea is that the questions that immediately follow could be asked multiple times as the focus of the interview changes from different domestic objects and spaces. Naturally, the order and structure of these questions would not have to be followed methodically, and could fluidly change depending on the specific participant and conditions.

Questions that could be used to investigate relationships with material things in different rooms in the home.

Goal: Understand how perception of material thing relate to (and help curate) domestic space.

Can you describe this room?

Is it a shared space? Who do you share it with?

What things do you have out on display?

What motivated you to put them on display?

Can you describe what some of the most meaningful things are that you have them this room?

What does it mean to you? What kind of story does this thing they tell about you?

Has its meaning changed over time? Why? How?

What has motivated you to hold onto it?

How much longer do you think you'll have possession of it?

Are the things that you have on display related to each other in some way? For example, if they had to collectively tell a story about you, or say something about you, what would it be?

Why did you chose to put these objects in this room, compared to another room? Would they be just as appropriate to be in another room? Why/Why Not?

How often do you rearrange them?

How often do you put new objects out on display?

What motivates you to do this?

Do you ever take objects away from being on display in the room? Why? Where do they go?

Questions about cherished objects not on display.

Goal: Understand relationships with material things not on display, or in 'deep storage'

Do you have any material possessions or collections that are deeply meaningful, but not out on display? (e.g. in closet, shoebox under the bed, in a chest)

Can you describe what they mean to you? Why do you continue to hold onto them?

How long have you had them? How long do you think you'll continue to have them? Where will they go after you're gone?

Is it important that they are kept together?

What did you chose to keep them in this room rather than in another room?

Are there any other things that you want to keep, but that you don't want to see or have on display?

Questions about objects that once were in the home, but have now been disposed.

Goal: Understand how and why people get rid of personal things to later compare to digital things.

Can you reflect on whether you ever possessed something that was meaningful, but you got rid of because it no longer represented you, or reminded you of memories you no longer wished to think about? (e.g. a letter from a former lover, music from a band no longer liked)

How long did you have it?

How did you get rid of it?

Did you make this decision together? How did you decide?

3. Digital/Virtual Possessions

Goal: Understand perceptions of digital things compared and contrasted to material possessions

Script: Now we would like to ask you some questions about your digital possessions. First, however, we'd like to ask you some general questions about your technology use.

3.1 Trigger Questions

Depending on the proceeding of the interviewer, interviewers can choose some of questions to start interview

- What things come to mind when you think about your most treasured or important digital things (e.g. diary, photos, music, etc..)?
- Can we take a tour of your other digital possessions? For example, do you keep digital photos on your phone? On your computer?

3.2 General questions

- What comes to mind when you think about a digital thing that's important to you?
- Where is it stored?
- How do you access it? (e.g., computer, mobile phone, etc.)
- Why is it in this room?
- What kind of story do they tell about you?
- What does it mean to you?
- What does it say about you?
- How does this thing represent you?
- What has motivated you to hold onto it?
- How much longer do you think you'll have possession of it?
- Has its meaning changed over time? Why? How?
- Why and how did you get rid of it?
- Have you ever shared it with others or given to other?
- What will be the future of the possessions that you mentioned as meaningful thing?
- (About Cloud-based virtual things) do you access it in different rooms? Why?

3.3 Checklist and Detail Questions

		Check	(Optional) Detail questions
a. Types of possessions			•
b. Stories about possessions	i. Created		•
	ii. Used		<ul style="list-style-type: none"> • What kind of (messages) do you send? What do you communicate to people you frequently send messages to? • How often do you modify your (phone)? Do you change the background images of your phone, or customize it in any other way? What motivates you to customize your phone? What does it say about you? • Do you ever look at data associated with your (music collection)? For example, the amount of times you've listen to a song, or the top songs you've listened to, etc.? What does this mean to you?
	iii. Trashed		<ul style="list-style-type: none"> • Do you have (music) that you no longer listen to? Why do you keep it? • Have you ever intentionally deleted any files on your devices because they reminded you of something you no longer wanted to remember? How did you delete them? Where did they go? Are they 'gone'? • Would you be upset if you lost your (Facebook account)? If so, Why? What about it feels valuable?
c. People	i. Ownership		•
	ii. Identity		•
	iii. Social relationship		• Do you edit things on your (Facebook account) so that only certain people can see them? Why?
	iii. (Lifestyle) Transition to early adulthood life		• Are there material possessions that you gained or trashed by the change of your lifestyle
d. Things	i. Time		•
	ii. Spatial relationship		•
	iii. contents		•
e. Future wishes/desires			<ul style="list-style-type: none"> • How will you keep and store them? • How do you want to manage material possessions that are meaningful now but will lose the meaning as time goes by?

Technology Usage Questions

Do you have wifi in your home?

How frequently do you send SMS messages? Each day? Per week? How long have you been using SMS? (e.g., how many years?)

Who do you frequently send SMS messages to? (e.g. friend, family members, partner)

What kind of messages do you send? What do you communicate to people you frequently send messages to?

When you think about the bulk of SMS messages you've sent to a specific person (you frequently text), what kind of story would it tell about your relationship with them?

Are there any SMS messages that you've wanted to hold onto or preserve?

Why were they special? Where did you put them? How did you preserve them?

Can we now take a tour of your other digital possessions? For example, do you keep digital photos on your phone?

How many photos do you have on your phone?

What are they of?

When do you look at them?

What is the oldest photo on your phone?

Do you produce new photos directly through your phone?

How often do you modify your phone? Do you change the background images of your phone, or customize it in any other way? What motivates you to customize your phone? What does it say about you?

Do you use your phone to 'view' or use your digital possessions, like photos, in your home? Where and when? Why do you use it as opposed to your computer? Are there particular places you or times you prefer to use your phone to view your digital things in your home?

What other devices do you have that you have your digital things stored on? (e.g. desktop, laptop, mp3 player, iPad or tablet computer, digital camera, etc.)

Questions related to digital content/things stored locally on devices

Note: the questions that immediately follow could be adapted to explore each of the aforementioned possible devices

Can you describe where you use these different devices in your home? (i.e. living room, bedroom, etc.)

Where do you keep your collection of digital photos (locally, i.e. on the computer)? Can you show us? How did you decide to organize them? How do you view them? Do you produce physical photographs from them (i.e. print them or send them to be printed)?

How often do you produce or acquire new digital photographs?

How would you compare or contrast digital photos to physical analog photos? Do you use digital photos in any ways different to physical ones?

How important are your digital photos to you? What kind of stories do they tell about you? Do you share them with others? How?

Where do you view your digital photos in your home? (i.e. in your home office, in your living room, in your bedroom)? Why do you choose these locations? Is there a location that would feel more appropriate?

Do you use your photos or any other digital materials to customize your computer? For example, how did you select the background image on your computer? What does it say about you? How often do you change it? When you change it, what do you do with the old images?

What is your current screen saver set to? How did you make this decision? What does it represent about you?

Are there any other ways you've modified your computer to be more representative of 'you'?

Where do you keep your digital music collection? How many songs are in it? How important is it to you? How long have you had it? What is the oldest song? What is the newest song? What does your digital music collection say about you?

Do you have music that you no longer listen to? Why do you keep it?

Do you ever look at data associated with your music collection (for example, the amount of times you've listen to a song, or the top songs you've listened to, etc.)? What does this mean to you?

Have you changed the album art of a song in your music collection? What do you change it to? What motivated you to do this? What does the new image mean to you? Did you change it again?

Have you given music to anyone? How? What motivated you to do this? What did it mean?

Does you digital music feel different in any way than physical music (e.g. vinyl, tapes)?

Can you give us a tour of any other things that you have on your computer that you consider to be meaningful? Or, things that you desire to hold onto? What are they? How long have you had them?

Have you ever intentionally deleted any files on your devices because they reminded you of something you no longer wanted to remember? How did you delete them? Where did they go? Are they 'gone'?

Questions exploring Virtual Possessions online or in the Cloud

How long have you been using email? Do you have multiple email accounts? If so, how many? Why?

What other kinds of online services do you use?

How frequently do you access Facebook? (multiple times per day? Once a day? Every few days?) Yesterday how often did you access it?

How frequently do you access Facebook from your home?

How long have you been using Facebook? (e.g., how many years?)

What does your Facebook account say about 'you'? What kind of story does it tell about you?

Do you edit things on your Facebook account (photos, for example) so that only certain people can see them? Why?

Do you send status updates out that are only viewable to certain people?

Would you be upset if you lost your Facebook account? If so, Why? What about it feels valuable?

Have you ever printed anything out from Facebook (e.g. photos)?

Have any of your photos acquired comments or 'likes' from other people?

Did this change the way you think about them? Why? How so?

After a photo acquires a comment or 'like' does it change the way you think about it compared to the original photo? For example, is it 'the same'? If it does change, how so? Are the comments something you would want to keep? How would you keep them?

What about comments or posts people leave on your 'wall'? What kind of meaning or story do they have for you? Would you want to hold onto some of them to look back on in the future? All of them?

Have you ever left any of your devices open and logged in to your Facebook account to monitor what is activity occurring on it?

Do you use any other social networking or social media services (e.g. Twitter, MySpace, MapMyRun, FourSquare, Brightkite.com)? (services may vary by location)

4. Relationship between material possessions and virtual things

Goal: Explore any experiences of transitioning things between material and digital forms

General questions

- Have you ever transformed digital contents into material things or the other way around?
- Why and how did you transform it?
- After the transformation, how do you use the original one and the replica?
- What do they mean to you? Are there difference?
- How much longer do you think you'll have possession of it?

4.3. Detail questions

- Have you ever printed anything out from (Facebook) (e.g. photos)?
- Do you feel different between (digital music) and (physical music such as records, cds or cassette tapes)?