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

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ABSTRACT

We describe the design, implementation and deployment of Photobox, a domestic technology that prints four or five randomly selected photos from the owner's Flickr collection at random intervals each month. We deployed Photobox in three homes for fourteen months, to explore how the slow pace at which it operates could support experiences of anticipation and re-visitation of the past. Findings reveal changes in attitude toward the device, from frustration to eventual acceptance. Participants drew on the photos to reflect on past life events and reactions indicated a renewed interest for their Flickr collection. Photobox also provoked reflection on technology in and around the home. These findings suggest several opportunities, such as designing for anticipation, better supporting reflection on the past, and, more generally, expanding the slow technology research program within the HCI community.

Author Keywords

Slow Technology; Home; Interaction Design; Design

ACM Classification Keywords

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

INTRODUCTION

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 hosted roughly 210 billion photos in 2011, making it the largest single photographic archive in the world [11]; and this archive continues to grow.

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

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

how big their archives are. And, because they do not take up physical space, people feel less inclined to curate their collections and conserve domestic storage space [24]. In parallel to these emerging issues, there has been a growing concern within HCI to develop new approaches enabling people to experience their personal digital content in more succinct, accessible, and meaningful ways [e.g., 29, 32].

While people are amassing more diverse kinds of virtual possessions [24], this paper focuses on digital photos, one of the most enduring and expansive contemporary forms of personal content. We 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-reflection and re-visitation of the past. In addition, we wanted to investigate the use of *slow technology* [13], and how this contrasting concept could challenge the idea of domestic technology being always on and accessible. Following this work, we wanted to explore how slowness might grow anticipation and create an interaction pace that supports self-reflection.

To investigate these issues, we created *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). We 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.

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.

This paper 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.

BACKGROUND AND RELATED WORK
Related work falls into three areas: material possessions and photographs; intersecting HCI research on reflection and reminiscence; and slow technology and anticipation.

Material possessions play important roles as triggers for personal and shared memories, signifying our evolving sense of self and relationships with others over time [1]. Csikzentmihalyi and Rochberg-Halton [4] describe how possessions become meaningfully integrated into one's life through the processes of reflecting on the past and prospectively looking forward toward one's idealized goals. Many others across the social sciences and humanities have investigated the roles material artifacts play in supporting memory, reflection and reminiscence [e.g., 21]. In this context, physical photographs have received particular attention. While initially emerging as a way to visually capture family histories in the late 19th century, photos have become a resource for individual identity construction and communication [38]. Photos can viscerally remind people of who they once were in a way that invites comparison and highlights how they have changed [see 1].

The shift to digital technology greatly expanded the practice of personal photography [31]. Van House [37] describes how this shift produced rapid increases in the everyday production, consumption, storage, and sharing of photos. Online services have created additional opportunities for people to share photos as a resource for self-presentation and expression [e.g., 36].

However, these collective shifts also produced unintentional consequences. Digital photos lack the enduring presence and "casual durability" of paper photos [37, p. 129], requiring more maintenance and effort to experience them. They can also easily become fragmented across several devices and online places, making them difficult to browse, search and retrieve [24]. Importantly,

digital photo collections are prone to rapidly grow out of control, leaving people overwhelmed, which further complicates efforts to curate, organize, preserve and reflect on them [29, 32, 37].

The increasing prevalence of personal digital content affected by these issues, along with a growing interest in HCI toward designing for contexts of everyday life, has led to a stream of work exploring how reflection and reminiscence might be better supported. A core theme researchers have focused on is personal archiving practices [e.g., 17]. Another body of work has investigated the creation of new technologies to attach digital content to physical mementos [e.g., 29, 35], and ways to capture and explore image-based and audio recordings [6, 28, 32]. Most recently, Cosley and colleagues [3] demonstrated the potential value for re-experiencing social media to support reminiscence. Nonetheless, it remains unclear how to manage personal digital content as collections rapidly become larger, more diverse, and more fragmented.

Considering the rapid rate of digital photo production, we see an opportunity to explore how consumption might be slowed down. In their seminal article on *slow technology*, Hallnäs and Redström argue that the increasing presence of technology in contexts outside of the workplace require interaction design practice to move beyond creating tools to make people's lives more efficient to "*creating technology that surrounds us and therefore is part of our activities for long periods of time*" [13, p. 161]. These authors outline an agenda aimed at designing relationships with computational artifacts that will endure and develop over time, in part through supporting experiences of reflection on these things. Over a decade later, there has been a recent resurgence of work in the area [12, 19, 20, 25, 26, 33, 34].

Additionally, we see an opportunity for connecting slow technology with the experience of *anticipation*. While this topic has rarely been tackled head on in HCI, McCarthy and Wright's [22] elegant description of anticipation in the context of felt experience is a noteworthy exception. They describe anticipation as occurring in two temporal phrases; the first occurs before an experience has happened, while the second occurs during the experience as one actively reflects on whether their expectations have been unmet, met, or exceeded [see 22, p. 64]. We want to explore how slowness might open a space for anticipation over time, and how this might affect people's perceptions of their digital photo collections.

Collectively, these strands of research have made important contributions to understanding how interactive technologies could better persist in people's lives over time and how experiences of reflection and reminiscence might be supported. They also reveal how new problems are emerging as the rapid growth and fragmentation of personal digital content threatens its ability to be a valuable resource for reflection. Our work attempts to bring these strands of research together. We want to investigate how technologies

might be designed to slow the consumption of digital photos and support experiences of reflection and re-visitation of the past. A secondary goal is to investigate how slow technology might fit within (or complicate) households' existing practices, and, more generally, their experiences living with slow technology. Beyond work that has gone before, we do this by grounding discussion around a fourteen-month deployment study of the Photobox prototype in three separate households.

METHODOLOGY

We designed the Photobox 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. We also aimed to investigate how these qualities could shape the perception of the digital photo archive in general. Specifically, we wanted to create a technology that might challenge the always-on-and-accessible qualities of many contemporary consumer devices. We intended 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. Our methodology drew on several approaches including speculative design [7], reflective design [33], technology probes [15] and research through design [40].

Process, Rationale and Implementation

The process leading to the development of the Photobox consisted of the following. We reviewed theoretical literature and empirical studies (a sample of which are noted in the prior section). We then ideated many design concepts and progressively refined and clustered several conceptually related sets to construct an understanding of the overall design space. We then engaged in iterative development and critique of the design concepts themselves to arrive at the final design (see [25] for more detail on our design process).

We intended the Photobox form to appear familiar to other non-digital cherished things, aiming for its material aesthetics to evoke a sense of warmth associated with older domestic artifacts. We settled on the final design because of its distance from 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 2"x3" prints). We decided on using a chest that had already gathered a healthy amount of patina as it seemed to symbolize a well-aged artifact that could support the idea of re-visiting past experiences whose materials could inspire a sense of perceived durability [27]. To this end, we decided to use a printer to make digital photos material, contrasting the potential durability of paper prints with digital files.

We augmented the oak chest 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* [26].

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 service application we developed then enacts the following set of procedures (which we 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 [18] and, more generally, open a space for pause and contemplation [39]. We could have curated 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. We wanted to explore how people might confront a technology delving

into their personal archive and how their perceptions might change over time.

Participants, Data Collection and Analysis

We recruited three households from a large Midwestern city in the United States to participate in our study (9 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 [15], and several field studies since then [e.g., 8, 9], we want 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. We 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, we 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 7-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 18 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 5-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 6-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 [36]). 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, our participant pool helped support our goal of exploring how people might more meaningfully re-visit their photo archive on a general level.

We 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, we found many people's locally-stored photo archives were fragmented across various hard drives and physical media (e.g., DVDs). As a result, we decided against using locally stored digital photographs, as the effort required to make these archives cohesive would have complicated our goal to easily introduce a prototype into the home. Second, at the time we created the Photobox prototypes, the Flickr API emerged as the most flexible and robust option for the .NET application we developed.

We 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 our 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). We deliberately gave brief descriptions of the Photobox, noting it will occasionally print a photo from the owner's Flickr archive. We wanted participants to develop their own interpretations over time. We 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 our 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, we visited each household to collect the prototype and conduct in depth interviews with participants (these sessions lasted 2-4 hours). We 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. We 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 [10]. We held weekly meetings to discuss emergent findings. Analysis of the data was an ongoing process. After each home visit, we conducted preliminary analysis, searching for emergent (and shifting) patterns across recordings field notes and photos to draw out underlying themes [23]. We coded raw data documents with these themes. We also created conceptual models and affinity diagrams to reveal unexpected connections and differences among households. In what follows, we present several descriptions and examples taken from field observations that help illustrate the themes.

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, we first describe how this *trajectory of appreciation* [8] unfolded across our three households, with particular attention to when the transition from disappointment to acceptance occurred. We then describe ways in which the Photobox shaped participants' perceptions of their digital photo collections. Finally, we detail insights into participants' reflections on living with slow technology.

Experiences over time: from frustration to acceptance

Gaver et al. [8] 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.

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, we briefly describe these stages.

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, we 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,

Figure 3. From left to right. H1's Photobox after the laptop was moved under a living room couch (in month six of the study). H2's Photobox kept alongside many electronics and entertainment technologies. H3's Photobox kept near the kitchen and living room.

balance their expectations with its slowness.

However, as the study progressed, we 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 we 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.

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 we 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.

Transitioning the online archive from digital to material

A core aspect of Photobox's design is its ability to make 2"x3" material copies of Flickr photographs. We 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 4): "*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 4. 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.

Collectively, 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.

Living with slow technology

Beyond experiences with the printed photos, households discussed living with the device itself. Drawing from our final bi-monthly and closing interviews, we 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 of our participants described how, over time, the relative slowness of our 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.

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 our 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, we present several research and design considerations for the HCI community that emerged from our work.

Designing for anticipation

A core goal of our 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, we 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 [22]. However, little work has directly explored how these notions could be applied to the design of new technologies for reflection on the past. Our 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. We imagine prior research on the relationship between autonomy and reflection [9, 30, 39] could be leveraged in support of this direction.

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. We imagine 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 our 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, our prototype itself could easily create a proliferation of digital prints that could induce overwhelming experiences. Importantly, in the aim and ambition of technology probes [15], our goal was not to engineer a solution to the problem of digital content proliferation. Instead, we hoped to further develop the design space for future exploration by HCI researchers and practitioners.

Slow Technology Future Research Considerations
Another goal of our 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 our 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 [34], our 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 research teams' disposal.

The slow technology design space presents an under-engaged yet fruitful opportunity area for future research in the HCI community. Our study 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., 5, 16, 26, 27]. On a broader level, we see our study as a case building on and expanding prior research [2, 7, 9, 12, 13, 19, 20, 33] articulating how embracing values alternative to the more dominant focus of efficiency and usability can critically nurture and expand future research in the HCI. We hope this research will inspire the community to explore designing slow technology in the future as they increasingly focus on the intimate contexts of everyday life.

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