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Experiences With Designing Tools for Everyday Reminiscing

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Experiences With Designing Tools for Everyday Reminiscing

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Reminiscing is a valuable activity throughout the lifespan, helping people establish and maintain their identities and their relationships. Much of this happens in an *everyday* way, with reminiscing arising naturally out of one's experiences, thoughts, and conversations. In this article we describe work around Pensieve, a tool to support everyday, spontaneous, individual reminiscing through *memory triggers*—e-mailed reminders that contain snippets from content one has previously created in social media or generic questions that encourage people to reflect on their past. Through a combination of interviews, questionnaires, design activities, and a long-term deployment of Pensieve, we demonstrate the potential value of social media content such as Facebook wall posts and status updates for supporting reminiscence, the utility of systems that support spontaneous reminiscing and writing about the past, the importance of reminders to both reminiscing and lifelogging systems, and insights into people's current practices in reminiscing in social media. Through this work, we generate a number of design goals, issues to consider, and directions for future work around designing systems to support reminiscence and other types of reflection on personal experience.

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CONTENTS

1. INTRODUCTION AND BACKGROUND
 2. SUPPORTING SPONTANEOUS, INDIVIDUAL REMINISCING
 - 2.1. Prevalence of Reminiscence-Worthy Social Media Content
 - 2.2. Evolving Pensieve: Design Goals
 - 2.3. The Design
 3. EXPERIENCES WITH PENSIEVE
 - 3.1. How Pensieve Supported Reminiscing
 - 3.2. When Didn't People Reminisce?
 - 3.3. Was Pensieve Worth It?
 4. REMINISCING TOGETHER—OR NOT
 5. DISCUSSION
 - 5.1. Reminiscence, Lifelogging, and Reflection
 - 5.2. Applying Our Design Goals More Broadly
 6. CONCLUSION
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1. INTRODUCTION AND BACKGROUND

Reminiscing is an important aspect of our lives that serves a variety of functions. It helps people create their identities and accept their pasts (Butler, 1963; C. N. Lewis, 1971), use past experiences to work through current issues, and maintain relationships (Webster & McCall, 1999). Although much of the work around reminiscing focuses on the elderly and reminiscence as therapy (Hsieh & Wang, 2003; Hughston & Merriam, 1982; M. I. Lewis & Butler, 1974), it is also common among families (Petrelli, Whittaker, & Brockmeier, 2008) and friends (Cosley et al., 2009; Shen, Lesh, Vernier, Forlines, & Frost, 2002), providing value throughout one's life (Bryant, Smart, & King, 2005).

The increasing prevalence of personal digital content, along with the growing tendency in human-computer interaction (HCI) toward designing technologies for homes, families, and experiences (Bell, Blythe, & Sengers, 2005), has led to a stream of work exploring how HCI might support reminiscence. One main theme of this work is to understand people's reminiscing practices, from photo sharing (e.g., Frohlich, Kuchinsky, Pering, Don, & Ariss, 2002) to the use and creation of mementoes in the home (Petrelli et al., 2008). Another is the exploration of new technologies to support reminiscing: ubiquitous photo capture (Sellen et al., 2007), new interfaces for photo sharing (Apted, Kay, & Quigley, 2006), tools to attach digital content to physical mementoes (Stevens, Abowd, Truong, & Vollmer, 2003), ways to capture and explore audio memories (Petrelli, Villar, Kalnikaite, Dib, & Whittaker, 2010), and so on.

This work generally examines intentional acts of capture and sharing, placing reminiscence and reflection as a focal activity, as it often is in care homes, families, and lifelogging applications (Li, Dey, & Forlizzi, 2010; Petrelli et al., 2008; Woods, Spector,

Jones, Orrell, & Davies, 2005). But much of the lived experience of reminiscence is spontaneous, arising from chance conversations (Cosley et al., 2009), mementoes (Petrelli & Whittaker, 2010), cultural references (Krakovsky, 2006), songs (Woods et al., 2005), or simple thoughts. That is, much reminiscing is everyday reminiscing, in the everyday computing sense (Abowd & Mynatt, 2000)—woven through our relationships and lives rather than being an activity unto itself.

Our work builds on these studies by focusing on spontaneous, primarily individual, reminiscing. In this article we discuss the evolution of Pensieve (Cosley et al., 2009), a tool that e-mails people *memory triggers*, or reminders to reminisce. These triggers may contain users' own content from social media including Flickr, Picasa, Last.fm, Twitter, and Blogger, which often has personal significance and contains cues useful for triggering autobiographical memory (Sellen et al., 2007). Triggers may also contain generic, but evocative, text prompts such as "Do you remember learning to cook?" that are based on reminiscence therapy (Woods et al., 2005). Pensieve also allows people to write a diary about the past by responding to these triggers. The combination of e-mailed reminders and the privacy implied by the diary metaphor means that Pensieve primarily supports individuals, again complementing existing work that focuses on shared, family experiences of reminiscing (Apted et al., 2006; Petrelli et al., 2008).

We make several contributions toward using technology to support reminiscing. One contribution is to present the design goals and trade-offs we made as we developed Pensieve, informed by a series of interviews and prototypes that helped us better understand people's reminiscing practices (Cosley et al., 2009) and the utility of social media content for reminiscing. Our second contribution is to show the potential of everyday reminiscence based on a 6-month deployment of Pensieve. An earlier study focused on quantitative analysis of people's diary entries (Peesapati, Schwanda, Schultz, Lepage, et al., 2010); here, we extend that work with a deeper look at how Pensieve fit into people's reminiscing practices more broadly.

The third contribution is to press on several issues that arose from that deployment, particularly around people's practices when reminiscing with others in social media, in order to understand why an attempt to add social features to Pensieve failed. Our final contribution is to draw connections between systems for reminiscence (Petrelli et al., 2010), lifelogging (Kalnikaite, Sellen, Whittaker, & Kirk, 2010), and personal informatics (Li et al., 2010), discussing how our design goals and experiences might apply more broadly.

2. SUPPORTING SPONTANEOUS, INDIVIDUAL REMINISCING

The idea for Pensieve came from the lead author's personal struggles. He has few memories from the past, and knowing this, he kept a diary-like blog for many years. However, as with people who rarely revisit photographs (Petrelli & Whittaker,

2010), he almost never looked at prior entries. One day he realized that he could write a program to remind him to reminisce, sending blog snippets throughout the day as short message service (SMS) messages to encourage spontaneous reminiscing. The prototype was quick and dirty, but also useful and pleasant. Others who saw it agreed that the idea of prompting reminiscence with social media might be useful, leading us to develop a more generally useful version.

2.1. Prevalence of Reminiscence-Worthy Social Media Content

A key assumption of Pensieve is that social media content might support reminiscing. For instance, in Facebook or Twitter, people might post status messages, wall posts, or updates that capture both important and mundane aspects of their daily lives. These moments fade away as new content pushes them down the page, and for active users, it may take many clicks to access content only a month old.

To study the potential of status updates and wall posts to support reminiscence, we wrote a Facebook application that shows people 50 of their own status updates and wall posts from their friends from about a year ago. It asked people to rate how likely each post was to make them reminisce on a 5-point Likert scale from 1 (*extremely unlikely*) to 5 (*extremely likely*) and to explain why two posts were especially good or bad for reminiscing. We also asked open-ended questions about Facebook's Photo Memories, which shows older photo albums from friends, as well as whether a similar tool for displaying status updates, wall posts, and past events might be useful.

A total of 96 students from Cornell University (ages 18–33, *Mdn* age = 19; 71 female, 24 male, 1 unknown) participated, receiving course credit for doing so. They rated 995 status updates and 3,632 wall posts with a roughly even distribution of ratings, suggesting that some—but not all—of this content could support reminiscing. People's average rating also varied ($M = 3.0$, $SD = 0.7$); some found much of their content useful for reminiscing, whereas others found very little useful, aligning both with prior work on the different uses people have for Facebook (Joinson, 2008) and with findings that some people are more prone to reminiscing than others (Webster & McCall, 1999).

Participants' descriptions of what made posts good or bad for reminiscing led to three main themes around *people*, *context/specificity*, and *experience*; Figure 1 shows examples of each. Posts that reminded participants of people they wanted to reminisce about, content that was specific enough to recall the context of the post, and uncommon or rich experiences were seen as valuable. Overall, these themes point to the importance of meaningfulness—important experiences and people, and legible context—in determining whether a post might be useful for reminiscing.

Photo Memories was fairly well liked and often used. Of the 65 participants who were aware of the feature, 33 liked it (51%) and 11 did not (17%); whereas 37 actively used it (57%). Those who like it enjoy looking back through their Facebook photos and seeing past memories: “I do! I like looking back through photos, especially from freshman year. It reminds me why I am friends with my friends and the fun times

FIGURE 1. Examples of descriptions as to why Facebook content was rated good or bad for triggering reminiscence for each of the three categories

	Suitable	Unsuitable
People	“I remember how Dan and I hadn’t had a lot of time to hangout that summer. . . . This made me look back to how much our relationship of friends has had to adjust due to certain circumstances.”	“I knew the person who wrote the message in middle school and hadn’t talked to her in 8–9 years. We weren’t close friends so her message didn’t mean anything to me.”
Context/Specificity	“Used specific quotes to remind me of a specific past conversation that I wouldn’t have necessarily remembered otherwise, but the specificity helped me remember.”	“The message was short, vague, and could have applied to many different things/events. Without more information I don’t know what the message is referring to so I can’t reminisce about it.”
Experience	“. . . it was my first time seeing snowfall. It was a truly amazing experience I will never forget.”	“It was a common courtesy [post] about an unremarkable event.”

we’ve been through.” Those who did not like it find the pictures “insignificant,” “random,” or “creepy.”

People also saw value in the idea of a similar application powered by status updates, wall posts, and events: 36 of the 94 participants liked the idea (38%), 18 did not (19%), and 40 did not comment (43%). Those who liked the idea said that they enjoyed the study and wished Facebook would display “random older wall posts” and that “this experiment has made me reminisce a lot more than Photo Memories. Wall posts cover a lot more than pictures do.” Others thought this content might not be as useful as photos: “I use the photos but I don’t think it would be helpful for statuses or wall posts cause I don’t remember what most of them referenced and they’d be irrelevant now.”

Overall, we find that many year-old Facebook status updates and wall posts may cause people to reminisce, especially if the content is personally meaningful. Several participants mentioned—without being prompted—that they enjoyed taking part in the study and looking at their older Facebook content. This appreciation of being reminded to reminisce also appeared in an earlier study in which we interviewed people about their reminiscing practices (Cosley et al., 2009). A number of participants also liked the idea of using older Facebook content to reminisce. These findings support our assumption that social media content is a promising resource for reminiscing.

2.2. Evolving Pensieve: Design Goals

Our overall goal was to support individual, spontaneous reminiscence, an area that has received less attention than reminiscing as a focal activity for families. Informed by this goal, our initial prototype’s use of reminders and social media,

and interviews and prototypes described in Cosley et al. (2009), we set four design goals for Pensieve: (a) integrate into everyday life; (b) leverage existing practices, tools, and data; (c) support lightweight capture in context; and (d) respect people's privacy and control.

Our goal of supporting spontaneity led us to the everyday computing perspective (Abowd & Mynatt, 2000). Everyday computing activities extend over time, have no definite endings, and are interleaved with other life activities in a variety of contexts. Keeping a shopping list or a calendar are canonical examples, along with maintaining awareness of, connection to, and coordination with others. Spontaneous, individual reminiscing seemed to fall into this category as well, with our interviewees commonly reporting most reminiscing as involuntary and being triggered by external causes (Cosley et al., 2009). Thus, a major design goal for Pensieve was to *integrate into everyday life*, working to help people reminisce in ways they already experienced.

This led us to prefer tools that people already use, rather than special-purpose artifacts such as SenseCam (Sellen et al., 2007), the Living Memory Box (Stevens et al., 2003), or FM Radio (Petrelli et al., 2010). We didn't want to require people to carry extra devices or be rooted to a particular location, and requiring people to learn new tools and practices is the HCI equivalent of herding cats. Instead, we were inspired by systems that repurpose people's existing behavior, such as visualizing e-mail archives (Viégas, Golder, & Donath, 2006) or editing and reading activity in documents (Hill, Hollan, Wroblewski, & McCandless, 1992). As we saw earlier, Facebook content might be useful for reminiscence, and people regularly share online photos, write about their lives in blogs, and so on. Thus, our second goal was to *leverage existing practices, tools, and data*.

We also value the idea of incorporating capture into existing practice. People often wish to capture and organize more of their memory-laden content (e.g., Cosley et al., 2009; Froelich et al., 2002). One answer is ubiquitous capture, as proposed by systems such as MyLifeBits (Gemmell, Bell, & Lueder, 2006). However, the benefits of ubiquitous capture for reminiscing and reflection are unclear (Sellen & Whittaker, 2010) given the selective, reconstructive nature of autobiographical memory (Conway & Pleydell-Pearce, 2000; Nelson, 1993). Instead, we are inspired by the practice of using cell phone cameras to capture opportune moments, supported by technologies such as GPS that provide cheap metadata. We believe low-cost, relevant context and appropriate timing will help people capture content and cues that will support reminiscing (Sellen et al., 2007), leading to our third goal, to *support lightweight capture in context*.

Finally, using personal content to trigger reminiscence raises issues of privacy and sensitivity to people's emotions. Interviewees described reminiscing, both alone and with others, as nuanced (Cosley et al., 2009). Photo Memories illustrates the difficulties in providing memory triggers while being sensitive to people's feelings and privacy. Like Pensieve, Photo Memories re-presents past content. Unlike Pensieve, it uses others' photos, not your own, and infers whose photos to show based on activity in your social network. We think trying to leverage users' context to help people reminisce is a good idea (and our second goal), but relationships change,

leading the initial version of Photo Memories to make mistakes such as showing ex-partners with new loves. This, combined with the lack of control Facebook provides, angered a number of people. Thus our final goal was to *respect people's privacy and control*.

2.3. The Design

We now turn to how Pensieve realizes these design goals. From a user's point of view, Pensieve has three main features: account management via the Pensieve website, memory triggers delivered by e-mail, and a diary with both an e-mail and a web component. People first encounter Pensieve through its home page, which explains what Pensieve is and allows people to log in or register. Registration requires only a valid e-mail address (to receive triggers) and informed consent. People may connect their Pensieve account to accounts on social media services including Picasa, Flickr, Blogger, Last.fm, and Twitter. Everyone's account is also connected to a Pensieve service that contains non-personalized text prompts similar to those used in group reminiscence therapy (Woods et al., 2005), such as "Your family's Thanksgiving traditions. What do you eat? Is there a separate kids' table?" or "The smell of someone you care for." People can also specify how often they would like to receive memory triggers with a default of "daily," turn off memory triggers entirely, and request a new trigger at any time.

Most interaction with Pensieve happens through e-mailed memory triggers that contain content from the services. Pensieve keeps no user model, so when it is time to send a trigger, it randomly chooses one of the user's services, then randomly chooses an item from that service to create an e-mail containing the memory trigger, as illustrated in Peesapati, Schwanda, Schultz, Lepage, et al. (2010). The focus of the e-mail is the trigger, but each e-mail mentions additional things to do, such as give feedback, recommend Pensieve to friends, or write diary entries.

The last main component uses a diary metaphor to allow people to write about their past. The diary exists because many interviewees wished they wrote more about their past and because writing in concert with reminiscing can be useful in care home settings (Kelly & Mosher-Ashley, 2002). Each user's diary contains the triggers Pensieve has sent them, and they can write one or more text responses through the web interface or by replying to an e-mail. Users can look at the diary to support longer term reflection.

All of these decisions follow from our design goals. Using e-mail and the web leverages existing practices and fits into many people's daily lives. Requiring minimal information to use Pensieve and allowing people to choose which media to receive, and when, respects privacy and control. We leverage existing social media data, whereas non-personalized prompts support people who don't use social media, or don't want to expose that content to Pensieve. The services we chose are popular, span a variety of media, and offer public application programming interfaces (APIs), eliminating our need to store passwords or other personal data. The ability to request

additional triggers came from prototype users' reports that some prompts were not useful, supporting control. Sending triggers by e-mail and accumulating them in the diary also supports control by allowing people to defer reminiscing to a convenient time, whereas allowing people to create diary entries by responding to e-mails supports lightweight capture in context by coupling writing with reminiscing.

We made a number of compromises. The change from the original prototype's use of SMS delivery to e-mail was difficult: e-mail is less spontaneous and less integrated into daily life than SMS messages, at least for younger users. However, our prototype users and interviewees wanted control over when they viewed memory triggers and worried about the immediacy and cost of SMS (Cosley et al., 2009), and these concerns won out despite the lead author's protests. This was probably for the best. Using e-mail made it easier to send a variety of media and to create diary entries, whereas e-mail-to-SMS gateways support that use case.

We also would have liked to leverage other resources for reminiscing. Facebook was an obvious candidate, but API and terms of service restrictions at the time made it unsuitable. It would also have been useful to follow the Living Memory Box and FM Radio in leveraging nondigital data such as journals, home movies, and printed photos that our interviewees used for reminiscing (Cosley et al., 2009). However, collecting these data would have raised both cost and privacy concerns, so we chose to do without.

Limiting ourselves to a textual diary rather than more expressive writing interfaces was another compromise. Users of *kultagg*, a prototype tagging interface that includes elements of color and tag arrangement, enjoyed the expressive features and compared them to scrapbooking (Cheng & Cosley, 2010). We had considered a more scrapbook-like interface, allowing people to arrange triggers, diary entries, and other content to help them build narratives of their past, but simplicity and lightweight capture won out.

Finally, our focus on privacy and control, and on supporting individual reminiscence, led us to avoid social features, despite the value of people as both a subject and object of reminiscing (Cosley et al., 2009; Webster & McCall, 1999). We had considered allowing people to share their whole diaries or individual entries with the community but decided this was both a privacy risk and a violation of the diary metaphor. We did create a public forum and the ability to create non-personalized prompts to share with other Pensieve users, but these were rarely used.

3. EXPERIENCES WITH PENSIEVE

We now explore how people used and thought about Pensieve during a 6-month public deployment from February through July 2009 first reported in Peesapati, Schwanda, Schultz, Lepage, et al. (2010). That publication focused on quantitative analysis of the usage data from 91 accounts, especially around the diary entries people wrote. For example, people tended to respond more often to triggers based

on personal photos than non-personalized prompts. We also looked at whether characteristics of non-personalized prompts such as emotional tone, length, and topic might affect whether and how people responded. For the most part, this was not the case, although people did tend to write longer responses to longer prompts. Instead, people tended to write about other people and cultural content such as entertainment and food, no matter what the topics of the prompts were.

Here, we step back from the focus on behavioral data and writing to look more broadly at people's beliefs about and practices around *Pensieve* and reminiscing in general. Our primary data source is a 19-item questionnaire that we mailed to all 91 users, of whom 20 responded (seven aged 18–25, six aged 26–35, three aged 36–45, four unknown; seven female, 10 male, three unknown). It started with the broad question, “Tell us how you use *Pensieve*.” We then asked more specific questions about patterns of *Pensieve* use (e.g., frequency of use, when they respond to triggers), how using the system makes them feel, the types of reminiscing they do with *Pensieve*, whether using the system has changed their reminiscing, and how they feel about the different types of triggers. We concluded by asking if they would be interested in features that allow sharing, how *Pensieve* could be changed to work better for them, and how their use of *Pensieve* compares to other social media sites. Two researchers analyzed the responses and organized them into themes, which we report below. Participant numbers corresponding to quotes from the questionnaire are noted as (P#) at the end of each paragraph. In addition, *Pensieve* users sometimes included feedback in their diary entries and through a feedback form on the *Pensieve* website; these quotes are noted as (D) and (FB).

3.1. How *Pensieve* Supported Reminiscing

Our first main question is about how people integrated *Pensieve* into their lives and how it supported reminiscing. Questionnaire respondents reported a variety of practices around reminiscing with *Pensieve*. The dominant use was reflecting, at least for a moment: “I spend a few moments considering the cognitive prompts.” People also reported using *Pensieve* in a spontaneous way: “Sometimes the topics jar me out of my busy, busy mindset that I typically have when at work.” Evidence of spontaneity is backed by quantitative data as well; Figure 3 from Peesapati, Schwanda, Schultz, Lepage, et al. (2010) showed that people often attend to a prompt within the first hour after it is sent. (P19, P17)

Pensieve's design also supported multiple modes of use. Although the user above described the topics as changing their mindset at times, others reported that it simply became part of everyday life and thinking: “If anything, *Pensieve* has made reminiscing more casual, which I suppose is a good thing.” It also supported both the spontaneous uses previously described and more deliberate use enabled by the deferability of e-mail and the diary's aggregation of triggers: “If I am busy I just delete the email and after few of those when I have more time I go through the diary and comment on things I didn't before.” By using e-mail as the delivery mechanism rather

than SMS, Pensieve achieved a balance of reminding and control that served people well. (P20, P4)

People reported processing the triggers on multiple levels. They supported recalling specific episodes and events along with how these events felt, and what they meant: “I think they’re interlocked because you normally have an emotion tied to a memory, at least for me I do.” This difference between data and memory came up a number of times: “The details are just bits and pieces. It is the feelings about them that weave me into a person.” So did the difference between memory and feelings: “I think more about the memories themselves. The feelings are there, but I tend to feel them again, rather than think about them.” These findings support Sellen and Whittaker’s (2010) argument about the need to move beyond capturing data to thinking about its role in reflection. (P3, P2, P11)

The relationship between the personalized photo triggers and the non-personalized text prompts also highlights this tension between data and feeling. Usage data from Peesapati, Schwanda, Schultz, Lepage, et al. (2010) showed that people write diary entries in response to personalized photo triggers more often than to non-personalized text prompts. Qualitative data suggest that the photos work better than the text prompts for reminiscing because people like both the visual and the personalized aspects of these triggers: “Don’t like the basic prompts. I like the image prompts”; “I like seeing old pictures. I’m a picture junky”; “I was too busy to think much about them, if they were more personalized, I may have.” However, the same study also showed that diary entries about the text prompts tended to be longer and more storylike, whereas entries about personalized photos often had the feel of capturing metadata about what was visible in the picture. This also aligns with findings from Sosik, Zhao, and Cosley (2012) that presenting pictures or wall posts about events in a relationship leads people to focus on details of the specific event itself rather than the relationship as a whole. (P16, P13, P14)

Writing was a small but important aspect of using Pensieve. A majority of people (58/91, 64%) wrote at least one diary entry, whereas 21% (19/91) wrote 10 or more. A main use of writing was to “remind myself of past events, feelings, etc. To send brief notes to myself,” especially when the prompt caught people’s attention: “If the prompt touches a chord, I send it a brief message in response, usually a mini-story related to a memory.” These uses aligned with our goal of supporting lightweight capture in context. Writing also served other less expected purposes, including helping people “feel more creative and thoughtful. . . . It is almost an exercise in creative writing as well as conjuring up old memories.” For some people, writing was a satisfying activity in its own right: “However, when I’m replying, it feels really nice.” (P20, P1, P12, P11)

On balance, people reported that both writing and thinking about the past were associated with mild improvements in their mood: “Usually, in a positive way. If it makes me think of something good, I will respond to the memory, otherwise I ignore it.” In fact, people often actively sought to avoid negative memories: “Why would you want to elicit bad memories?? My triggers have been very negative lately, and it makes me hate getting those emails.” This positivity bias may be pervasive in social media.

LIWC (Pennebaker, Francis, & Booth, 2001) counts the percentages of words in a text corpus that fall into linguistic categories such as positive and negative affect. Its standard personal writing corpus has a balance of positive and negative affect (2.7% vs. 2.6%). However, both diary entries (2.8% vs. 1.1%) and the status messages and wall posts collected in Section 2.1 (7.1% vs. 2.8%) showed that people tend to write on the bright side. (P20, FB)

However, Pensieve's nature as a reminiscing tool and its explicit prompting to reflect made it harder to ignore negative triggers compared to other social media: "Pensieve is more confrontational. If a Facebook or Flickr memory stirs up a negative memory, I move on. If Pensieve triggers a negative memory, I feel like I need to deal with it somehow." This working through of past negative memories was also seen as useful, at least at times: "When I really think about the message and the memories related to it I typically feel better even if the memory itself is bittersweet. I guess it is a sort of perspective taking process." (P18, P17)

Working through the past is one of many functions of reminiscing that Pensieve supports. Webster and McCall (1999) identified a number of uses that Pensieve appeared to support, including maintaining intimacy: "Thank you. This prompted me to email Debbie"; using the past to address the present: "I try to connect it to issues I am dealing with currently. I think, like therapy, this helps understand myself"; and identity creation: "It has helped me value the more mundane parts of my life, like recipes and jingles I remember from childhood. They are ordinary and yet culturally special parts of when I was raised and who I am." (D, P12, P2)

3.2. When Didn't People Reminisce?

Sometimes Pensieve did not work well. The most common failure was to send content that was not meaningful: "Also, some prompts or photos are 'Ah, whatever. Not really interesting, I wish it was something more fun to reminisce about'; "There is a picture I keep getting . . . and it is just annoying. It is not even a fun picture, but some mushroom on a tree trunk that my mother-in-law took a picture of . . . I think she thought it was artistic." Recent content was also problematic, both because of life stages: "It sometimes doesn't work since I'm 22 and 'The last time I pulled a prank.' was yesterday" and limitations of the social media sources it drew from: "Pensieve often sends me tracks I just listened to (from Last.fm) or tweets that I just posted, within the last few days. These are really much too recent to trigger reminiscing." (P4, P3, P18)

An interesting case of unsuitable content was that some triggers, such as one about prom, were seen as "very American-culture oriented." These prompts were useless, and perhaps offensive, to some users: "I also find the triggers extremely US white middle class centric and as such, often irrelevant to me." In a follow-up study (Peesapati, Wang, & Cosley, 2010), we explored how congruence between cultural themes in photos used for reminiscing and a person's own culture affected how people thought about the photos. Not surprisingly, people felt closer to same-culture photos.

However, they were just as able to label photos from other cultures as from their own, again underscoring the difference between data, memory, and feeling. (P16, P15)

For other participants, the problem wasn't individual prompts; rather, Pensieve could not support their practices. Some people needed to be both ready to reminisce and ready to reminisce about the particular memory trigger sent: "For me it pointed out that reminiscing has to do with the timing of the current experience and the trigger. This kind of match that would induce reminiscing for me appears to be very rare and would be difficult to produce." A smarter version of the system that knew a little more about users' context—what they were doing, who they were talking to—might be more able to send content that could trigger effective reminiscing. Other aspects of daily life, such as "other pressing demands, like my child crying" or being "in a hurry checking my email" could also reduce people's attention to the triggers, highlighting the need to consider reminiscing as just one of many activities that people engage in. (P15, P2, P5)

People also sometimes avoided writing. Despite our goal of supporting light-weight capture in context, people still found that "responding takes time, and I'm unsure of the selfish benefits for me," especially for those who didn't know they could create diary entries by replying to an e-mail: "Responding . . . it requires actually going to a web-interface, it requires putting random, relatively unorganized thoughts into something readable and organized." The personal nature of reminiscing also sometimes led people to avoid writing. Negative and private memories were seen as better suited for internal contemplation: "Once I was reminded of a fight with a friend. There are lots of things about my life that stay in my head. That was one of them." This would help to explain the positivity bias in writing diary entries seen earlier. Others saw limited value in sharing their reminiscing with either a computer: "Some memories feel really private, and I don't feel like sharing them with a computer" or with researchers: "There seems potential risk and no reward to giving very personal memories to Cornell." (P19, P15, P10, P1, P8)

3.3. Was Pensieve Worth It?

On balance, respondents found the system valuable: "I enjoy it"; "It is a different experience"; "I like seeing old pictures"; "It's like an extra conversation partner, targeted at my past"; and "It feels useful." This was true even if they experienced some of the problems previously described: "Really think about the . . . cultural relevance of non-image triggers & timing of triggers. . . . Keep up the good work!" Both usage and qualitative data suggest that Pensieve has long-term value as well. Most accounts (85%, 77/91) continued to receive prompts as of the end of the data collection period, and most respondents said they would continue using it: "Although I don't necessarily respond to the triggers that often, it would feel weird not having prompts being sent anymore." (P3, P6, P13, P20, P1, P15, FB)

A number of features contributed to Pensieve's working well for many people. Respondents said it helps make more of the past accessible: "I am remembering more

details about my distant past, including the good parts instead of just the bad,” as well as making the activity of reminiscing more frequent: “I guess everyone sort of has their personal memory cache and they access it. I see Pensieve as a way to access it more often, which I think is not a bad thing (especially since it’s very much an opt-in thing).” The lightweight nature of the prompts and people’s ability to schedule attending to them meant that even those who saw only modest benefits were often willing to keep receiving them: “Probably, because it isn’t really a commitment and sometimes it’s interesting.” Reminding also played an important role in supporting continued use: “I guess I always spend a minute doing so when I get the email so now there’s sort of a scheduled reminiscing time.” (P2, P1, P5, P5)

Finally, for most people, Pensieve struck a balance between enabling new practices and fitting into existing routines: “I think that as long as I get prompts, I will respond to some. It’s kind of nice, not too intrusive, can be done on the bus.” On the other hand, people who felt Pensieve required them to change their practices were less likely to continue using the system: “I am not really using it now. It was work putting answers to all the questions, and I was not feeling corresponding benefit from it.” That person likely thought that either we as researchers or Pensieve as a system was requiring them to write. Most people, however, described it as just another way to reminisce, and when asked, they reported that although it made the activity more salient, it didn’t change their practices in a fundamental way: “Nah. Can’t say there has. I usually just get the prompt and react to it immediately.” This was a fine outcome given our goals. (P18, P8, P16)

4. REMINISCING TOGETHER—OR NOT

The importance of fitting people’s practices and routines was driven home further by an unsuccessful attempt to integrate social reminiscing into Pensieve that we describe next. Although we had sound reasons for focusing on individual reminiscence in our initial design, we knew we were ignoring important social elements. Reminiscing serves social purposes including intimacy maintenance and developing relationships (Webster & McCall, 1999). Interviewees from Cosley et al. (2009) reported people as a major trigger, topic, and reason for reminiscing, a description confirmed by the prevalence of people as a topic in people’s diary entries (Peesapati, Schwanda, Schultz, Lepage, et al., 2010). Some Pensieve users also explicitly wanted social features: “Sometimes when there’s a trigger that makes me remember a funny story, I find myself wanting to share it with someone and writing it in the ‘Diary’ just isn’t satisfying because I know nobody will see it.” (P5)

Thus, in fall 2009, we looked to add social reminiscing to Pensieve. Our key insight was that our original thinking about sharing diary entries was faulty. Rather than sharing an entry with everyone or no one, we realized people could share entries with a specific, fixed group of people, similar to Facebook messages. This choice supported privacy and control while aligning with the need to choose appropriate

topics for reminiscing with others based on the relationship (Cosley et al., 2009). Participants also described reminiscing with others as conversational, which we tried to support in the redesign.

The main interface change was to the diary page. Each trigger included a text box and Share button, allowing users to enter the e-mail addresses of one or more people they would like to reminisce with about that trigger. The e-mail addresses do not have to correspond to existing Pensieve accounts. Once the user clicks “Share,” the list of addresses is fixed and cannot be edited. We do this because everyone’s diary entries around this trigger become visible to everyone in the group, and we wanted to respect the group’s privacy by not allowing newcomers to be added to the ongoing conversation.

When a diary entry is shared, the group receives an e-mail that looks much like other memory triggers, with additional information about who shared the trigger and who else it is shared with. For recipients who are not current users, the e-mail also briefly describes Pensieve. Any member of the group can continue the conversation by clicking on a link in the e-mail that takes them to Pensieve. Shared triggers are visible on the diary page of each person they are shared with, so existing users are taken to that entry. Nonusers are taken to a version of the diary page that displays only entries that have been shared with them. When anyone in the group adds a response, everyone in the group receives an e-mail to make them aware of the ongoing conversation.

We publicized the new features by sending e-mail explaining them to all active Pensieve users, as well as adding a pop-up window to the diary page that introduced the features the first three times people visited the site after they were deployed. Uptake, however, was near zero; a few triggers were shared but we saw almost no conversation. At this point we realized that, although we had gathered information about face-to-face social reminiscing in our original interviews, we had not looked closely at people’s practices around reminiscing with others using social media.

To remedy this, and to better understand why the social features went unused, we undertook a study of how people use computer-mediated communication (CMC) tools to reminisce with others. We conducted semistructured interviews of 12 students from Cornell University (ages 19–23, *Mdn* age = 21; 10 female, two male). The interviews lasted about 45 minutes, for which participants received either \$10 or course credit. The interviews were broadly about using social media to maintain relationships; here we focus on the role of reminiscing in maintaining these relationships. We asked participants to describe recent experiences where they reminisced with others, both face-to-face and through CMC, how the conversations started, what media they used and why, who the conversations were with and what they were about, and how they felt about the experiences. As in our original interviews, we showed participants the social Pensieve features, described how they worked, and asked people’s opinion of the system. We did not ask about Facebook’s Photo Memories because it had not been released at the time of the interviews. Each interview was recorded and transcribed in full, and we created affinity diagrams to analyze and call out the themes in the transcriptions.

Half of our participants preferred reminiscing face-to-face, giving three main reasons. First, face-to-face interactions naturally support reminiscing through conversation, whereas on Facebook, reminiscing requires starting a wall post, message thread, or a comment. Continuing the conversation takes more effort than face-to-face. Second, they saw face-to-face as more personal than CMC tools, which matches people's descriptions of reminiscing as a personal and emotional experience. Finally, as described earlier, many social media are "now" oriented to support awareness and provide novel content that encourages repeated use; this makes it less likely that past content will trigger reminiscing. Despite these perceived drawbacks of using CMC to reminisce, four of the six participants who preferred face-to-face reminiscing said they still find tools such as Facebook beneficial for reminiscing with geographically distant people.

The other six participants reported liking and using face-to-face and CMC tools to reminisce about equally. They saw some of the same drawbacks as the other group but identified two contexts for reminiscing that Facebook was particularly well suited for. As with the other group, these participants said that Facebook was great for reminiscing with those who were far away. Five of these six participants who actively reminisced with others using Facebook saw it as especially useful for reminiscing with groups, allowing them to share stories with many people at once instead of telling the same story on different occasions. Facebook's message feature supports this kind of group reminiscence well; three of these participants use ongoing message threads for long-term reminiscing with at least one group of friends (often from high school).

Participants also described how they moved between face-to-face and CMC in the course of reminiscing. They described two phases of reminiscing with others: The first phase is when someone is reminded of an experience, and the second is when they talk about it with others. Technology can be involved in neither, one, or both of these phases. "Neither" corresponds to face-to-face, whereas "both" is social Pensieve, or reminiscing entirely within Facebook. The "one" cases are interesting. Participants were sometimes reminded of an experience in CMC (such as seeing a photo in Facebook), then talking about it with others face-to-face—not unlike the Pensieve user who was prompted to contact Debbie. They also sometimes reported that in the course of their offline activities, they were reminded of an experience with particular others that prompted them to reminisce with them using CMC tools.

Four participants liked the social Pensieve idea of being prompted to reminisce and share with others, describing it as "formatted for the past" as opposed to Facebook's being "in the moment." They also saw it as useful for getting to know people and explicitly sharing pictures with others. The remaining eight participants said they would not use social Pensieve. Four saw using a separate system for social reminiscing as redundant with Facebook, and also preferred Facebook because it is not focused on reminiscing: "With Facebook there is like spontaneity in reminiscing and it's not solely dedicated to reminiscing which I think I personally like." The other four said they would not use social Pensieve because they did not like the idea of

using technology to reminisce: “I think this would be really popular with other people who do use stuff like that. I am not a big fan of technology.”

These insights help us better understand why the social features of Pensieve failed. In general, they were not a good fit for people’s practices around using social media to reminisce. When people do use social media for reminiscing, they tend to use Facebook; social Pensieve’s standing outside of Facebook worked against it. Pensieve also doesn’t support reminiscing that moves into or out of CMC media, which participants commonly reported. Some people thought the reminders, which were so useful for supporting individual reflection in Pensieve, were artificial in the social context, not prompting the sort of reminiscing that supports social functions like intimacy maintenance. Pensieve’s original design as an individual-focused tool also likely made it hard for existing users to revise their impressions and use it socially. The practice of writing diary entries by responding to e-mailed triggers, so useful for supporting lightweight capture in context, also probably harmed social Pensieve, because we were not able to create a satisfactory email interface for sharing. E-mail forms were incompatible with most clients, text-only e-mail interfaces for specifying recipients were awkward, and using e-mail headers was ruled out because it made it too easy to add other people to the group.

Thus, social Pensieve, despite the value of other including other people in reminiscing, fit neither social reminiscing practices nor Pensieve use practices well enough to succeed.

5. DISCUSSION

We now turn to how our work might inform other systems for reminiscing, loggeling, and reflection. We start by owning our limitations. One main limitation is that it is hard to catch people in the act of reminiscing. Reviewers of Peesapati, Schwanda, Schultz, Lepage, et al. (2010) pointed out that writing is not all of reminiscing, leading us here to look beyond diary entries and toward how people described their experiences. But describing reminiscing is not reminiscing either, and as Sellen and Whittaker (2010) argued and our results show, neither are the pictures and other artifacts that trigger reminiscence. Thus, the question is how to examine reminiscing *in the moment*. In Cosley et al. (2009), we first asked people to describe a recent instance of reminiscing. People had trouble with this question, describing their reminiscing as spontaneous and almost unconscious. Field studies of practice in homes (e.g., Oleksik, Frohlich, Brown, & Sellen, 2008) and lab studies of remembering and tool use (e.g., Sellen et al., 2007) give some insight into reminiscing practice, but our knowledge of how people reminisce in daily life is still murky.

Our other main limitation is that 6 months is only sort of “long term.” Pensieve is still running, and people occasionally still report being happy to receive triggers, 2 years later. But a series of problems—a limited number of non-personalized prompts (meaning that some people saw them all), bugs in the original code that surfaced when

other sites changed their interfaces and APIs, and up-and-down availability during the development of social features—make it hard to discuss how the system fared for longer term use. As with getting at the actual act of reminiscence, we think that long-term evaluation is a key question for research around systems for reminiscence and reflection. Short deployments and lab studies are useful but are vulnerable to novelty effects and give little insight into how systems might integrate into or change people's practices over time.

5.1. Reminiscence, Lifelogging, and Reflection

We see similarities between reminiscing work and other applications around memory and reflection such as lifelogging and personal informatics. Sellen and Whittaker (2010) called out reminiscing as one of many potential uses of systems that automatically capture elements of everyday life, whereas Li et al. (2010) argued that supporting review and capture—key elements of Pensieve—are also key stages in the lifecycle of personal informatics systems designed to help people attain self-knowledge. Lifelogging and personal informatics systems also are often used to reminisce, whether the goal of the system is to support this or not (Lindley et al., 2009; Viégas et al., 2006).

The definitions and main concerns in this space of applications are still in flux. Sellen and Whittaker defined lifelogging systems as those that seek total experience capture, whereas Li et al.'s model of personal informatics is broader. Most work on reminiscing in HCI focuses on family settings, despite the history of studying its individual benefits in gerontology; systems might work at levels ranging from individuals and relationships to families and communities. Few systems in this space take the workings of autobiographical memory (Conway & Pleydell-Pearce, 2000) to heart in their design, although this mechanism likely cuts across all of these domains. These differences probably arise from the relative newness of reminiscing and lifelogging as topics in HCI. Work that maps out the benefits (Sellen & Whittaker, 2010), processes (Li et al., 2010), practices (Oleksik et al., 2008; Petrelli et al., 2008), and design goals of these systems will help to define these applications and the connections between them.

Another key question for these systems is what kind of thinking and reflecting they will support. Reminiscing can fall on a spectrum between simple recall of past events and evaluative meaning-making about the past (Webster, Bohlmeijer, & Westerhof, 2010). Reflection and reminiscing overlap in the form of evaluative reminiscing, because making sense of unstructured content is one way that reflection has been defined (Moon, 1999). Our data show elements of both. When responding to photos, people often provided simple facts, whereas responses to text prompts were more likely to be in the form of a narrative about the experience and what it meant or how it felt. Questionnaire respondents also explicitly distinguished recalling an event “without really thinking too hard about the trigger” from using memories as “data” that serve as “raw materials that this human machine uses to produce knowledge, stories, understandings.” (P5, P10)

Moving from capture and reminiscing about moments toward reflection and construction of narratives is another interesting direction for these systems. People use photos and scrapbooks not just to remember the past but to tell stories to themselves and others. Further, reminiscing often has a “chaining” character, where one memory triggers the next, and a set of related memories emerge. Pensieve’s focus on individual moments and simple text diary entries made it a poor tool for this kind of narrative building, and we expect that narrative tools can help bridge reminiscing and reflection activities. Narratives might be especially useful for lifelogging systems that support the formation of new habits and attitudes: imagine being able to create an identity as a weightlifter, a nonsmoker, or a healthy eater by combining aggregate visualizations of past data with user-curated stories based on meaningful incidents such as milestones or hard choices.

5.2. Applying Our Design Goals More Broadly

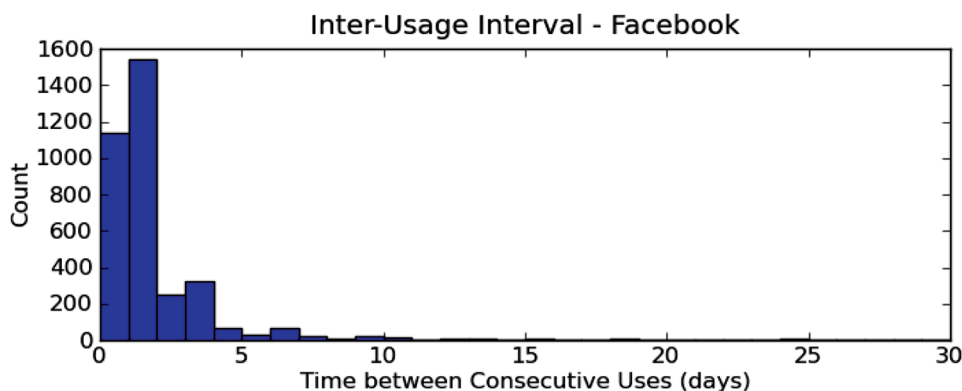
Earlier, we posed four main design goals: integrate into everyday life; leverage existing practices, tools, and data; support lightweight capture in context; and respect people’s privacy and control. Here, we add a fifth—remind for regular use—and look at how these goals might apply broadly to reminiscence, lifelogging, and reflection tools.

One way for these systems to integrate into daily life is to make them available and salient at appropriate times for their task. For Pensieve, with its focus on spontaneity, to *integrate into everyday life* means to be ubiquitously available. For tools aimed at supporting family reminiscing in the home, on the other hand, *integrating into everyday life* might mean to create artifacts like the FM Radio or the Living Memory Box that sit in view and call for attention through their presence. Tools for reflection on personal data such as Themail (Viégas et al., 2006) and other visualizations of lifelog data might be embedded in the context where the data collected are used, to remind people that they are there and to be salient and ready at hand.

Some of these tools, particularly those that attempt to start new practices or habits, will benefit from Pensieve’s strategy of *reminding for regular use*. Reminding makes activities and values salient. Our interview and Facebook participants often reported that they valued the reminder that reminiscing is important. Within Pensieve itself, people were regularly reminded to reminisce but not to write about it; though people continued to think about the triggers, they stopped writing if they went for more than a few days between entries (Peesapati, Schwanda, Schultz, Lepage, et al., 2010). We saw a similar pattern with a Pensieve-like Facebook application that used status updates and tagged photos to support reminiscing. The application did not send mails; instead, people had to remember to visit the application. Figure 2 shows that without reminders to visit, people either made it a habit or abandoned it entirely.

We believe that reminding Pensieve users to write would have increased diary use; that reminders for the Facebook application would have increased its usage; and that reminders to engage in systems that support lifelogging, reflection, or healthy

FIGURE 2. Days between receiving Facebook Pensieve triggers by the same person. Most people, who use it, use it regularly. (Color figure available online.)



habits would increase behaviors in those systems as well. General-purpose reminding tools such as HassleMe (<http://www.hassleme.co.uk/>) are a start, but we believe that context-appropriate integration of reminders into the design of reminiscing and reflection tools will be a big win.

Special-purpose artifacts for reminiscing or lifelogging such as SenseCam or the activity sensors used by UbiFit Garden (Klasnja, Consolvo, McDonald, Landay, & Pratt, 2009) impose costs because they don't directly *leverage existing tools*. Particularly careful attention to *existing practices*, such as the work leading up to FM Radio (Oleksik et al., 2008), and ways to *leverage existing data*, such as our own work or personal informatics systems that repurpose archives of activity, will be important to reduce the cost of adopting such systems and increase their chance of success. Our own troubles with integrating social features into Pensieve also show the importance of respecting practice.

Leveraging rich data, as with FM Radio's use of audio, may support more effective reflection. As one Pensieve user said in response to the questionnaire, "I can't always remember which songs are which from last.fm. Oh but if I could hear the song, that might make a difference." (P10) These media might come from a variety of sources, including photos, mementoes (Petrelli et al., 2008), or home movies (Cosley et al., 2009). Places also can create strong feelings of attachment (Rowles, 1983); some participants in a study that used Google My Maps to trigger reminiscence (Peesapati, Schwanda, Schultz, & Cosley, 2010) used StreetView to bring back richer memories.

Existing data might also be used to reason about users' contexts. A "Smart Pensieve" could create a user model based on interests, age, recent social media activity, and so on, and use the model to prompt people with material containing topics, people, time ("five years ago today"), or places that are context relevant and thus probably more salient and meaningful than randomly chosen material (Sellen et al., 2007). Lifelogging systems that support reflection on past data might also encourage repeated use and increase their utility by making connections from past

data to present activities. To better support thoughtful use, systems could use both general patterns—for instance, information on healthy eating behaviors will be more valuable near mealtime—and responses to the system itself, noting which health tips people follow or which prompts they respond to.

Not all reminiscing systems will require capture, but for those that do, attention to *supporting lightweight capture in context* is critical. Diet tracking is a notorious example of lifelogging where capture is difficult, whether the technology is paper, a website, or a mobile device. People forget the milk in their coffee or that half bagel from the colloquium, they estimate quantities poorly, and looking up foods is tedious. Combining automatic capture with a simple interface for marking notable events to review later, as with the Personal Audio Loop (Hayes et al., 2004), seems like a useful approach for supporting lightweight capture in context.

Sometimes reminiscing or recording will be a primary goal, and at those times, richer capture interfaces such as the Living Memory Box (Stevens et al., 2003) become more apropos. The increasing capabilities of smart phones and tablet computers to present and record data may afford new possibilities for supporting reminiscence and reflection. Imagine asking people to carry a tablet to capture memories using video, audio, and text. We suspect that the embodied nature of the experience, plus the cues in the environment, would lead to a rich experience of reminiscing and capturing data in context. Pictures can also simplify capture, as in photo food diaries.

Finally, *respecting people's privacy and control* is something that any system designer should consider but that becomes more salient when the personal, the private, and the precious are at stake. This is a particular danger for ubiquitous recording systems such as SenseCam that impose privacy risks on other people, but less obtrusive systems may also carry privacy risks. UbiFit's visualizations of exercise activity might convey information about goals or self-perception that people would rather not share, even if the interface itself is abstract (Klasnja et al., 2009).

This becomes even more important in social contexts. Social reminiscing in families and in groups of geographically dispersed friends is an important element in people's lives. But Photo Memories—and the thousands of people whom Facebook has reminded of relationships turned sour through its well-intentioned but unsubtle algorithms and the inability to turn the feature off—reminds us of the risks involved for systems for reminiscing, for those that use social support for personal informatics applications, or for those that help people reflect on social data such as conversational archives. The problem of building socially nuanced systems is not new, but as with our unintentionally culture-specific prompts, this is the kind of problem that's easy to overlook and hard to get right.

6. CONCLUSION

We think that reminiscing and related topics around supporting personal memory and reflection are one of the most exciting domains for HCI research, with both

huge potential real-world impact (everyone reminisces!) and an enormous space for work. Reminiscing, capture, and reflection take place at all scales, from individuals, to groups of family, friends, and strangers, all the way up to entire cultures. The style and method of reminiscing can range from incidental reflection and phone camera capture of offhand occasions to a focal activity for relationship building or therapy. These applications also open questions of values: the value of remembering, and forgetting, in a digital age, and the ethics of systems that use collected data as a tool for motivation and persuasion. The size of the space and the relative newness of these applications mean there is a need for work in many domains, including cognitive and social psychology, design and technical innovation, and critical analysis.

Our work provides a novel cut through this space. By focusing on individuals over groups, and on spontaneous over planned reminiscing, our studies give new insight into people's practices and the potential value—and pitfalls—of reminiscing with social media. People create a treasure trove of personally curated content in these media, and when meaningful, it is potentially valuable for reminiscing. Through the development and deployment of Pensieve, we show that this content, as well as impersonal but evocative reminders, can support a wide range of practices around reminiscing. Whether spontaneous or planned, and whether people wrote or simply reflected for a moment, being prompted was valuable and served many of the important purposes of reminiscing. Our experience also shows that reminding may be especially useful as a way to encourage long-term use of systems for reminiscing and reflecting.

Our mistakes are also instructive. We were blindsided by the cultural issues involved with the non-personalized text prompts, and we were punished when we strayed from our design goals, as with social Pensieve's failure to respect people's practices around how, when, and why they use social media to reminisce together. These design goals are likely to be useful across a broad range of the scales, styles, and values previously described, although their specific interpretation will vary based on the task and context to be supported. We hope that this work helps other researchers studying reminiscing and reflection do better work in their own contexts.

NOTES

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