Experiences with a publicly deployed tool for reminiscing

Dan Cosley[1], Victoria Schwanda[1], S. Tejaswi Peesapati[1,2],
Johnathon Schultz[1], Jonathan Baxter[1]

[1]Information Science
Cornell University, Ithaca NY 14850, USA

[2]College of Engineering and Science
Louisiana Tech University, Ruston LA 71272, USA

{drc44, vls48, stp53, jtb42, jts228}@cornell.edu

ABSTRACT

This paper discusses the design and use of Pensieve, a system that prompts people to reminisce through emails containing either social media content or text prompts about common life situations. We discuss how existing research on reminiscence informed design goals and tradeoffs in the creation of Pensieve, then analyze data collected from 72 people's use of the system over four months. We find that people valued the spontaneous reminders to reminisce and the ability to write responses to these prompts; based on their responses, we find that shorter, more general prompts are better and that personalized pictures draw more responses, but less thoughtful ones, than the text prompts. We conclude with a number of design ideas for both researchers and designers at the intersection of technology and reminiscence.

Categories and Subject Descriptors

H.5.2 [**Information Interfaces and Presentation (e.g., HCI)**]: User Interfaces

General Terms

Design, Experimentation, and Human Factors

Keywords

Reminiscence, memory, autobiography, social media

1. INTRODUCTION

This paper describes the design and initial use of Pensieve [4], a prototype system that supports people in reminiscing. Reminiscence is a valuable activity throughout a person's life [12], and a number of systems have been developed to support memory and reminiscence, from supporting photo sharing (e.g. [1][10]) to capturing relatively complete records of everyday experience [5] using technologies such as sensecam [9] which automatically takes pictures throughout the day.

Pensieve differs from these other systems; rather than focusing on capture and retrieval of memory-related information, it leverages existing practices around capture and supports the less structured, more spontaneous [13] activity of reminiscing. Pensieve has two key features. First, it sends occasional memory triggers through email. These triggers arrive at unexpected times with the goal of causing the same sort of spontaneous reminiscence that reading a

newspaper story [4], seeing a nostalgic cultural icon such as a classic car [7], or hearing a particular song [13] may trigger.

Second, Pensieve chooses triggers from both a set of non-personalized prompting questions based on common life situations (a common strategy for group reminiscence therapy [13]) and from content people already create in social media sites such as Flickr, Blogger, and Twitter. This content is often laden with personal significance and, because most social media sites emphasize current activity, it is rarely revisited—making it ideal for supporting reminiscence. Pensieve also allows people to write more about their memories, a goal of many people [4], by responding to these memory triggers.

We make several contributions to both design and research at the intersection of technology and reminiscence. We first describe Pensieve, describing how the existing literature on reminiscence shaped the design goals and informed the tradeoffs we made in building it. We then present a preliminary analysis of data collected from 72 users over four months. In this period, over 8,000 triggers were sent, while people wrote over 650 responses and provided feedback about their experiences with Pensieve.

We analyze these responses and this feedback in order to provide insights into the ways people reminisce using Pensieve. In general, Pensieve facilitates people's reminiscing practices as described in the research literature; people like both the spontaneity of and the ability to respond to triggers. A temporal analysis shows that people tend to respond to triggers either quickly or not at all. People also tend to respond more often to shorter text prompts than longer ones, and more often to personalized pictures rather than these text prompts—but the responses to pictures sometimes appear to be metadata rather than reminiscence. Our data suggest that aggregating reminiscing content and supporting social aspects of reminiscing are promising directions for future research.

2. PRESENTING PENSIEVE

Pensieve has two main functions: to remind people to reminisce, and to allow people to write about their reactions to these reminders. These reminders, or "memory triggers", are sent by the Pensieve server, which chooses when to send triggers and which triggers to send, based on people's preferences for receiving email and the social media sites they have linked to Pensieve. It packages the memory triggers as emails; Figure 1 shows examples of triggers from Last.fm, Flickr, Twitter, and a non-personalized memory prompt.

These emails are the primary interface for Pensieve, promoting the primary goal of supporting reminiscence. A web interface allows people to customize their experience, write about the triggers they receive, and interact with the Pensieve team. On the account page, people can turn Pensieve on or off, modify how

often they receive triggers, and link accounts on social media sites to Pensieve.

One of the main features of the Pensieve website is the diary, which exploits the metaphor of a real diary. People can see and write about every memory trigger Pensieve has sent, recording reactions or stories the trigger elicited. They can also make diary entries by replying to an emailed memory trigger and can create entries unassociated with a particular trigger. Pensieve also provides ways for people to contribute. People can submit ideas for new non-personalized text prompts to be used as memory triggers, as well as providing feedback or answering questions about their reactions to Pensieve.

2.1 Design goals
In addition to the main design goals of reminding people to reminisce and leveraging content people already create in social media, the design of Pensieve was driven by a number of goals drawn from studies of reminiscing as well as our own experiences with early prototypes and interviews [4].

Fit current practices. Many technologies aimed at supporting reminiscing require new software or technologies (e.g., [1][10]) that may not fit people's current reminiscing practices. Pensieve was designed to use existing communication media and to leverage properties of reminiscing such as spontaneity [7]. Sometimes respecting practice led to compromises. For instance, we planned to use SMS messages to increase the spontenaiety of reminders, but early prototype users preferred email so they could have more control, and in the U.S., to pay less.

Require minimal effort. For people who don't currently use social media, we provide non-personalized prompts; for those who do, rather than having them import data into Pensieve we allow them to point to existing accounts; we choose which content to send rather than making people choose; and rather than making people remember to visit the website, we push content through email. The emails themselves are simple. We resisted the temptation to ask regular questions about how people used Pensieve in the emails, thinking that although this would be good for data collection, it would both increase people's effort and be bad for reminiscing.

Respect privacy, provide control. The sometimes sensitive nature of reminiscing led us to a number of design decisions, including not caching content from other sites and not using sites that required passwords. One painful tradeoff was to minimize social features. Even though reminiscence is often social in nature [4] and we deeply believe in systems that explore ways to support social reminiscing, we feared the accidental exposure of personal information.

Use multiple media. Both the research on reminiscing and our interviews suggested that a number of media, including pictures, newspaper stories, music, and smells, triggered reminiscence. This led us to provide access to a variety of media including text (Twitter, Blogger, non-personalized text prompts), pictures (Picasa, Flickr), and music (Last.fm). We started with Picasa and Flickr because pictures are often evocative, and because the Pensieve developers had accounts. Twitter, Blogger, and Last.fm are very recent additions, so in this paper we focus on Picasa, Flickr, and non-personalized prompts below.

2.2 Related Web Tools
In addition to the research work on tools to support reminiscence, Pensieve is related to other websites that support capturing memories such as Plinky, Joggle, OneNote, and Evernote. Like Pensieve, Plinky uses prompts to encourage writing. Its prompts are more general (e.g., *What makes someone funny to you?*), and it allows people to see each others' responses to prompts. Joggle and similar lifestreaming technologies support the aggregation of multiple social media, though again, without Pensieve's focus on reminiscence. Finally, Evernote and OneNote support capture in context, although here the focus is on collecting information created by others rather than one's own personal memories.

3. USAGE DATA
Pensieve was released in late February 2009. As of June, it has 72 registered users (34 females, 20 males, 18 of undisclosed gender). Over half of the users (37) were aged 18-25, with 6 aged 26-35, 4 aged 36-45, 6 aged 46-55, and 19 of undisclosed age. The prevalence of youth probably stems from both Pensieve's spreading by word of mouth from the current research team (12 of whom are also Pensieve users), as well as the relative prevalence of younger people using social media. An initial analysis of
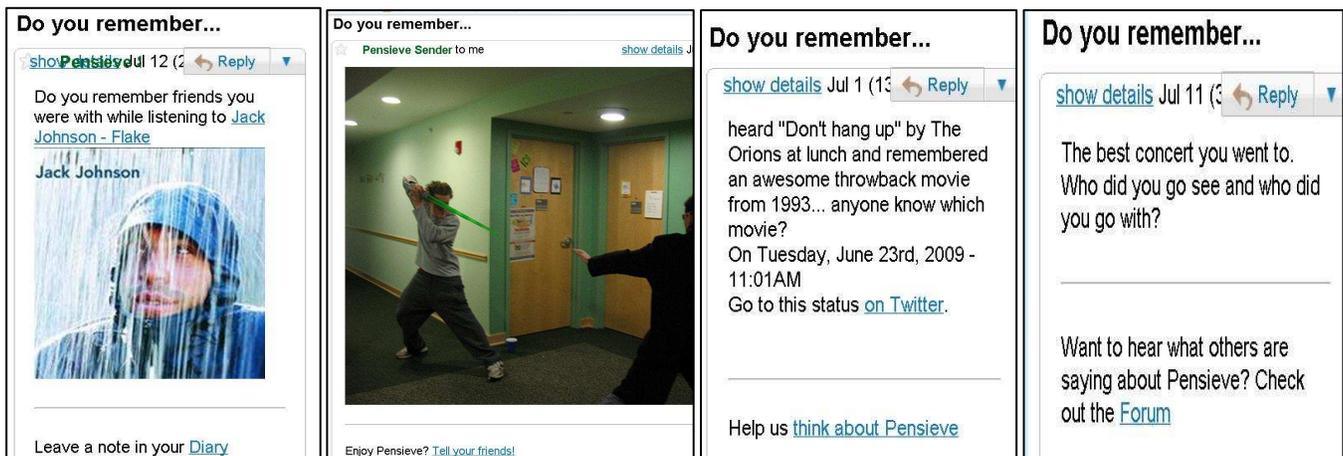

Figure 1. Example memory trigger emails from last.fm, Flickr, Twitter, and the non-personalized text prompts.

demographics did not find significant differences in use. We hope to return to this analysis as Pensieve accumulates a wider variety of users, since although reminiscence serves valuable purposes throughout life [12], some research suggests it may be especially valuable for the elderly [2].

Of the 72 users, only nine have turned Pensieve off, suggesting either that people have effective mail filters or that they value receiving the triggers:

> *"Will this site continue to be up even after the project is over? I love waking up in the morning and reminiscing. This is a great idea."*

The majority of people (38) receive triggers once per day; most of the rest chose to receive triggers two or three times per week, although a few chose to receive them three times per day. Once per day is the default, suggesting that once per day is a plausible choice for reminding people to reminisce.

3.1 Studying people's responses to triggers

We focus on responses to triggers for several reasons. Pragmatically, unlike the reminiscing itself which is private, responses are visible to us. These responses do give insight into people's reminiscing processes and topics, because they are generated in the moment. We analyzed a total of 654 responses by 44 of our 72 registered users. We discarded responses that were blank, test responses, and responses complaining about repeated triggers (which happened sometimes because of a bug). Responses follow the log-log distribution that often characterizes social media: 15 people had 10 or more responses; the median and mean for respondents was 4 and 15, respectively, and for all people were 1 and 9, respectively.

3.1.1 Characterizing people's responses

In this section we present an initial exploration of the topics of people's responses, based on a coding scheme we are developing that groups responses along the lines of family, schooling, music, work, and so on. The goal is to find common patterns of responses, as well as unusual responses, both to characterize people's reminiscing behavior and to look for design inspiration. The coding scheme is still evolving, so the data presented here should be taken as interesting preliminary observations rather than received truth. We also occasionally refer to the kinds of language people use, as measured by Pennebaker et al.'s Linguistic Inquiry and Word Count Tool (LIWC) that computes word frequencies in linguistic categories such as pronouns and affect words [8].

The literature on reminiscence calls out a number of positive aspects of reminiscence [12] About 2.6% of words people used in Pensieve are associated with positive emotions, while 1.2% are associated with negative emotions, compared to 2.7% positive and 2.6% negative in a large corpus of personal writing [8]. This suggests that on balance, people found reminiscence in Pensieve to be a positive experience.

People tended to reminisce about love, fun, and friends, even if the prompts were not specifically about those topics. For example, the prompt *Are there any songs that make you think about people in your life?* led to reminiscence about friends and fun, as well as about their teenage and college years—a time period called the "reminiscence bump" from which people often draw their favorite books, movies, and records [6].

A specific benefit of reminiscence is maintaining connections with other people [12]. LIWC analysis showed that people
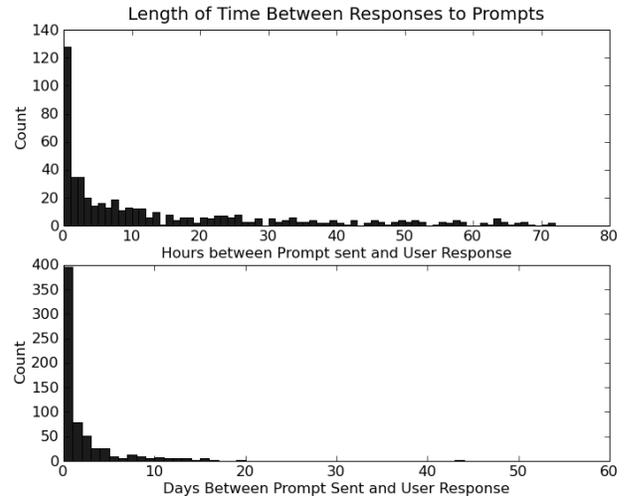

Figure 2. Time between receiving a trigger and responding to it. If people respond to triggers, they generally do shortly after receiving them.

frequently used pronouns in their responses, 13.5% versus 11.4% in the LIWC personal writing corpus [8]. This suggests that people were a dominant topic of reminiscence, according both with this benefit and earlier interviews that highlighted the importance of people in reminiscing [4]. Some people wrote responses saying they intended to get in contact with old friends they hadn't talked to for a while, which suggests that Pensieve helped people maintain and revive relationships.

People tended to respond less frequently to triggers that explicitly referenced family members. When they did, the responses often contained strong feelings. For example, for the prompt *Your favorite book as a child. Did you have your parents read to you, or did you read on your own?*, one respondent was reminded about a grandmother who used to narrate bed-time stories; she is currently in the hospital, and the response was strongly emotional. This leads us to wonder whether some topics led to very strong reminiscence that people are sometimes unwilling to share.

Not all responses were positive. Sometimes people disliked specific triggers: *"This is a terrible trigger, I refuse to respond."* The same trigger could sometimes produce both happy and sad responses. One prompt asked people to reminisce about *The birth of a sibling or their leaving home; did the arrival of a younger sibling or the departure of an older one bring nervousness or joy?* Some people with siblings responded that they felt happy when their sibling left home, but one replied, *"I am only child…It just made me look that much more alone."*

3.1.2 Temporal patterns in responses

We now turn to analyzing temporal aspects of how people responded to triggers. Our data suggests that, like reminiscence itself, people's writing around reminiscence is often spontaneous and immediate, and that capture in the moment is important—but so is providing tools for aggregation and revisiting content.

If people are going to respond to a trigger, it's likely that they are going to respond to it shortly after receiving it. Figure 2 shows how long it takes people to respond to a trigger after Pensieve sends the email. There is a large spike within the first hour, suggesting that people do, in fact, spontaneously reminisce given

a triggering event (and that many people have an unhealthy email addiction!). About 61% (396/654) of trigger responses happen within 24 hours of receiving the email.

For those triggers people respond to beyond 24 hours, it appears that people are using the website to respond to a number of previously received triggers in succession. Figure 3 shows the inter-trigger response time; that is, for a given person, how long after making one diary entry does it take them to make another? About 38% (249/654) of diary entries happen within an hour of the person's previous entry; since Pensieve sends triggers at most five times a day, this means people are responding to multiple triggers using the diary. This behavior is consistent with people's reporting "chains" of reminiscing in an earlier study [4]. Figure 4 also suggests that people who respond do so regularly, with over 85% (557/654) of inter-trigger response times being seven days or fewer. This suggests that systems that encourage people to write as part of their reminiscence must provide regular writing opportunities and reminders.

For completeness, we also looked at the time of day and day of week when people responded to prompts. People followed a roughly diurnal cycle in their activity, responding more during the day, less at night, and perhaps more at lunchtimes. No interesting trends showed up in the day of week analysis.

3.1.3 How trigger types influence responses
The effectiveness of the triggers is crucial to systems like Pensieve. Here, we discuss aspects of triggers that led to more frequent and longer responses. We define a trigger's response rate as the number of times people responded to a trigger divided by the number of times it was sent, and a trigger's response length as the average number of words in responses to that trigger.

We first look at non-personalized text prompts, since those are consistent across participants and may inform the design of topics used in reminiscence group therapy [13] as well as systems like Pensieve. Here, we examine whether prompt length and emotional tone affect people's responses.

We examine prompt length in two ways. Analogous to response length, we define prompt length as the number of words a prompt contains. We also define the number of "parts" a prompt contains as the number of separate clauses. For example, the following prompt has three parts: [*Your first job*]. [*How did you get it*]*, and* [*who were your coworkers*]*?* Prompts with more parts tend to contain specific questions related to a general theme.

Table 1 shows descriptive statistics for text prompts broken down by number of parts. Longer prompts have lower response rates (by prompt length, R^2=0.139; by parts, R^2=0.552), although the response length increases (by prompt length, R^2=0.121; by parts, R^2=0.0558). All of these trends are weak, but observable in the data, and suggest that more general prompts are likely to be easier to respond to.

We also explored whether the emotional tone of a text prompt affected people's responses. We classified individual prompts as being positive, negative, both, or neither. Positive prompts contain words such as favorite, fond, impressed, and best. Negative prompts contain words such as trouble, fight, embarrassing, and disaster. The coding aligns with LIWC's categories of positive and negative affect words (10.2% positive, 0.2% negative for positive prompts; 0.5% positive and 3.9% negative for negative prompts). Prompts can also be classified as containing both or neither positive and negative words.
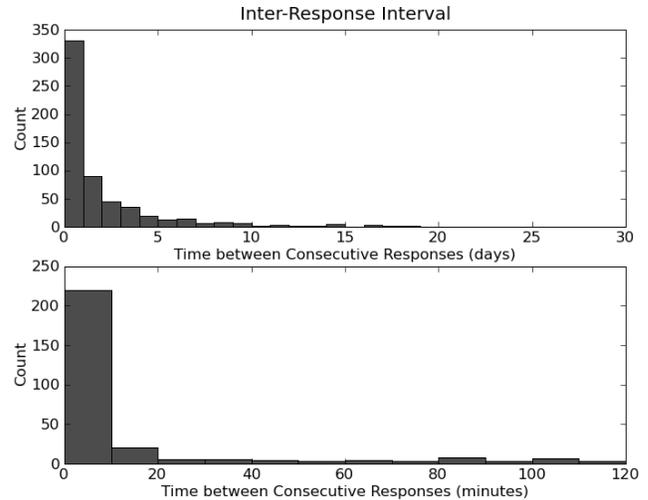

Figure 3. Time between diary entries by the same person. Most people who write, write regularly (top); writing is also often bursty, with people responding to multiple triggers within minutes (bottom).

Table 2 shows the breakdown of prompts by emotional tone. There were no significant differences in either response rate or response length, although prompts classified as both have the longest responses, followed by negative, then positive, then neither. This order is the same as the order of the categories based on the average number of parts, presumably reflecting the effect of prompt length on response length. However, we did receive feedback that suggested people dislike negative prompts:

> *"Why would you want to elicit bad memories?? My triggers have been very negative lately, and it makes me hate getting those emails."*

The prompts people contributed support these findings. Five people submitted 16 prompts. Supporting the preference for shorter prompts, 10 had 10 or fewer words, while nine had one part, six had two parts, and one had three parts. Nine of these prompts were positive and seven were neither positive nor negative; the overall positive tone of the prompts suggests that avoiding negative prompts may be a good design decision.

Table 1. Responses for prompts by number of parts.

Parts	# of prompts	Avg. prompt length	Response Rate	Avg. response length
1	42	19.0	8.5%	37.9
2	23	14.5	9.2%	47.6
3	21	17.5	7.7%	47.8
4+	16	25.6	7.7%	67.3

Table 2. Responses for prompts by prompt emotional tone.

Type	#	Avg. length	Avg. parts	Response Rate	Avg. response length
Both	4	24.3	3.8	7.3%	71.0
Negative	17	18.7	2.5	8.3%	56.3
Positive	36	13.1	2.1	8.9%	47.1
Neither	45	13.3	1.9	8.0%	40.6

3.1.4 Media, personalization, and response rate

Finally, we examined whether media type and personalization made a difference in how people responded to triggers. We focus on Picasa and non-personalized text prompts because the response rates for the other services are very low, partly because of bugs that often generated malformed prompts for Flickr and partly because the Twitter, Blogger, and LastFM services were added to Pensieve very recently People responded more often to Picasa prompts (11%, 63/567) than text prompts (8.3%, 551/6628); this difference was statistically significant ($\chi^2(7809,1)$=4.321, p<0.05).

However, the character of responses was different. The average Picasa response length was about 35 words, compared to about 47 for text prompts. An informal content analysis suggested that people often responded to Picasa prompts with metadata about the picture (the people in it, the event it was taken at, or the location) rather than actual reminiscence. One person suggested that we include information such as the album and caption to mitigate responses that are just recalling the "who, what, where" and encourage a higher level of emotional content.

Unfortunately, because Picasa was only used to send personalized content, we can't say whether the differences in response rates were because Picasa triggers were pictures or because they were personalized. Based on the observation that responses to Picasa focused on metadata, our tentative conclusion is that the non-personalized text prompts are just as effective as personalized pictures at stimulating reminiscence. We are also curious about whether non-personalized pictures might be an effective way to support reminiscence, as [13] suggests.

4. DISCUSSION

On balance, we consider Pensieve to be successful as a prototype. Most people who sign up continue to receive emails (though we can't know whether they attend to the mail without intrusive remote monitoring), and people send positive feedback suggesting they value receiving triggers and having the ability to write about reminiscing, even if they don't actually do it:

> *"I really like coming to the website and having this personal space to write whatever I want about long-forgotten things."*

> *"Although I don't necessarily respond to the triggers that often, it would feel weird not having prompts being sent anymore."*

Below, we present several important considerations for systems that support reminiscence. These are tentative and preliminary: our dataset is fairly large but is based on a snowball sample of people who self-selected as interested in reminiscence; it is mostly behavioral in nature, and would be better if supplemented with data about people's beliefs and intentions; and our analysis here is preliminary in a number of respects, including an informal approach to data coding. Still, we believe the data and the guidelines offer a real contribution to both researchers and practitioners in this area.

Manage repetition. Because of a bug, a number of participants with Picasa and Flickr accounts received the same picture several times. People sometimes left feedback or diary entries noting they had seen a repeated trigger, and generally disliked it:

> *"It is really frustrating when I get repeat triggers— and lately I've been getting a lot of them."*

On the other hand, one informant from an earlier prototype reported that seeing the same trigger multiple times caused him to reminisce differently each time. One purpose of reminiscing is to come to terms with past events; people revisit some events many times as their understanding—and, according to theories of autobiographical memory, the memory of the event itself [3]—changes over time.

Managing repetition is an important issue for systems that use content to support reminiscence; even common "photo slide show" screensavers that cycle through a collection of pictures will necessarily show duplicates many times. An interesting line of research with both technical and social science aspects would be to estimate how likely a particular trigger will be to generate responses. Pictures containing people may be more evocative than those that don't, since people tend to reminisce about others; triggers that many people respond may be better candidates for repetition, and so on. Personalizing these decisions would also be interesting: someone might particularly enjoy receiving triggers about a friend whose birthday it is or who they recently spoke with.

Couple capture with reminiscence. People want to write more when reminiscing than they currently do [4]. Pensieve's diary feature coupled writing with reminiscing, helping people record personal content they might otherwise have forgotten. Minimizing effort by allowing people to create diary entries through email responses was a major reason the diary worked: 51% of diary entries were created through email (333 of 654).

These data suggest that both minimizing user effort and allowing people to write when reminiscence was most salient are valuable design strategies. One flaw in Pensieve's interface was that it was not obvious that replying to an email would create a diary entry; it likely would have done even better had this feature been more obvious. Lifelogging technologies such as MyLifeBits [5] offer capture without user effort, but this very ease of use may make the content captured less salient for reminiscence [9].

Create value through aggregation. Fourteen people returned to previous pages of their diary, presumably to reflect on things they had written previously. In general, aggregation provides value: people often make lists of books they have read and movies they have seen; they enjoy recognition for high levels of sustained performance such as being on the Amazon reviews leaderboard; they like having their photo collections in one place.

Designs to support reminiscing might use aggregation as a strategy for creating value. For example, a design might support "family portraits", using either tagging or text analysis to create collections of reminiscing content related to specific others. Another idea is making a "timeline" to support autobiographical writing by sending triggers such as *Write about something that happened in 1989*. Providing aggregate, organized views of reminiscence about family members or one's own life might give people extra incentive to continue reminiscing. These approaches might also help with the problem of managing repetition; people may remember a number of events about a family member or from a specific year. Sending the content people create in Pensieve as a memory trigger later is another potentially interesting strategy for supporting reminiscence.

Support social aspects. One awkward tradeoff we made was to protect privacy at the expense of social aspects of reminiscence. We did include generic social features such as the ability to add

prompts and a forum for public discussion, but these were rarely used. People commented on the lack of sociality:

> *"It seems likely that fully integrating into social sites and using the relationships people express in them to form groups will be helpful..."*

Studying social reminiscence may be a promising area of research. Designs could suggest patterns of social reminiscing to see which ones people respond to. For instance, a system might let people designate other people on the system as "friend" or "family" and share some or all of their diary entries with these people in order to foster and study social reminiscence. Another option would be to allow people to "publish" their diary entries to the public, which would appear on a common "feed" that could be displayed to the whole community, somewhat like Plinky. A third option might be to allow people to "forward" triggers to others not using the system, allowing them to control who they reminisce with while increasing both the system's sociality and its userbase.

5. CONCLUSION AND FUTURE WORK

Our next steps will be to increase the generality and validity of our results. We are conducting questionnaires and interviews with current users to better understand how Pensieve affected them. We have also developed a second prototype, deployed in Facebook but still focused on individual reminiscing, to see whether our results hold in a different system and user population. We also expect that as our coding scheme evolves, it will tell us more, and we will explore whether differences in demographics or location affect the way people appropriate tools that support reminiscing. Finally, the long-term value of reminiscing leads to a natural desire to conduct longitudinal observations. Do people continue to use systems like Pensieve for months? For years? Does the character of their reminiscing change?

Our results so far are promising. People valued a system that reminded them to reminisce and made it easy to write about their reminiscing. The design of Pensieve, and people's use of it, both support earlier findings from the reminiscence literature and suggest a number of interesting new directions to follow. These include understanding how to choose appropriate triggers for reminiscing and creating systems that allow people to reminisce socially, as well as specific design ideas such as using non-personalized pictorial triggers and creating topic- or person-focused aggregations of the things people reminisce about. We hope to explore whether all of these ideas can increase both our understanding of—and the value people gain from—reminiscing.

6. ACKNOWLEDGMENTS

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