txt 4 l8r: Lowering the Burden for Diary Studies Under Mobile Conditions

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Abstract
We present and evaluate a new technique for performing diary studies under mobile or active conditions. Diary studies play an important role in a variety of disciplines as a means for ecologically valid participant data capture. The burden of diary entry, however, can undermine validity when participants have to capture information while active or mobile. Our technique suggests the capture of small snippets of information in the field, which then serve as prompts for participants during a thorough web-based entry completed at a convenient time for them. We first describe how our system automates collection of snippets via SMS (text), MMS (picture) and voicemail messages and later presents these snippets for full entry elicitation. We then present results from an evaluation of this technique.

Introduction
The diary study technique is commonly employed (both within the HCI community, and in other disciplines) to capture data in situ [5]. In diary studies participants are responsible for data capture, which has both advantages and disadvantages. Because there is no observer present to affect participant behavior, diary studies potentially increase ecological validity. They also reduce the per-participant burden on the
researcher because the researcher does not need to be present for data collection to occur. Shifting the burden of data collection to the participant, however, can lead to biases in the space of events reported: occurrences which seem trivial to the participant (but may not be to the researcher) or which occur at inconvenient times may go unreported.

As Palen and Salzman suggest, this problem often arises when participants are asked to complete diary entries under mobile or active conditions [4]. Motivated by a desire to perform a need-finding study in the mobile computing domain, and inspired by current work on improving diary study techniques by employing various medias and tools [1, 2, 4], we have developed and evaluated a technique for lowering the in situ burden of diary studies.

The remainder of this paper proceeds as follows. We first describe our technique in detail, and discuss the implementation of a system which supports this technique. We then present our evaluation criteria, and discuss the methodology used to evaluate our technique. Finally, we present the results of our evaluation, and discuss future work.

**The Snippet Technique**

Our technique centers on the in situ capture of snippets: bits of text, audio, or pictures captured in a matter of seconds. Participants record and transmit these snippets to a server using standard mobile phones through SMS or MMS messaging, or by leaving a voicemail message. Then, at a convenient time, participants access a website to review their snippets and complete thorough, structured diary entries. We present a diagram of our system in figure 1, and a view of the structured web interface with several snippets is on the first page.

![Figure 1](image)

**figure 1.** The system diagram for our implementation of the snippet technique.

We believe this approach has a number of advantages which make it amenable to participant data capture under mobile conditions. First, it lowers the in situ data entry burden by an order of magnitude (from minutes to seconds). Second, it leverages a device that most participants have with them whenever mobile, and that they know how to use—no special software or carrier services are required. Third, the various input modalities (text, picture, audio) allow participants to choose a media that they feel most comfortable with and/or fits the situation most appropriately.
**System Implementation**

In our implementation, SMS and MMS collection takes place using the NowSMS gateway and a Sierra Wireless 860 GSM modem. Voicemail collection takes place through Skype and a custom voicemail application written using the Skype Java API for call answering, Virtual Audio Cables for sound I/O, and Lame for MP3 encoding. All of these services provide the sender’s phone number, which we use for automatic routing of the snippets. The snippets are stored in a MySQL database, and the web front end is written in PHP running on Apache. A custom Flash player that allows streaming of MP3 data plays the audio snippets.

**Evaluation**

Through two studies, we evaluated the following four hypotheses:

- **H1** Our snippet technique leads to longer entries in a shorter time when compared to current in situ techniques for mobile data capture.
- **H2** Entry accuracy is not significantly affected through the use of the snippet technique.
- **H3** Participants are willing to contribute more “trivial” events when using the snippet technique than when using current in situ techniques.
- **H4** Media choice for the snippet will be dictated by both content and context of entry.

Each study was two weeks long, and in both studies, 15 participants were recruited. Nine participants (5 female, 4 male) completed study one, and 14 participants (9 female, 5 male) completed study two. All participants were undergraduate or graduate students at our institution. 187 entries were collected in Study 1, and 255 entries were collected in Study 2.

All participants were asked to complete structured diary entries about mobile computing needs.

**Study 1 – Comparing the snippet technique to in situ methods**

In this study, participants were randomly assigned to groups a and b. Initially, group a was asked to use an in situ technique that allowed them to complete structured entries using any variety of media they desired: written text, voice, or pictures. The only restriction was that the entire entry had to be completed in situ. Group b was asked to use our technique. After one week, the groups swapped techniques.

**Study 2 – Effects of media in snippet recording**

In this study, all participants began using our snippet technique, but were limited to recording text snippets. After one week, participants were allowed to use all medias for snippet entry.

**Results**

**H1 – ENTRY LENGTH AND TIME SPENT**

Both groups from Study 1 wrote statistically significantly longer entries when using our snippet technique compared to their in situ entries *(In Situ/Web difference P-value: 0.028, one-sided paired t-test, 8 d.f.)*. Study 2, which used our technique exclusively, also created entries with an average length longer than the in situ entries from Group 1a and 1b.
While the difference in entry completion time is not statistically significant—likely due to the large variance across users—our results coupled with qualitative feedback suggest that web entries take no longer to complete than in situ entries (In Situ/Web difference P-value: 0.16, two-sided paired t-test, 7 d.f.).

In exit interviews, participants reaffirmed the conclusions from our data analysis. When asked which technique was less time consuming, participant s9 said, “I was much faster at responding to the questionnaire online than on paper.” S9 expressed his early skepticism about the potential invasiveness of our technique, but went on to say, “It definitely did not interfere with my life, even though I thought it would initially.” He then offered this explanation for why he made longer entries with our technique: “It was great to have the option to fill it in online later, because I could do it anytime I wanted and make a fuller entry.” Both our usage data and participant interviews support our hypothesis that our technique would take less time and result in longer entries than in situ techniques.

H2 – ENTRY ACCURACY
One of the primary arguments for making complete entries in situ is that it reduces the window where participants could possibly forget their entry. We believed that the snippets would serve as useful enough cognitive artifacts that participants could reconstruct their original need without losing significant accuracy. At the end of each web entry, participants filled out a Likert Scale in response to the prompt: “All of the data contained in this entry is accurate.” Participants selected either “I strongly agree” or “I agree” on over 87% of the entries they completed.

In the exit interviews, no one strategy for how to use snippets emerged. Several popular tactics did come out, such as participants who use photos to establish context—where was it and who was there—along with a text message to describe the specific need. S28 said that this “combination of photos and text helped my
Another common technique was to create a keyword system to give meaning to short text snippets. S9 described this as, “For the texts, I would usually have keywords that I entered and the needs were separate enough that I could differentiate them based on the keywords. Even though the snippets were small...I would remember what the exact need was.” Decreased entry accuracy with our technique was one of our principal concerns, but participant feedback indicates that remembering the intent of snippets when completing the web entry was a non-issue.

H3 – “TRIVIAL” CONTRIBUTIONS
Because we guaranteed to participants that we would not read the contents of their entries, we were unable to garner statistical evidence for our hypothesis that participants would be more willing to contribute mundane events when using the snippet technique. We did collect qualitative evidence to support this hypothesis in our exit interviews. S3 remarked, “A couple [of entries wouldn’t have been made without snippets.] Smaller things were too trivial to open up a diary for.” A frequent complaint about doing entries in situ was that many active situations made it difficult to complete a full entry. S15 said, “Some of the [in situ] entries I couldn’t do at the time because I couldn’t stop the car, or if I was talking to someone.” S9 echoed s15’s complaint: “Most of the time, I would write the paper entry after it happened because most of my mobile needs happen when I’m active, like when I’m walking or driving.” It is clear from our interviews that our technique, in comparison to writing full entries in situ, lowers the threshold for creating entries in situations where either the need is so small that writing a full entry “isn’t worth it” or if the need occurs while the participant is active.

H4 – MEDIA CHOICE FOR SNIPPETS
Initially, we thought that participants would choose what media to use for each snippet based on the content and context of the entry. Our usage data and interviews instead point to individual preferences as the primary motivating factor when selecting snippet media type. When given the choice of using text, photos, or audio, no participant used all three options. One-third of the participants used exclusively one type of media, with five using only text and two using only audio. As figure 6 depicts, participants usually had a strong preference for one type of media.

In the exit interviews, participants often felt strongly about the media type they preferred. S16 said, “Text was easier and faster. I only had to write one or two words to remind myself.” S23, on the other hand, hated text: “Voice was so much easier. I hate the T9 and I’m slow with the original text.” Although there were proponents of audio and photos, overall media usage was heavily weighted towards text.
Participants were reluctant to use audio often because they felt awkward leaving a strange sounding voicemail in front of other people. S28 described this when he said, “I didn’t send voicemails because I felt goofy doing it.” The lack of picture usage seems primarily due to the difficulty of sending picture messages and the poor photo quality of most camera phones. S15 said, “I didn’t do picture messaging because the camera quality on my phone is atrocious.” But in the future, many participants said they could see themselves using photos when the technology improves. S15 continued to say, “If the quality was better, I would have used it more.”

We initially believed that participants would have greater entry making flexibility because each media type would be appropriate for different situations. Instead, we found that the media options gave participants the flexibility to use whatever media(s) they felt most comfortable with. This had the same effect as our initial hypothesis of creating a more diverse range of entry making situations. Forcing participants to use a media they did not prefer would likely have lowered both total entry output and quality.

It is also interesting to note that when full in situ entries were required in Study 1, only one entry (out of 122) used a media other than written text.

**Future Work**

We are currently preparing to use this method for a larger scale need-finding study in the mobile computing domain. As we will be using a more diverse population for this study, we will gain additional feedback about the applicability of this technique that will likely lead to refinements. Other researchers at our institution have also expressed interest in using our technique, driving further design iteration. To support this, we are also considering extending our tools to support snippet-based experience sampling methods (ESM), as ESM is often an effective technique for evaluating Ubicomp applications [3].

Finally, we would like to make our system easily deployable and usable by a broader base of researchers. We are currently exploring the use of VMWare Virtual Appliances as an easy mechanism for deployment.

**References**


