Experience-Sampling Tools: a Critical Review

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ABSTRACT
In this position paper I argue for the merits of the experience-sampling method for HCI research and a wider scientific community and for the support of the method through publicly available, freely configurable tools. I will take a critical look at some of the relevant tools available. On that basis some recommendations for the design of ESM tools are given and a design space for ESM tools is sketched.

Categories and Subject Descriptors
H.5.1 [**Information Interfaces and Presentation**]: Multimedia Information Systems – *Evaluation/methodology*

General Terms
Design, Human Factors, Measurement

Keywords
Experience-sampling method, ESM tools, evaluation, studies

1. INTRODUCTION
The Experience-Sampling Method (ESM) lends itself well to the study of experiences in the wild – in fact, it was originally designed for that purpose [4].

As the settings of human-computer interaction (HCI) become increasingly mobile and temporally fragmented [11]; and its constituent parts become increasingly distributed across devices and locations [3], new challenges for the study and evaluation of these settings arise.

ESM has been used to study interruptibility in office settings [9], and mobile settings [8]; or to study users' information needs as part of a requirements analysis for a ubiquitous computing application [2]. We studied the change of player engagement over time in a long-term SMS-based experience by means of an ESM-based experiment [5].

Traditional ethnomethodologically-informed ethnographies focus on the *observable, overt action* by using techniques such as the observation of interaction *in situ* [3]. ESM in turn, is concerned with the *experience* that is *covert* to the eye of the observer, as it is *subjectively perceived* [7]. It is also a method that allows for *longitudinal* studies, as the participants are repeatedly prompted to assess their experience over a desired timeframe.

ESM has been applied to study such diverse fields as the quality of experience in everyday life, the experience of work, the examination of cross-cultural differences, and to educational and clinical research questions [7]. With a strong tradition in psychology and diverse application fields, it has just more recently been adopted by HCI researchers to study mobile and ubiquitous applications in the wild.

Hence, the method is being used by researchers from diverse backgrounds, not all of which have sufficient technical skills to implement an ESM-based study. The implementation of studies that use ESM is often costly and would benefit from supporting software. What tools are out there to support ESM studies? What are their benefits, what are their shortcomings? More generally speaking, what are the processes that a researcher conducting an ESM based study is involved in and how could they be supported?

2. REVIEW OF EXISTING ESM TOOLS

2.1 ESP and iESP
The experience-sampling program version 2.0 (*ESP*) has been reported as a early as 1999 [1] and is still available to the public[1], at the time of writing in version 4.0. It is a software package that contains a native application to trigger and run the ESM questionnaires on the PDA Palm Pilot, and a desktop application for Windows or Linux to create the logic for the timing of the prompts and the content and structure of the questionnaires in a browser-based application and to facilitate deploying the studies to the PDAs.

Intel Research continued the development of ESP into iESP [2] but a lack of information suggests that its development is discontinued – and a note on the ESP website says that its latest version includes and improves all features of iESP.

Whereas the feature that the content and the logic of the ESM study are created through familiar browser windows may contribute to the user's ease-of-use, it is the choice of the device eventually carried by the user that is dubious. The Palm Pilot is outdated since 1998. By choice of ESP, the researcher is locked into using an outdated device without connectivity or any communication functionality, not to mention sensors of location or acceleration. In fact, it does not even have a colour screen.

2.2 CAES
Context-aware experience sampling is the term a project at the MIT gave their contribution to research in ESM-based studies, with the twist that the questionnaire triggering may be influenced by contextual clues derived by additional computation of data captured with the device[2]. They also developed a tool [10] for a

[1] http://www.experience-sampling.org

[2] http://web.mit.edu/caesproject

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PDA running Microsoft's PocketPC, Windows Mobile's predecessor.

Unless you are forced to use a device running PocketPC, there is no reason to use this tool. This tool is probably the least developed of the ones reviewed here; in fact, the authors say that the tool is no longer supported and that they have now joined forces with the *MyExperience* initiative.

2.3 MyExperience

MyExperience is open-source software that runs on devices with Windows Mobile 5.0 [6]. In addition to explicit data from questionnaires, it can be configured to collect sensor data collected with the device (e.g. GSM cells, GPS positions) alongside with user activity on the device (address book access, photo capture, phone calls, SMS usage etc.).

The tool does provide the researcher with interesting features to study experiences in the wild. Questionnaires cannot only be triggered by time (random or scheduled), but also by additional sensor data gathered from the environment (e.g. GSM cells), the devices position (acceleration) or the phone activity. So to speak, it combines automatic logging software such as ContextPhone [12] with the possibility to trigger questionnaires. However, the creation of the studies requires the researcher to be technically savvy, as it is done by editing XML files.

2.4 Conclusions

Let us consider and evaluate the tools presented from the perspective of the users, both the researcher that designs the study and the participants of the study. For reasons outlined above, we will only consider the ESP and MyExperience tool.

In all cases, the researcher has to familiarize himself with the tool-specific ways of creating a study. In *ESP*, she can use a browser-based series of forms to configure the logic and content of the questionnaires and to facilitate deployment to the devices, e.g. by defining the number of devices. In MyExperience the researcher has to edit XML files to configure the logic and the content of the questionnaires and duplicate them as many times as devices she wishes to deploy the questionnaire to. Additional configuration is necessary to employ other than the time trigger for the questionnaires.

The fact that both tools are native applications entails costs for the researcher. To recruit participants for the study, the researcher has two options: Recruit only people that own the required device or obtain the devices and provide the participants with them. With usually sparse resources in research, how large a sample can you reach with that approach?

Even though MyExperience includes a facility to post data to a server, this functionality does not come out 'of the box'; at least, a server would need to be set up for this. The (default) design decision to store the gathered questionnaire responses on the device instead of making standard use of connectivity over the air gives rise to another problem for the researcher: Not only has she to collect the data from the single device and aggregate it for analysis, she also has no means to monitor the distributed experiment's progress while the experiment is running. Do the participants continue to engage in the experiment? Do some people need motivation or assistance? It will be a black box for the researcher.

3. RECOMMENDATIONS FOR THE DESIGN OF ESM TOOLS

3.1 Think client-server

Why make the deployment of a native application a requirement for the study? Today's mobile devices have data connectivity that should be used. Instead of putting everything on the device, give the researcher his own server and a gateway so that she has to configure everything just once. The devices can access resources on the server and transmit data to it for further computational processing or for later statistical analysis.

3.2 Design for authoring

A tool that supports ESM studies should be designed for easy-to-use creation of the studies. An authoring interface should be designed so that the widest possible range of users is able to use it effectively and efficiently. A browser-based interface to a series of forms could let a researcher configure the timing of the prompts and the content and structure of the study.

3.3 Make use of people's own devices

People have mobile devices. Let them use their own devices for the study; it is less expensive and chances are higher they will actually carry the device on them when you prompt them to answer your questionnaire. You can recruit more people and don't even have to meet them physically to enroll them in the study.

3.4 Design for different levels of study complexity

Include different configuration options for your experience-sampling study. Chances are that your participants will either be able to receive SMS or email. Use that channel to prompt the participant to answer your question. Your questionnaire is easily accessed via the device's browser, your server will figure out if it should show the questionnaire as WML or as (X)HTML. Provide native applications as an additional option if the researcher wishes to collect phone usage or sensor data, or if sophisticated triggering is required.

3.5 Separate logging and questionnaires

Where phone usage data or data from sensors in or connected to the device is desired, create client software to be deployed on the phone. Sophisticated triggering could be deployed directly to the client as well, supporting scheduling either by asynchronously downloading trigger schedules from the server, or by waking up the trigger application remotely, based on logic derived by the server. Still, the questionnaires can be accessed online from the device's browser.

3.6 Make wise client choices

Designing and implementing client-side applications is costly. Be aware of the consequences your design choices may have. If your aim is to develop for interoperability and develop, e.g. a J2ME or Python application, be aware that it may not be easy to access all the phone and sensor data you require. If your aim is to develop for a native experience and develop a native application, e.g. for the iPhone, be aware that your application cannot currently run in the background and thus be 'woken up' to trigger a question, or that the deployment of the software may incur extra costs or is subject to a political selection process.

3.7 Support orchestration

A server-based solution would also allow a researcher to orchestrate the study, i.e. monitor the progress of the study, motivate participants to engage more, help out with technical problems, alter the content or structure of the questionnaire, or even expel participants.

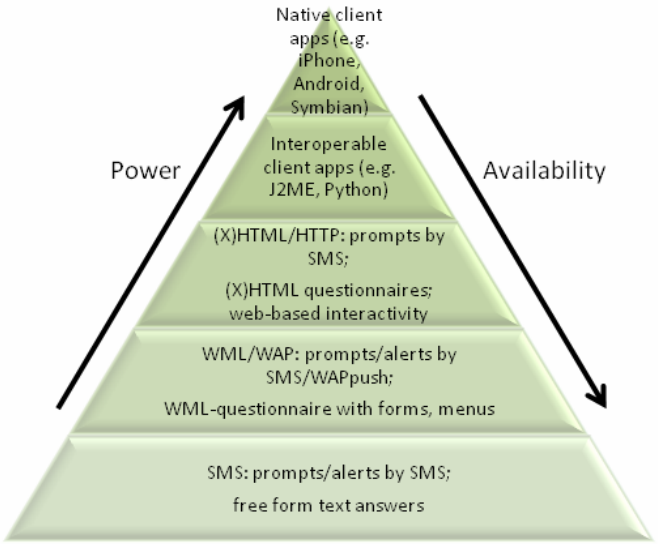

Figure 1: The design space for a proposed experience-sampling tool. With increasing power of functionality, the availability of the required technologies decreases.

4. DESIGN SPACE FOR A FLEXIBLE ESM TOOL

Following from the recommendations in the previous section, a successful ESM tool would be flexibly configurable by a researcher so that it would operate successfully in the design space depicted in figure 1. In a nutshell, the 3 lower levels would not require client-side software, while the two upper levels enable the researcher to gather data from the device such as phone usage and sensor data. While the power of the experience-sampling study increases in terms of complexity and richness of data gathered towards the pyramids narrow end; the availability of required technologies in the real world is broader at the pyramids broad base.

On its lowest level, a flexible ESM tool would support a study solely relying on communication by SMS. SMS from the server configured by the researcher would serve as prompts and as questions, SMS send back by the participants would be the answers. Of course, this is error prone, as it would require the users to type.

The next level would allow the researcher to ask questions in a more user-friendly and constrained way as simple WIMP elements such as lists, buttons and hyperlinks become available in the device's WML browser. Prompts to answer questionnaires should still be send by SMS, even though some devices support WAPpush messages.

On the third level, full web capabilities become available to the researcher constrained only by the devices browser implementation (e.g. currently Flash is not supported by many mobile browsers), enabling data transfer over HTTP. The embedding of pictures, or even audio and video becomes possible. Prompts however, are still most reliably sent by SMS.

If and only if the researcher requires data than can only be accessed natively on the mobile device should additional software be installed on the participant's mobile device. Client software can use the devices HTTP connection autonomously to communicate with the server and be instructed to 'wake up' in order to trigger a question for the participant; and it can access the data on the device and transmit it to the server for further computational processing or for later statistical analysis. Whereas clients developed to run with the support of middleware on several platforms may not easily access all of the required resources on the device, the development of native applications is more costly and entails platform specific risks and problems, as outlined above.

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