

EXPERIENCE SAMPLING:

A workbook about the method and
the tools that support it

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Index

Preface	3
What is Experience Sampling?	4
Scenario of use	4
Methodology for ESM	5
Review of Experience Sampling Tools	7
MyExperience	7
ESP	8
Entyware	8
PMAT	8
PsycLab Mobile	9
CAES	9
D’PUIIS (Dynamic Product Usage Information System)	9
Reconexp	10
Related studies for eliciting requirements for future ES tool	13
Providing feedback during ES study to participants	13
Defining inconvenient times during an ES study	13
UbiComp framework for prototyping and evaluation	14
Momento	14
Why is there a need for a new ES tool?	15
A Reading Guide	16
References	17

Preface

This is the first version of a workbook on Experience Sampling, a method that is gaining popularity in the technology studies, as people are getting interested in how technologies are experienced as part of the daily life of people. This method is already popular in other fields, such as medicine, as a result of the growing interest in an evidence based approach.

The workbook is intended as a simple, down to earth introduction of what the method is and how to execute it. It focuses on the computational tools that are available to support researchers carry out Experience Sampling studies.

Our contention is that current tools do not sufficiently support the researcher who wishes to execute this method. Our review of current tools is the first step in a process that will try to address the need of the researcher and provide tools that enable us to reap the full benefits of the method.

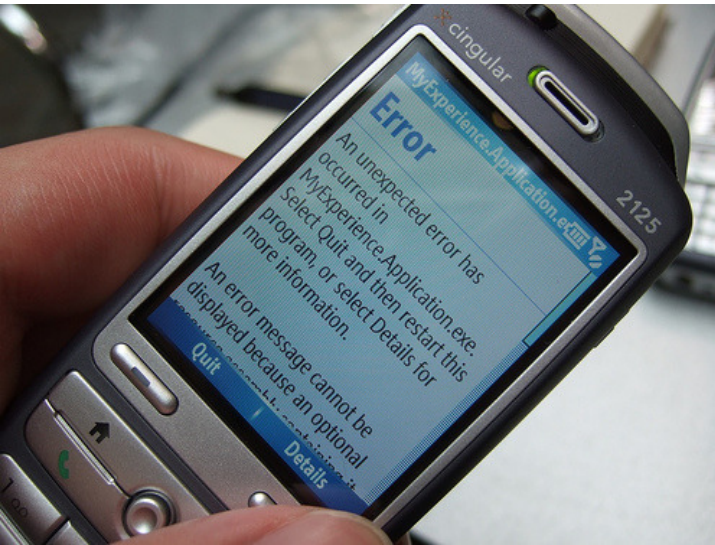
The workbook will be revised in the course of the project (ie., in the next 14 months). There are developments taking place worldwide relating both to methodological research like ours and to the increasing availability and capabilities of mobile technologies that are used to support the method.

We hope this is an interesting introduction to researchers interested in the topic, and that it will invite potential users of such technology to participate in the last phase of the Ambient Awareness project, funded by Senter IOP-MMI, that aims to develop further our own tool called RECONEXP.

Vassilis Javed Khan
Panos Markopoulos

Eindhoven, June 29, 2009

What is Experience Sampling?



The Experience Sampling Method (ESM) is a survey method, i.e. a way to collect self-reported data from participants that is executed over sustained periods of time, e.g. days, weeks or even months (Hektner et al., 2007).

It can be thought of as a questionnaire that is filled in repeatedly by a participant during the study period. In this sense it is similar to what many know as the diary method or journaling, with the difference that informants are prompted to provide information through some technological

means rather than at the time they choose to.

In the early applications of the method this was done through a pager device. Currently it can be done through a handheld device (PDA or smartphone). The choice of when to prompt an informant is one of the variable for how this method is executed. This prompt can be delivered at a moment chosen by the investigator, at random times or following some logic that is programmed into the device that delivers the prompt (e.g., at random times).

In the most usual form, the researcher will program the logic for delivering the prompts as well as the questions than need to be answered by the informant into a handheld device. The informant must carry this device for the period of the study, and is expected to answer as many as possible of the questions delivered to him/her.

Questions may concern behavior or even self-report of feelings of the informant. Multiple answers per subjects allow the investigator to study a phenomenon in naturalistic settings and as it evolves over time.

Scenario of use



Kees has just arrived at the train station. His train has 15' delay. He hears a "beep" sound from his device. It is a question posed by the latest study of SNS insurance agency. SNS is interested in the probability of people carrying their laptop when at a train station. The question which pops-up on the device of Kees is: "Do you carry your laptop with you?"



Methodology for ESM

When to use it

ESM is particularly useful for studies that last long, that happen in the field and where the data we wish to collect is not easy to observe directly, e.g., about feelings and thoughts, or about activities of the informant.

Roles

We distinguish (a) the investigator who sets up the sampling protocol and the questions and (b) the informants, who have to answer these.

*Related Methods*₅

The ESM method is very similar to diaries and probes in that data collection takes place in the field and over sustained periods. It differs from them regarding the sampling protocol: the technology has the initiative rather than the user. The "Day Reconstruction Method" (DRM) has also been proposed as an alternative to the ESM (Kahneman et al., 2004). In DRM respondents first revive memories of the previous day by constructing a diary consisting of a sequence of episodes. Then they describe each episode by answering questions about the situation and about the feelings that they experienced, as in experience sampling.

Tips

- Alternate the questions you ask; participants might feel bored and loose motivation if they receive repetitively the same question-s
- Personalize the questions prompted on the handheld device; personalization of the questions will make the study more meaningful and will motivate even more participants
- Provide feedback to participants; it has been shown (Hseih et al., 2008) that the motivation of participants increase if they are given feedback on their performance (i.e. how many questions have they answered)
- Use the collected information for the debriefing interview; the information collected during the experience sampling period is very valuable in driving the discussion on the debriefing interview
- Review input of participants during the experience sampling period; this will help in both preparing for the debriefing interview as well as in contacting participants if for example have misunderstood a question or forgot to answer queries

Pitfalls

- Participants may refrain from answering at exactly the moments you need to study: e.g., if you want to study busy moments
- Participants will get bored and stop answering questions after a while or worse, give a short and convenient evasive answer
- Participants might forget to carry the querying device
- Participants might loose the querying device

Review of Experience Sampling Tools

In the last years numerous software applications have appeared that can be used to support experience sampling. We call these Experience Sampling Tools and we shall review some of the most prominent ones below. Typically they run on mobile device platforms like Windows Mobile, Symbian or Palm OS.

MyExperience

Description



MyExperience (Froehlich et al., 2007) has passive logging of device usage, user context, and environmental sensor readings and active context-triggered user experience sampling to collect in situ, subjective user feedback. Queries can be targeted to moments of interest by triggering off sensor readings. Researchers by using XML can define survey

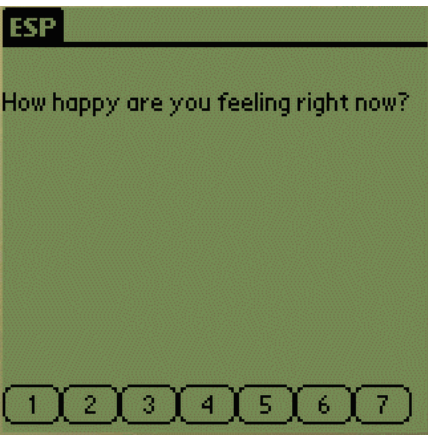
questions and configure sensors, triggers, and actions. Embedded scripts are used to provide flexibility and expressiveness in specifying the conditions to trigger surveys. MyExperience supports sophisticated survey logic including multiple branching, parameterized questions, and persistent states. It supports audio, photo and video capture. Although it opportunistically synchronizes collected data it does not provide a web interface for participants to review their answers and fill out the missing queries of the ES part. Even though it is designed to run on participant phones and although there is extensive work been done to simplify the installation process still there are issues with installing it in a Windows Mobile. Moreover, it still requires a long installation process. Furthermore in the case a researcher wants to have real time retrieval of data it requires to have and manage MS SQL database server with replication features. Another shortcoming is that it requires removal of security lock from the phone which might allow programs such as dialers to run without the users consent. MyExperience is open source software.

Link

<http://myexperience.sourceforge.net>

ESP

Description



ESP, an open-source tool developed at Boston College (Barrett and Barrett, 2005). The latest version (ESP 4.0) includes a suite of software packages, a Palm OS based application that interacts with participants and a PC application for designing experiments, configuring ESP settings, and collecting data which runs on Windows and Linux. ESP can ask questions in a fixed order, or in random order. Questions can appear at fixed times, random times, or on demand. When the experience sampling study is completed, the researcher can download the collected data to a PC and analyze it with statistical applications such as SPSS.

Link

<http://www.experience-sampling.org>

Entyware

Description



Entyware is used to conduct sophisticated questionnaires for a wide range of survey applications, including face-to-face interviews, diary studies and photo diaries (Techneos, 2009). The software provides

analysis-ready data in SPSS, Excel or ASCII formats and it runs in both Windows Mobile and Palm OS devices. It provides immediate access to response data that is collected from mobile users. Finally, Techneos, the company which has developed Entyware rents even devices in North America to provide its customers with a packaged solution. Entyware provides Windows-based survey authoring tools for survey design, most of which can be done via a point-and-click interface. When something more complex is needed, a sophisticated scripting language is provided to program routing/branching logic, numeric calculations, and manipulation of open-ended text answers, as well as to validate that answers are correct and/or within a suitable range.

Link

<http://www.techneos.com/>

PMAT

Description

Purdue Momentary Assessment Tool (PMAT), which was developed Military Family Research Institute at Purdue University (Weiss et al., 2004) and supports both time based and event based studies and it also provides a desktop application to configure parameters of the ES study. A time-based study prompts the participant to answer survey questions at scheduled or random times during the day or night. An event-based study asks participants to complete a survey only if a specific event has occurred. However, in PMAT the event-trigger is left to participants.

Link

<http://www.cfs.purdue.edu/mfri/pages/PMAT/>

PsycLab Mobile

Description

PsycLab Mobile, a tool which supports audio recording on a pre-defined schedule (Mehl et al., 2001). It is specialized for language researchers to make a sequence of audio recordings that sample a research subject's natural spoken language. PsycLab Mobile software is designed for the PocketPC PDA platform and Windows Mobile 2003 SE operating system.

Link

<http://www.psyclab.com/>

CAES

Description

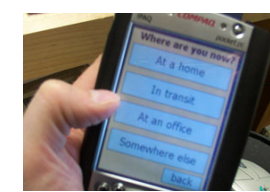
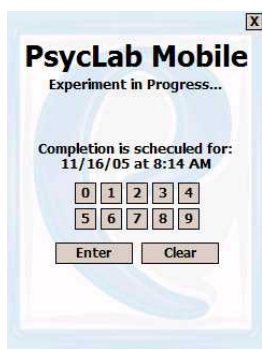
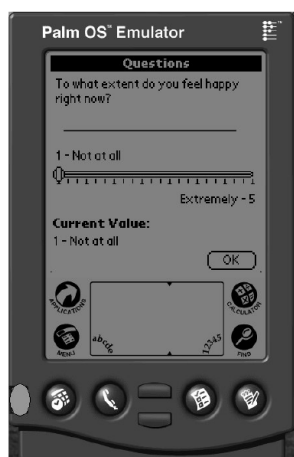
CAES (Intille et al., 2003), a pioneer in combining sensor input to trigger queries based on events recorded by sensors. CAES was innovative in event based triggering of queries rather than time based. Moreover it was innovative in tying up data collected by sensors distributed in the environment. However, the project is discontinued and has joined forces with MyExperience, described earlier in this publication.

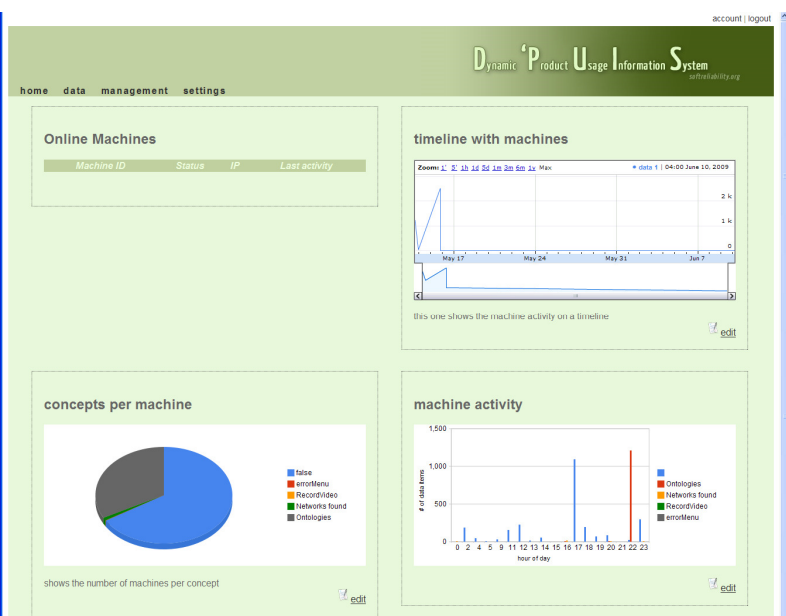
Link

<http://web.mit.edu/caesproject/>

D'PUIS (Dynamic Product Usage Information System)

Description





The D'PUIS (Dynamic Product Usage Information System) framework enables direct collection of usage data from remote products in a flexible and reconfigurable way (Funk et al., 2009). It is built to scale up to many product instances under observation and features an easy-to-use graphical editor to specify observation, what data is collected on the products and how this data is processed and finally presented to the information stakeholder. The framework supports explorative evaluation of user interfaces and whole products in the habitual environment of users who might be located all over the

world. Although it can support prompting queries to participants it is designed and developed to remotely log usage of products. It is developed in Eindhoven University of Technology.

Link

<http://www.softreliability.org>

Reconexp

Description

Compared to a conventional experience sampling executed with a mobile device Reconexp (**Re**constructing **Ex**perience) has two major differences (Khan et al., 2008). The first lies in a step before executing the ESM; that of personalizing it. The second lies in parallel with the experience sampling; that of reconstructing the sampling during the day.

Personalization step

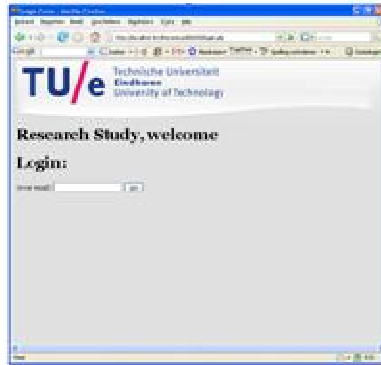
The motivation for having the personalization step is to minimize the time and effort needed for participants to respond to the mobile device when prompted to do so. When participants know that responding to the device practically means for them a few clicks and therefore a few seconds, it is safe to assume that the probability of responding each time they are prompted will increase. This personalization step has further advantages. From a research point of view it enables the researcher to compare the answers given for the personalization step with the experience sampling itself. This comparison is actually a very interesting one since it compares the participants' ¹⁰ expectations with what actually



INSERT INFO TO PERSONALIZE THE ES



EXECUTE ES FOR N DAYS



FOR EACH ES DAY REVIEW ANSWER AND FILL OUT THE MISSING POINTS

happens in their life. Such expectations are a baseline life pattern which participants' record. Thus, not only such a step will decrease the response time during the experience sampling and therefore increase participation but it will also provide a basis for making a useful comparison from a research point of view. The personalization step depends on the research goals. In our particular study the personalization step had four parts.

Reconstruction step

The motivation for having the reconstruction step is again twofold. The first motive is to retrieve data which are lost. It is a well known fact that when conducting an experience sampling study it is bound that sometimes participants will be prompted to respond at inconvenient moments for them. Such moments might be when being in a meeting or when driving or while doing the dishes. For those moments the experience sampling method fails. It is those moments however that might be particularly interesting from a research point of view. The reconstruction step which is conducted on the website aims to compensate for that data loss. Participants are asked to login and review the log of the sampling each evening. With such a step it will be easy for them to recover the queries they could not respond to during the day. The second motive is to provide a way for participants to annotate the samples taken during the day. As previously mentioned we want to design the sampling step as easy as possible for participants. Having to spend few seconds to respond to the query is part of that goal. However, then one is faced with the drawback of not being able to capture a lot of information during that query. That is why we

thought of providing participants a log of the sampling day. While reviewing this log participants can fill out missing queries. The queries they were able to respond to will act as a memory scaffold in helping them with remembering the context of queries they were unable to respond to. In addition they are given functionality with which they can annotate the₁₁ answers given.

Another advantage of synchronizing the log during the research study is that it enables researchers to follow the progress of the study. Thus, researchers are enabled to adapt the study while it is unfolding. Researchers can for example provide additional incentives or further instructions if they notice that a particular participant is not responding to the daily queries. It also enables researchers to promptly prepare questions for a debriefing interview anchored to specific events observed during the sampling period. This in return will provide in depth results and a more fruitful investigation.

Link

<http://www.awareness.id.tue.nl/Reconexp/>

Related studies for eliciting requirements for future ES tool

Providing feedback during ES study to participants

Showing participants their own collected information was offered to increase compliance rate. In a 25-day field study, Hsieh et al. (2008) found that users who saw visualizations of their own data were more likely to respond to sampling requests compared to users who did not see visualizations. The compliance rate of those receiving feedback was 23% higher than the rate of those who did not receive feedback. This result suggests that showing participants visualizations of their own answers has a positive effect to the study itself. The researchers do not report the use of any tool for conducting the ES therefore we assume that it was a custom made application.

Defining inconvenient times during an ES study

In their quest to measure and evaluate emotional responses to user interactions with mobile device applications Isomursu et al. (2007) deployed an ES study in which participants answered questions by selecting an appropriate emoticon on the mobile phone's screen. It was a custom made ES tool which allowed both system- and user-initiated experience recording. It supported event based triggering of queries. Participants could not insert text or any multimedia input. Further, the tool logged user interactions on the mobile device. The tool was running at the participants' phones. Additional comments could not be provided to clarify the answers. One important finding of their evaluation regarding the method was that participants would accidentally press a button and give an unwanted response in situations like driving, or when having the phone in their coat, or in cases that they would receive a phone call. Such a finding suggests that ES tools must support defining inconvenient moments for participants. Having such an option would be beneficial to researchers because they would not collect data which were accidentally inserted and they would not disturb participants with queries during inconvenient moments.

Isomursu et al. (2007) have also created the Experience Clip method. In this method, pairs of participants are recruited. Both of them are provided with mobile phones. One carries the application which is under evaluation and the other is instructed to take short video clips of the usage of the first participant. The participant taking the video clips was a friend of the other participant. Time stamps of the videos were used to match interaction events with the expressions of emotions captured by videos. As a conclusion the researchers state that having the users to decide which usage situations to record did not seem to spur versatile and innovative usage. This approach had the disadvantage that it was not clear which

captured situations represent real usage situations and which not. They suggest that a combination of the Experience Clips with other non-intrusive methods would perhaps yield better results. This method brings a different perspective into the computerized version of ESM. It advocates the involvement of people in the surrounding of the subject whose experience is sampled.

Ubicomp framework for prototyping and evaluation

The framework of de Sá et al. (2008) supports both prototyping and evaluation. It provides a log of events taking place on the mobile device and a researcher has also the ability to execute an ESM. It runs in Windows Mobile, Palm OS and Symbian OS devices. The logging engine stores a variety of events. Events range from each tap on the screen, each button press or even each character that was typed by the user. It supports audio and video capture. To analyze the collected data, a log player is provided. The log player resembles a "movie player" which re-enacts every action that took place while the user was interacting with the prototype. ESM can be event-triggered. The framework is public available.

Momento

A similar tool, supporting both mobile prototype creation and remote evaluation of those prototypes is Momento (Carter et al., 2007). It was created to support remote testing of ubicomp applications. Momento can also gather log data, experience sampling, diary, and other qualitative data. One of the requirements the researchers found while conducting interviews with ubicomp developers to elicit requirements for their system is the need for integrated tools for participants' annotating and reviewing qualitative data. Momento can run on participants' existing networked mobile devices. Researchers can use a desktop application to configure experimental details, to monitor incoming information from participants, send information to participants and review data or exporting it for analysis. Momento uses SMS and MMS and HTTP (if available) to share information between participants and researchers. It supports audio, photo and video capture and situated annotation of captured media. The mobile client is configured using a text file. Momento can also support the review and annotation of data by the participants after they have been collected. However it does not support the recovery of data lost during ES and the developers have not researched the potential benefits of such a feature. A disadvantage is that it needs desktop installation for both client and server and therefore support for troubleshooting and version track management. Momento is open-source software.

Why is there a need for a new ES tool?

The answer lies partly in the existing shortcomings of current tools and partly in current developments on the method itself.

Existing tools require considerable technical know how from researchers. This we believe is an important hindrance for researchers deploying ES studies. Another shortcoming is infrastructure; researchers need to have a number of relatively expensive mobile devices as well as ensure their connectivity to internet. If for a minute one forgets the shortcomings of existing tools, there is a plethora of reasons to develop at this point in time a new ES tool. First because today the adoption of powerful new devices is pervasive among a large amount of the population and second because there are lots of new features which could be implemented to make ES studies more effective and efficient to researchers.

From a methodological perspective there a number of developments lately that pose significant requirements for experience sampling tools. For example we previously mentioned that giving participants feedback of their involvement during the study improves their motivation. This finding means that experience sampling tools need to include such a feature.

Moreover, by making software open source does not necessarily mean that this software will be easier for people to use. The argument that the software is open source does bring some advantages but is far from actually helping researchers conduct an ES study.

Furthermore, the conditions for widely executing the method are ripe. According to research house Ovum, 172 million smartphone devices are expected to be sold in 2009. Moreover, internet in the mobile devices has become truly affordable. These two factors do definitely help in making the execution of experience sampling studies even more affordable.

For these reasons we strongly believe that there is plenty of room in developing a researcher-friendlier tool which would incorporate the latest methodological findings.

A Reading Guide

Hektner et al. (2007) provides a thorough description of the ESM methodology. This book focuses on motivating the method, describing the methodological choices in setting up an ESM Study and discusses issues relating to the analysis of the method.

Carter et al. (2007) and de Sá et al. (2008) have combined ESM tools along with ubicomp prototyping tools. It is a development that tries to integrate prototype creation and at the same time evaluation tools for prototypes.

Barrett and Barrett (2001) discuss the use of computational devices for supporting ESM. It was written in 2001, when the method was still less developed and handheld computational tools were sparser and less developed. Most importantly, software development and internet connectivity with such devices were more difficult than today.

Intille et al. (2003) paper was ground breaking in combining event-triggering of queries in experience sampling studies as well as combining sensor input for such studies.

Consolvo and Walker (2003) is a great source for the use of the experience sampling method in evaluating ubiquitous computing applications and systems.

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