Chapter 9
Experimental Setups for User Evaluation of Mobile Devices and Ubiquitous Systems

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ABSTRACT

Nowadays, mobile devices features are often linked up to the context of usage. As a consequence, researchers must consider not only the user and the device, but also the surrounding environment when designing effective user study evaluations. Two opposite experimental setups are possible: in-situ and in the laboratory. There is no consensus on their respective benefits, for instance with regard to the number of usability issues detected. In this chapter, the author isolates independent variables that could contribute to evaluation biases by proposing a taxonomy that splits the in-situ and laboratory experimental setups into two new setups. The author describes the concept of the “Uncertainty Principle” to emphasize the dilemma between precise observation and bias minimization and introduce the “Trojan Horse” technique to partially overcome the consequences of the uncertainty principle. As a conclusion, a methodology using the four experimental setups in a complementary way is proposed.

INTRODUCTION

In the last decade, mobile devices have reached the threshold of technical maturity to be widely used in both professional and leisure contexts. For instance, GPS-based automotive navigation systems or network capable smartphones are nowadays considered common objects. Moreover, as mobile devices continue to evolve, researchers have transitioned evaluating ubiquitous environments and pervasive systems from laboratory prototypes to real-world implementations.
The features of these categories of systems make the mobility of the user possible, either together with the system (for mobile devices), or inside it (for ubiquitous systems). Moreover, to work properly, these systems must be aware of their surrounding environment. For instance, an automotive GPS moves with the car (and so with its driver) and is aware of traffic jams. An augmented museum detects the presence of visitors as they move through the halls.

These two characteristics—mobility and context-awareness—of mobile devices and ubiquitous systems raise new methodological issues for system evaluation during user studies. It is thus not only an “interactive system” we must evaluate, but more generally an “interactive environment.” In other words, the evaluation cannot only focus on the device, but must also take into account the context of use, and its variations while the user is moving.

Traditional user evaluation methods. If we had to define a canonical description of user evaluation, we would say that, traditionally, user evaluation takes place in a usability laboratory, that is to say a closed room where the environment can be easily controlled. The user is requested to perform the tasks that have been chosen by the evaluators. The evaluation methods are based on the observation of users either directly, or through one-way mirrors, or via audio/video recording systems. Frequently, the user is encouraged to think aloud in order to facilitate the interpretation of his/her activity. A facilitator may be present throughout the experimentation or only at the beginning and the end. His/her role is to give instructions to the user, to answer any questions the user may have, and to observe. To sum up, the two key elements of user evaluation are observation and control of the experiment variables.

Unfortunately, traditional user evaluations methods cannot easily deal with the two characteristics—mobility and context-awareness—of mobile devices and ubiquitous systems. For instance, the user evaluation of a smartphone for skiers requires users to move—to ski down the mountain—with the device in a complex context—a ski resort—that could not be mimic in a traditional usability laboratory.

Motivations: user evaluation of interactive environments. As we have said previously, mobile devices characteristics—mobility and context-awareness—raise new methodological issues. The main issue is to set up a realistic interactive environment while keeping enough control to analyze the interactions between the users and the interactive system.

So, the question is: what is the degree of realism necessary to ensure the validity of user evaluations? In practice, we have to determine how to place the user in interrelationship with these elements, either by simulating them in a usability laboratory, or by using the elements of the real-world in-situ. Apriori, in-situ experiments should always be best. But this type of experiment is known to be complex to set up (Kjeldskov, Skov, Als, & Høegh, 2004). Our aim is to determine if the higher cost of in-situ experiments is justified by better results. In other words, we wonder if in-situ experiments are worth the hassle.

The article is structured as follows. First, we detail related work. After reviewing the state-of-the-art, our thesis is presented and our research roadmap is explained. Then, the three experiments of our roadmap are detailed. Finally, the article presents a generalization of our results and proposes a methodology for user evaluation of interactive environments.

METHODS: LABORATORY OR IN-SITU?

First, it is necessary to determine what are the relevant elements of the interactive environment that must be set up for the experiment. We propose to structure this set of elements into four categories: the user (or users if a collaborative environment is under evaluation); the devices in
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