Chapter XLVIII
Cognitive Models as Usability Testing Tools

Vanja Klajevic
NewHeights Software, Canada
Carleton University, Canada

ABSTRACT

This chapter discusses the idea that using computational cognitive models in usability testing has many benefits over the traditional approaches. It argues that computational cognitive models, anchored in the concept of cognitive architecture, offer an integrated approach to interactive behaviour emerging from the use of mobile phones. A cognitive architecture is a theoretical framework containing a set of relatively independent core constraints that are constant across time and tasks. It constrains models built within the cognitive theories based on the architectures, preventing proliferation of implausible theories. This proliferation, on the other hand, is typical of the traditional approaches to usability testing. In this chapter the benefits of using the model-based approach based on a cognitive architecture in usability testing will be discussed, with a special emphasis on mobile phone interfaces.

INTRODUCTION

Over the last 10 years, mobile phones have evolved from simple devices intended for making calls to devices with a rich set of features and many voice and data services. These include: downloadable ring tones, games, short message service (SMS), picture messaging, Internet browsing, e-mail access, and conference calling, and incorporate MP3 player, digital camera, video telephony, television, and information on traffic, mapping, and directions, as well as services for connecting physical and virtual urban life. New features and services that facilitate many activities of everyday life are being added to mobile phones so fast that nothing strikes us as a surprise any more. We can only expect a further increase in functionality of mobile phones, wondering, for example, why turning mobile phones into motion-detection game controllers has not happened earlier.

However, the increased functionality has brought about the complexity problem, opening
the question of what the optimal interface of such a complex interactive system would be. Namely, the problem here is to make a single device’s interface satisfy users’ needs for features and services that were previously provided by several devices. A new device requires a new conception of interface, with an easy access to features and seamless transition among the applications/services. The increased complexity requires more flexibility than the desktop computer-like interfaces of the current mobile phones allow. It is not only that the complexity problem requires a new and more integrated approach to user interface (UI) design of such devices, but it also further complicates the nature of usability testing of these devices, while usability testing is expected to support the UI design processes. It is impossible to empirically assess all the possibilities of a mobile phone UI design by means of traditional usability testing. This chapter claims that computational cognitive models are potential tools for such an assessment. Thus, it is claimed that modeling based on cognitive architectures may be a better alternative to theoretically unsupported, time-consuming, and often expensive traditional usability testing.

The main claims of this chapter are:

a. Usability testing requires solid theoretical underpinnings, the lack of which results in inconsistent and unreliable testing methods.

b. Quantitative usability testing is preferred to qualitative evaluations.

c. Computational cognitive models have the potential to become indispensable usability testing tools.

In order to support these claims, background information is first presented, introducing the fragmentation problem and showing how it is currently reflected in both theory and methodology of usability testing. After introducing the necessary conceptual and terminological clarifications pertaining to the word ‘usability,’ some of the problems arising from the recently proposed ISO quality models are discussed. The problems indicate that usability testing models need a solid theory, supporting the claim (a). Additional support for this claim comes from the argument on the recently identified evaluator effect found in three most widely exploited usability evaluation methods (UEMs): cognitive walk-through, heuristic evaluation, and thinking-aloud. This section also provides support for the claim (b). The main section of the chapter supports claim (c) and is devoted to usability testing from the computational cognitive modeling perspective and examples of such models pertaining to mobile phones. The rest of the chapter outlines the topics for future research, followed by a brief conclusion.

BACKGROUND

Because of the striking lack of consensus on the definition of usability, it is necessary to make the following distinctions:

1. The general ergonomic definition of usability vs. usability of interactive software applications

2. Usability of a software product vs. its quality in use

From a general ergonomic point of view, usability of a product is its fitness for purpose. The definition actually refers to the product’s functionality, although it also implies that a product is usable if it can easily facilitate user’s completion of a task at hand. When applied to a user interface, which most users usually identify with the whole product (Mayhew, 1999), the general definition of usability fails, because it is too vague. The main question that an attempt to apply the general ergonomic definition of usability to a user interface is: How do we determine a product’s usability, given that what all the users notice is the interface, while, on the other side, behaviour and appearance of the elements of the interface depend on the system’s underlying structure and code (Zetie, 1995; Schneiderman & Plaisant, 2005)? In addressing this question, the International Organization for Standards (ISO) has published several standards and standard type documents on software usability, placing the
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