Mobile HCI:  
Issues Surrounding Cognition, Distraction, Usability and Performance  

Robin Deegan, Cork Institute of Technology, Cork, Ireland

ABSTRACT

Humans are approaching a new and intriguing time with regards to Mobile Human Computer Interaction. For years we have observed the processing power, memory capabilities and battery life of the mobile device increase exponentially. While at the same time mobile devices were converging with additional technologies such as increased connectivity, external peripherals, GPS and location based services etc. But what are the cognitive costs associated with these advancements? The software used on mobile devices is also becoming more sophisticated, demanding more from our limited mental resources. Furthermore, this complex software is being used in distracting environments such as in cars, busses, trains and noisy communal areas. These environments, themselves, have steadily become increasingly more complex and cognitively demanding. Increasingly complex software, installed on increasingly complex mobile devices, being used in increasing complex environments is presenting Mobile HCI with serious challenges. This paper presents a brief overview of five experiments before presenting a final experiment in detail. These experiments attempt to understand the relationship between cognition, distraction, usability and performance. The research determines that some distractions affect usability and not performance while others affect performance but not usability. This paper concludes with a reinforced argument for the development of a cognitive load aware system.

Keywords: Cognitive Load Theory, Cognitive Science, Mobile Human Computer Interaction (HCI), Mobile Usability, User Experience

INTRODUCTION

Mobile devices are challenging HCI in many new and unexpected ways. Many of these challenges can be seen to stem from two main aspects:

Firstly, mobile devices are becoming powerful and this is allowing increasingly complex software to be used on them. Secondly, mobile devices are being used in far more complex environments.

Examples of these phenomena can be seen, for example, in mobile learning software, where one of the main issues facing the usability of these types of applications was suggested to be cognitive load (Deegan and Rothwell, 2010a). Cognitive Load Theory explains how the human mind interacts with instructional materials for learning and has several guidelines that are used to assist in the design of instructional material used for learning (Sweller et al., 2011). This paper will explain related previous work and present the results of an experiment, the final experiment of the series, which investigates the relationship between Cognitive Load Theory and Mobile HCI. This experiment suggests...
that there are two different types of distraction which uniquely affect performance and usability separately.

**LITERATURE REVIEW**

Usability is defined by the ISO as “the effectiveness, efficiency and satisfaction with which specified users can achieve specified goals in particular environments.” (ISO 9241-11, 1998). A usable system should be easy to use (utility) and easy to learn (learnability) (Nielsen, 1994).

In recent years the notion of ‘ease of use’ has been applied to Usability where the general philosophy is based on making things ‘easy’ for the user. This approach stemmed from work done by Miller (1956) which determined that human cognitive resources were limited. Miller’s work led, in part, to the development of Cognitive Load Theory.

Cognitive Load is the demand for mental resources associated with processing information in working memory. HCI attempts to reduce the inputs that humans had to process; making things easier (less Cognitive Load) meant making things more effective, efficient and satisfying to use. Research (Sweller et al., 2011, Sweller et al., 1998, Sweller and Chandler, 1994, Sweller, 1998, Paas and Van Merrienboer, 1994) suggests that our Cognitive Load can and will vary depending on the characteristics of the task and those of the user.

Cognitive Load Theory was developed primarily as a theory for learning, specifically to help understand problem solving (Sweller et al., 1998, Sweller, 1998, Bannert, 2002).

Previous research (Deegan and Rothwell, 2010b) suggested that there were many unconsidered extraneous distractions that a mobile user would face and presented a model of these distractions. They suggested that distractions can occur from 1) the content itself 2) the application 3) the system software 4) the device hardware and 5) the greater environment (Figure 1).

*Figure 1. Sources of cognitive load*
George Nezlek and Gerald DeHondt (2013). *Integrations of Technology Utilization and Social Dynamics in Organizations* (pp. 31-47).
www.igi-global.com/chapter/gender-wage-differentials-information-systems/68134?camid=4v1a

A Research Framework for Investigating the Benefits of Technology in Treatment and Management of ADHD in Tertiary Students
www.igi-global.com/article/a-research-framework-for-investigating-the-benefits-of-technology-in-treatment-and-management-of-adhd-in-tertiary-students/152286?camid=4v1a