Difficulties in Skill Acquisition and Pervasive Environments

Adam Boulanger
MIT Media Lab
20 Ames St, Cambridge, MA 02139
adamb@media.mit.edu

ABSTRACT
Pervasive computing implies new application opportunity as a result of technology integrated into everday environments. Whether considering the sophistication of emerging mobile platforms, or the automation of routine tasks in service provision, technology mediated interaction is woven into the time between home, work and leisure. Two recently emerging areas of innovation regarding mobile and pervasive applications pertain to health and learning. However, where recent findings in these areas seem to indicate the potential for ubiquitous applications in everyday environments, there are caveats presented by the nature of interactions between traditional work, home and leisure environments. The paper introduces the opportunities, challenges and potential solutions to integrating robust health and training applications into automated journeys.

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Novel user experiences, outdoor applications, pervasive application design, interaction design

ACM Classification Keywords
H.5.m [Information Interfaces and Presentation]: Miscellaneous

INTRODUCTION
With an ever-growing cohort of individuals getting older, health care and social systems are struggling to redefine what it means to consume resources and remain engaged during the later stages of life. In tandem with this demographic based need, aging is one of many areas to have had a renaissance of sorts, in response to recent findings regarding brain plasticity. The brain is malleable, positively reshaping itself in response to many different forms of learning. In contrast, as we get older the brain undergoes characteristic degenerative changes[13]. Somewhere between these two processes, it has been found that maintaining a rich intellectual life, learning new skills throughout life, and adhering to a minimum of physical activity not only maintains a higher general level of cognitive function, but also staves off disease processes such as Alzheimers disease[12, 7].

It becomes possible to envision applications that utilize multimedia rich mobile platforms to engage skill acquisition at diverse moments in our daily lives towards positive health. However, several key considerations of movement through cities contradict concerted skill acquisition during these transient moments. When mobile, is it possible to consolidate information? Secondly, as one can expect a modicum of passivity in transitional environments, does learning require active engagement? Lastly, how can training systems compete with the interface of the environment to support any attention from a user?

CONSOLIDATION
Efficiency requires downtime. An interesting area that highlights this fact is sleep research[11]. It has long been understood that sleep is necessary for optimal cognitive function, as it is reflected in the behavior of sleep-deprived individuals. Sleep deprived individuals are worse-off. However, recent neuroscience studies have been providing insight into the process of consolidation, in which many different types of memory require a cascade of brain changes that only happen during sleep. Our understanding of these processes is at the cellular level of detail. For example, researchers Gais, Rasch, et al. [6], with a placebo controlled crossover design, have shown a visual task where, if a certain neurotransmitter is inhibited during sleep, improvement in the measured visual skill simply does not take place the following morning. Neural cellular processes also support time-course sensitive procedural learning while awake[1], as explored by mechanisms such as long-term potentiation[8] and long-term depression[2] (a kind of sensitivity of activated cells to prime for subsequent information from the same stream in the future). The point is that consolidation and downtime is critical to learning.

Turning to everyday environments, the contradiction of integrating skill acquisition tools into our everyday environment is that efficiency is not monotonically related to the amount of time engaged. Potentially, the time in between work, home and leisure is required to support cellular mechanisms of consolidation. A potential solution is to build systems that explore learning with sensitivity away from sheer repetition. By oscillating between moments where users are being exposed to information they are required to engage with to learn, and moments where the users are allowed to simply exist in the everyday environment devoid of direct engagement, technologies will mutually support skill acquisition while recognizing the biological limits reinforced by non-engaged movement through the city.

PASSIVE VERSUS ACTIVE LEARNING
Constructionism is a dominant theory of education in which learning is proposed as part of an active process in which

mental models of the world are tested, and tested best while users build in their environments[10]. This directly contradicts the idea that significant learning can take place passively. Moreover, as an individual passes between active environments, whether home, work or leisure activity, the transient everyday environment may be the exact opposite of what constructinists have shown to be the type of environment that supports active learning.

A potential solution once again lies along the time-course of information presentation. All moments in passing from one environment to another are not created equal. Some moments warrant attention, mediating any technology driven learning task to the passive background, and other moments do not. When a user reads a book on a subway train, they mediate their own give-and-take between activity and passivity of the reading endeavor. Technologies to support skill acquisition need to similarly allow for this give-and-take. To do so, repetition of key moments in the learning process, or during the presentation of information, distribute the pressure for a user to acquire the information across a larger period of time, supporting their external requirement to be able to be, at some moments, actively engaged, and at other moments, not. This doesn't address the lack of building opportunity in the everyday movement through the city, but such detail would need to be addressed given the nature of the skill to be acquired or the information to be learned.

Multi-sensory Interfaces

Similarly, purely from an interface perspective, the sensory domains in which a user is engaged at any given time during transition in their environment are disproportionately visual, tactile, or auditory, based on the task at hand. The train is loud. Driving is visually exhausting. Exchanging cash for services has a user in a tactile exchange. As human-computer interaction begins to examine assistive devices and universal access[5, 9], as well as multiple domains of input for novel systems[3, 4], these research agendas can teach us how to actively engage users across sensory disciplines. If a mobile learning tool, in parallel, presents information to multiple sensory domains, diverse competitive environments to the learning tool can be compensated for. If the environment in one moment demands disproportionate visual attention, or tactile, the other domains can compensate.

CONCLUSION

At the interface of pervasive computing and our desire to acquire intellectually fulfilling, and subsequently healthy lives, new interfaces that introduce skill acquisition and learning into our everyday environments are on the horizon. These interfaces have the challenge of existing in the transition between environments that are perhaps more suited to concerted study and learning - those of the home, work, or leisure environments. However, that does not discount the opportunity to combat where the environment is adverse to skill acquisition. We have shown that a better understanding of the biological limits of information consolidation, the nature of different types of learning, and drawing from ongoing research into multisensory interfaces can provide research based strategies to begin to develop learning applications for the automated journey.

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