EMOTIONAL ENGAGEMENT IN MOBILE MULTI-TASKING ACTIVITIES. A HUMAN FACTORS REVIEW

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ABSTRACT

Mobile devices are ever increasingly being used in multi-tasking situations, although the design for these multi-tasking scenarios has taken a backwards with the rapid uptake of the touchscreen. The neglected dimension of tactility is becoming very important for mobile device designers.
The investigation explores how tactility within mobile devices can be used to enhance multi-tasking. An exploration of the potential for tactility within mobile devices looked at how tactile interfaces can be used to communicate information. The ideas covered were then summarized in a design project of an electronic purse.

Keywords: emotion, haptic, tactile, mobile, user experience

INTRODUCTION

In January 2011 Cathy Cruz Marrero quickly became the prime example of what can happen when text messaging and walking at the same time, after she was captured on CCTV falling into a shopping centre water fountain. (ABCnews, 2011). More serious stories can be found, with examples of people wandering into traffic.
Andrea Lewis, a cyber-psychologist from the market research company FACE describes how designers trying to achieve a more immersive experience within mobile device use, are looking to address this set of challenges. *"The direct manipulation requirement of a mobile creates a cognitive and real world hindrance"* (Lewis, 2011). Mobile devices of today require absolute visual attention and are not truly designed for multi-tasking scenarios. An investigation in to issues surrounding contemporary mobile device design was carried out using a leading mobile phone, the Samsung Galaxy SII as a reference point.

SITUATIONAL AWARENESS WHEN TEXTING AND WALKING

In observations of users of the selected mobile device (Samsung Galaxy SII) and an interview with a long term device user, the most recurring issue mentioned was users becoming so absorbed with the task of texting, they often walk into things or other people. Situational awareness is about knowing what is going on and relates to this scenario, (Ajovalsit, M. 2011). Endsley (1995) describes situational awareness in three levels. Firstly, knowing what is in the environment; secondly, the comprehension of their meaning and finally a projection of their future status. A range of studies have been carried out that demonstrate how people fail to avoid potential

A recent publicity stunt was carried out, covering lamp posts in padding on London's Brick Lane to protect clumsy people from injuries whilst walking and texting. This was in response to a survey of over 1,000 mobile users which reported that 1/10 people were injured within the last year as a result of walking and texting (Dailymail, 2008). The AIM interactive laboratory researches mobile user hazard avoidance systems and has reported that, on average, one in five potential hazards, such as bollards, lampposts, raised kerbs or even moving vehicles, go unnoticed by mobile device users (Aston University, 2011).

Western Washington University (WWU) measured the situational awareness of mobile phone users whilst walking. Situational awareness is difficult to measure (as users cannot explain when they're unaware) and it is hard to investigate texting whilst walking outside of a laboratory. The research group at WWU developed a unique experiment observing and interviewing unaware participants as they walked through a central location at the university. There was a pre-planned “unusual activity” in the user’s path (A uni-cycling clown as picture in figure 3). Only 25% of mobile phone users noticed the uni-cycling clown. This phenomenon is recognized as “Inattentional Blindness”, people failing to recognise new stimuli in their environment (Hyman, Boss. 2009).

This phenomenon can also be described as “Selective Attention”, where an attentional “searchlight” of visual resources can be a result of the divided attention (Ajovalsit, M. 2011). Norman describes the phenomenon, “excessive focus leads to a kind of tunnel vision where peripheral items are ignored.” Selective attention is common in fatigued drivers. Motorists prefer to scan short distances over long distances. They prefer to avoid head movements which can result in drivers forgetting to check their blind spots (Wickens et al. 2004) and the same could be said for the mobile phone participants who failed to spot the clown.
To combat the users limited situational awareness when using the a mobile device, the display needs to be easy to interpret as it is “the first and most direct application of the situational awareness concept” (Wickens. 2004). Multimodal input in mobile phones could be exploited as a solution to the low situational awareness and combat the selective attention in SII users. Multimodal interaction methods (such as greater tactile interaction) reduce of the split of cognitive resources through parallel data processing (Ajovalsit, M. 2011).

FRAGMENTATION OF ATTENTION

The touchscreen of the mobile device requires the user’s visual attention to operate, this divides their attention in multitasking situations like texting and walking. The AIM research laboratory wrote: “currently, the way mobile phone devices are designed means that we have to focus our visual attention and a lot of our mental processing resources on our mobile phone if we want to, for example, write and then send a text message.” (Lumsden, 2011)

Observations of SII use whilst walking showed that users walked at a slower pace, mainly staring at the screen whilst briefly glancing at their environment and appeared uncomfortable. Oulasvirta (2005) states how when investigating real world mobile phone use (outside the laboratory) multitasking is pushed to an extreme of short bursts of attention for a few seconds simply due to the day to day obstacles existing in the real world.
“Tim Brown of IDEO mentioned in his CHI 2004 closing plenary that one goal for his team in designing pleasurable interactions for mobile devices is that completing a task should not take longer than 20 seconds”. (2004 Cited Oulasvirta, 2005, p2).

Oulsavirta’s recommendation is more extreme; “Shorten interaction units (down to less than five seconds). Chunking textual material and dividing episodic materials into smaller episodes might help. The briefer the intentional capture, the smaller the temporal overlap with other tasks” (Oulasvirta, 2005 P1). Oulasvirta’s experiment showed that in a busy street, a mobile phone attention burst could be as little as 4 seconds a time, with 8 switches of attention between the phone and the environment. Mobile devices need to be built up of short, simple tasks that allow the user to check the environment and then quickly regain their attention in texting (Oulasvirta, 2005). If mobile tasks were broken down into shorter bursts of interaction, placeholders could be used to provide some visual feedback of the tasks already completed, which would help avoid “momentary disorientation” (Wickens, 2004).

Oulasvirta’s and Stavrinos’s Investigations and the investigation at WWU all recognised how users walking and using a mobile phone slowed down or even stopped when multitasking, similar to observations with the SII. Oulasvirta (2005) described this as an instinctive method to combat mental overload. In scenarios like walking and texting Oviatt

(2004) demonstrated that users make the most of multimodal input, if available to them, as a way of self-managing the complexity of a task. The paper demonstrated how users increased the use of multimodal input as the task complexity increased. The CEO of haptics technology company, Immersion, Terence Warmbier spoke at the Mobile User Experience Conference in London about a study by Dr Stephen Brewster whereby “haptics were shown to be so important in the cognitive processing power that without haptics users were subject to an unusual degree of stress.” (Mex 2011) When haptic feedback is combined with sight and sound there are performance gains (Immersion, 2010).

TACTILE USER FEEDBACK

Looking to further the application of tactility in a mobile device, there can be further benefit to the user other than reducing the cognitive load. Haptics can be defined as the study of touch and tactile sensations perceived not just through the skin (Wickens, 2004). Although the SII is advanced in the market for use of haptics, user observation clearly showed there is an inability to blind navigate when using the device, typing errors are common and there is a lack of natural feedback (Benali-khoudja, M et al. 2004).

As with all current touchscreens on the market, the SII does not allow for blind navigation. Mobile phones with hard buttons enable basic functions to be performed without any visual attention, for example the user may be able to turn the volume of their phone down with the device still in their pocket. With the touch screen the lack of texture is understandable but there are three hardware buttons on the front of the phone that have no texture and do not provide any feedback so when operating by touch they are lost amongst the touch screen. Controls should be distinguishable by touch and furthermore their mode should also be distinguishable (Dul, 2003). Additional tactile information on these three buttons alone would allow basic functions of answering and ending calls to be performed blind.

Warmbier places the user centred haptic technology for haptic technology in mobile devices into four generations. (MEX, 2009). Haptic interface aims to reproduce the human sense of touch (V. Chouvardas, et. al. 2005).

With the touch screen input method on the SII, typing errors are still common. Brewster showed the addition of tactile feedback significantly improves finger based text entry bringing it close to that of a physical keyboard. “A second experiment showed that higher specification tactile actuators could improve performance” (Hoggan. Brewster. 2008).

Touch screens in the current format do not create a natural method of interaction. Interaction designer Victor states that naturally hands feel and manipulate things, touch screens do not cater for either of these natural behaviours. Victor points out that the interaction method, (wiping a fingertip on glass) has not ever existed prior to the touch screen in any tools that humans have developed to date (Victor, 2011). Marek Palowski, founder of the MEX conference described in an article how “Buttons reward us. They invite us to interact by broadcasting their function and then satisfy our tactile cravings by providing a distinct response. It speaks to our innate human desire to find useful tools with which to influence our surroundings.” (Palowski, 2010) The cause and vibrotactile effect of the SII touch screen is not yet as natural or satisfying as physical buttons, particularly die to the lack of located feedback in the SII (the primary parameters in vibrotactile effects are frequency, amplitude, duration and location (V. Chouvardas, et. al. 2005).

Fabian Hemmert of Deutsche Telekom Laboratories investigated more intuitive interaction methods, exploring weight distribution and changing shape . User feedback of the prototypes described them as more natural and intuitive (Hemmert, 2010). This is just one example of how in future mobile device there is scope to create more intuitive products, furthering the incorporation of the sense of touch.

TACTILE OPPORTUNITIES WITHIN MOBILE DEVICE DESIGN

"Our hands feel things, and our hands manipulate things. Why aim for anything less than a dynamic medium that we can see, feel, and manipulate?" (Victor, B. 2011). To create an effective mobile device for situations involving the need to multi-task, tactile information could be employed to provide an extra channel of information for the user. This tactile element would supplement, or at times remove altogether the need for visual attention.
Naturally our hands take in huge amounts of information; things we touch have various textures, shape, solidity, temperature, motion, and weight balance. With these varied aspects in mind and taking into account the technologies available today, it can be safely concluded that there are many potential channels for interacting with products that could be further exploited.

To better facilitate the researching and benchmarking of some of the contemporary haptic interface technologies and products, they were organised into four generations as outlined by Terence Warmbier, who worked with the leading haptic technology company Immersion. The four generations being; Generation One and Two look at vibration; Generation Three looks at dynamic and deformable materials; and Generation Four looked at the use of haptic technology to communicate emotion (MEX, 2010).

One project that was explored by Sebresos Hunter, named Hapticon, is an exciting example of how texture can be used to represent emotion. The missing elements of non-verbal communication often exemplified by emotions are communicated through texture. This concept has textures that correspond with excitement, calm and irritation.

Another example how the sense of touch is being used as an information channel is within a project called Squeeze Block. This was a "squeeze" interface developed by Gupta (2010) that was recommended to be used on a mobile phone to represent battery life, or the content of a message inbox. This corresponds with the common mental model of a pot being either full or empty when you squeeze it.

In designing a tactile interface, the design and tactile channel used needs to match existing mental models.

Having used the Samsung Galaxy SII as a focal point for the human factors investigation, it was again used to explore the development process of tactile interfaces. Four low fidelity prototypes were created for a concept development workshop. The four prototypes were: A flexible interface; hardness interface; warm to cold interface; and a thick to thin interface. Within an informal investigation involving five product design students, the low fidelity prototypes were used to explore what potential applications would be easily understood if applied to the different interfaces.

The workshop showed there to be very few potential applications for a temperature interface as it does not readily fit within the mental model required for many tasks, whereas the interface which imitated a device getting thicker or thinner can be applied to many tasks as the mental model easily lends itself to a number of different applications.
Fabian Hemmert (2010) developed a shape changing interface that had a varying device width and demonstrated how it could be successfully used as: A navigation tool; to suggest the size of a web page; or to describe the amount of texts on a page. When experiementing with the lo fidelity prototype for a thickness interface, similar to Hemmert's shape changing interface it could be applied to a wide variety of tasks on the SII.

For future mobile device designs there appears to be most opportunities within a shape changing interface as the mental model is flexible.

Sebresos Hunter, a visual strategist working with NASA said, "As dynamic materials emerge, designers will be seeking out ideal applications for them. An interesting opportunity is applying these materials to communication devices" (Sebresos. 2010).

Dynamic materials (smart materials) are materials that respond to a stimulus in their environment in a useful way (Nensi 2008). Continuous developments in technology will now support the realisation of such shape changing designs. Dynamic materials have the potential to dramatically change the way we interact with products.

DEMONSTRATION OF IDEAS

To further explore the design ideas covered within this investigation a brief was chosen to apply the thinking. The project looked to redesign an electronic wallet using tactility to enhance interaction. Existing designs and solutions for electronic payment offer a lot of convenience in payment but minimal convenience in the amount of money that is available to them. The project looked to help user perceive their spending using tactility to enhance interaction.

Early on in the project a concept was outlined that would provide two levels of interface. One level would provide some quite general information about the user financing the second interface level would provide detailed knowledge of the spending history.

For the first interface level that aimed to provide a general knowledge of the available funds on the device it was chosen to use a shape changing interface which would remove the need for any visual attention. The model of a money purse getting bigger when it is full of money and smaller as the money was spent was chosen.

For the second interface level a screen based interface was required so to be able to provide a detailed breakdown of the spending. The screen was on a pull out card and was designed looking to maximize the benefits that a new technology presented by Tactus Technology. Tactus Technology are a next generation interface company that has developed a transparent layer that can be applied to touch screens that creates bumps on the screen that can be controlled in location and size. These bumps support the placement of the finger on the screen when interacting and provide feedback when a button is pressed (Tactus (2012).

The final product was called "Clutch" and was an electronic payment device for women. The first level of interface was achieved with dynamic alloys covered by a membrane that increase and decrease in size according to the finances available. The second level interface used the tactus bumps on both sides of the screen which enabled the user to feel both sides of the pull out card.

CONCLUSION

This investigation has further exposed the neglected dimension of tactility within touch screen mobile devices and has looked at the potential of tactility to support devices that are truly mobile for multi-tasking situations. Tactile interfaces have the potential to be implemented, particularly shape changing interfaces which have a flexible enough model to have multiple function or tasks assigned to them. A concept of an electronic purse demonstrated the ideas covered ad shows how information can be communicated through touch.

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