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Mike J. Voumvakis, *The University of Western Ontario*

Supervisor: Lynn Shaw, *The University of Western Ontario*
Joint Supervisor: Jeff Holmes, *The University of Western Ontario*
A thesis submitted in partial fulfillment of the requirements for the Master of Science degree in Health and Rehabilitation Sciences
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EXAMINATION OF THE USABILITY OF THE IPAD AMONGST SENIOR CONSUMERS

(Thesis format: Monograph)

by

Michael Voumvakis

Health and Rehabilitation Sciences

A thesis submitted in partial fulfillment
of the requirements for the degree of
Masters of Science – Health and Rehabilitation Sciences

The School of Graduate and Postdoctoral Studies
The University of Western Ontario
London, Ontario, Canada

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Abstract

Background and Purpose

In the current technological-era there is assumption of universal Internet access of citizens in North America. Many senior citizens have the desire to access the Internet, however have limited experience-using computers. There currently exists multiple options in addition to personal computers to access the Internet such as tablet computers, however there has been limited research performed on the usability of these technologies by senior citizens. The iPad is a highly popular computing device, and a technology that may potentially be very suitable for many seniors wishing to access the Internet.

Methodology and Methods

This paper explores the usability of the iPad amongst a population of five novice senior iPad users. The research looks at the experiences and insight of the users as well as provides a detailed task and activity analysis of device utilization. Through focus group based discussion in combination with the use of a hierarchical task analysis (HTA) and an activity analysis (AA), and post-interviews this paper describes the experiences and insight of five novice senior iPad users as well an evaluation of the overall usability of the iPad amongst these users.

Findings and Conclusion

Overall, participants' experienced the iPad in a highly positive manner and all participants described the device as being highly useable. This usability described by participants was validated during the systematic task and activity analysis, as well as during a post-interview. Participants used the device with a high-degree of efficiency and rated the device as being highly intuitive. The main sources of difficulty resulted from a read-tap asymmetry,

ambiguous touchable areas within some applications and ambiguous icon depiction. Similar to the findings of prior literature studying the iPads usability with younger populations, this research found that the iPad was used highly effectively with an older population and the difficulties that this older population experienced were nearly identical to those experienced by younger populations in other research. These findings in combination with the positive and non-intimidating perception the iPad received from the participants, suggests that the iPad may be an effective and highly useful option for Internet access amongst seniors.

Keywords

Usability, Seniors, Occupational Science, Technology, iPad, Older Adults, Occupational Deprivation, Internet, Computer, PC, Tablet, Task, Adoption, Abandonment.

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Glossary of Terminology

Acceptance:	To a specified level to which users consider a device to be useful, suitable for their needs, likeability, device cost
Activity Analysis (AA):	Based in the field of Occupational Therapy, an AA provides information about human knowledge, skills and abilities required to complete tasks and subtasks effectively.
Consumption:	Device usage patterns characterized by media consumption such as reading iBooks, watching movies, listening to music, YouTube, etc.
Cost:	Specified level of capital costs to run the device.
Functionality	The degree to which a device can perform the desired uses of the user
Graphical User Interface (GUI)	Graphical user interface of a computer system involving standard components, Windows, Icons, Menus and Pointing (WIMP) and WYSIWYG (What You See Is What You Get)
Hierarchical Task Analysis (HTA):	A method for studying usability field of human factors. A HTA breaks down a task to subtasks, from complex to constituent operational elements (operations) and presents possible plans for task and subtasks completion.
Likeability:	to a specified level to which users will feel the device is suitable.

Productivity:	Device usage patterns characterized by work-based workflow such as composing and responding to emails and text messages, composing notes or other word-processing based documents, etc.
Seamless operation:	Device use characterized by a high ease of use, and limited in barrier to successful operation.
Usability:	The capability in human functional terms to be used easily and effectively by the specified range of users, given specified training and user support, to fulfill the specified range of tasks, within the specified range of environmental scenarios.
Ease of use:	To a specified level of subjective assessment (e.g., learning, using, remembering, convenience, comfort, effort, satisfaction, etc.)
Effective use:	To a specified level of (human) performance (e.g. time, errors, number of sequence of activities, etc.)
Utility:	To a specified level to which the device performs what is needed functionally.

Chapter 1

1 Introduction

Until recently, the only feasible means for accessing the Internet was via a traditional desktop or laptop personal computer (PC). In 2010, with the release of the first iPad, the market witnessed the first massive consumer adoption of a tablet computer. This massive consumer adoption and popularity of the iPad tablet gave rise to the first real "tablet-computing era" or as some analysts have termed the "post-pc era" (PC-Mag, n.d.). With the newfound mass consumer adoption of tablet computers and smartphones, the home user finally had multiple affordable technology solutions as a means to browse the Internet. In general the iPad is less expensive than a PC, lighter in weight, smaller in size, and more portable.

North American senior citizens represent a great portion of the population, however seniors also represent one of the largest groups of the population who do not regularly access the Internet (Chaffin & Harlow, 2005). Prior literature has identified that many older adult learners want to learn technology skills, and do not want to be excluded from computer training (Beisgen & Kraitchman, 2003). Additionally, society often exerts ageism when thinking about seniors learning how to use technology (Chaffin & Harlow, 2005). Chaffin and Harlow (2005) describe how despite the interest of many seniors in learning computer skills, there is a subtle belief in American society that seniors are unable to do so effectively. Research by Tomporowski (2003) have discovered that although seniors do have the potential to learn computer technologies, they learn at a much slower rate compared to their younger counterparts. This combination of seniors lack of computer experience, society's bias towards senior computer users, in

combination with society's expectation and assumption that everyone is now "online", can potentially be very threatening to many seniors' opportunities for participation in communications with friends and family and can restrict senior participation in instrumental occupations such as shopping or staying up-to-date on current world events.

With multiple technologies available to consumers wishing to access the Internet, it is important that research in this area of study diversify and study users experiences with a variety of technologies in order to help aid seniors make more informed decisions when electing to choose and purchase a device to "go online". Prior research has identified difficulties many seniors face with PCs, however after a system search of all research related to seniors and the iPad, it was determined that to the best of our knowledge there is very limited research that has been conducted on seniors experience with the iPad.

This exploratory study sought to explore and obtain insight towards seniors' experiences with the learnability of the iPad and explore the seniors experiences with the adoption of this technology. Another goal was to determine what specific occupations the participants were currently using iPads for, as well as their potential desired uses. Further, the research also sought to obtain first-hand ergonomic and usability data with senior participants performing specific subtask performances using the iPad. A usability study design was employed to explore how users use the device and what factors contribute to the usability of device with their everyday activities or occupations. Chapter 2 critiques the current literature on the iPad, as well as literature from a number of articles dealing with seniors experiences and difficulties with PCs, mobile phones, touchscreens, and technology in general. Chapter 3 provides a detailed overview of the study methods and methodology. Chapter 4 provides a detailed account of the research findings and

interpretations. Finally, Chapter 5 offers a discussion of the research findings and provides an account of the possible implications of the research.

Chapter 2

2 Literature Review

2.1 Introduction.

The following literature review was performed using a narrative review. The primary researcher critically examined the evidence to identify gaps and also examined conceptual literature in occupational science and humans factors that might inform topic of interest (Grant & Booth, 2009). The aims of this process were to demonstrate that the researched literature had been critically evaluated for its quality. This process went beyond mere description and included a degree of analysis and conceptual innovation (Grant & Booth, 2009). The literature review set out to provide an extensive search of related literature, along with a critical evaluation for quality, using a narrative style. The search was initially performed using the following key terms, the iPad, seniors, older adults and usability. However, after receiving no matches for the specific search terms, the primary researcher broadened the search to include any research that looked at the usability of the iPad. This broadened search retrieved one match, a study that looked at the iPad's usability with a younger to middle aged population. Finally, the primary researcher further expanded the search to incorporate significant terms related to seniors, including computers, technology in general, occupational science, occupational justice, occupational deprivation, and assistive technology. It is important to note that literature review process was an ongoing process throughout the duration of the research. This was needed to ensure rigor, as new research continued to emerge throughout the duration of this research, one in particular which specifically looked at the usability of the iPad with a senior population (Werner F., Werner K., & Oberzaucher, 2012). The assessment of all

literature involved no formal quality assessment. Finally the review sought to identify gaps in the literature and provide conceptual contribution to existing theories.

Prior research has identified difficulties many seniors face with PCs (Chaffin & Harlow, 2005), however there is very limited research conducted on seniors experience with tablet computers, specifically the iPad. The following literature review will review a number of articles dealing with seniors experiences and difficulties with PCs, mobile phones, touchscreens, and technology in general. Research analyzing the various physical and psychological difficulties seniors experience with computers will also be reviewed to identify gaps in the knowledge base.

Until recently, the only feasible means for accessing the Internet was via a traditional desktop or laptop personal computer (PC). In 2010, with the release of the first iPad, the market witnessed the first massive consumer adoption of a tablet computer. This massive consumer adoption and popularity of the iPad tablet gave rise to the first real "tablet-computing era" or as some analysts have termed the "post-pc era" (PC-Mag, n.d.). With the newfound mass consumer adoption of tablet computers and smartphones, the home user had multiple affordable technology solutions as a means to browse the Internet.

Currently seniors represent one of the largest groups of the population who do not regularly access the Internet (Chaffin & Harlow, 2005). Prior literature has identified that many older adult learners want to learn technology skills, and do not want to be excluded from computer training (Beisgen & Kraitchman, 2003). Additionally, society often exerts ageism when thinking about seniors learning technology (Chaffin & Harlow 2005). Chaffin and Harlow (2005) describe how despite the interest expressed by many seniors

in learning computer skills, American society holds an assumption that assumes seniors are incapable of doing do (p. 303). Research by Tomporowski (2003) discovered that although seniors do have the potential to learn computer technologies, they learn at a much slower rate compared to their younger counterparts. This combination of seniors' lack of computer experience and society's expectation of universal Internet access may potentially threaten seniors' participation in occupations necessary for a meaningful life, such as stay up-to-date on current world events (Nilsson and Townsend, 2011). Further, as the digital age further progress, Internet skills continue to become evermore important. With multiple technologies available to consumers wishing to access the Internet, it is imperative that research in this area diversify and study users experiences with a variety of technologies in order to help aid seniors make more informed decisions when electing to choose and purchase a device to "go online".

2.2 Isolation and Occupational Deprivation.

Traditional methods of participation in various everyday occupations are continually moving towards online-based solutions. Currently, there is a trend for various news sources, banks, social media, etc. to continually be more online based (The Australian, 2011). This trend has the potential to result in unintended social consequences, such as social exclusion and limited/reduced access among those who will fail to follow this shift. Research by Nilsson and Townsend (2011) examined occupational justice theories using illustrations from a study of leisure and the use of everyday technology in the lives of very old people in Northern Sweden. The authors assert that maintain an occupational justice lens may inspire and empower health professionals to engage in critical dialogue

on occupational justice. Using illustrations from a qualitatively based interview study on leisure and the use of technology in the lives of seniors in Sweden, Nilsson and Townsend (2011) suggest that an occupational justice lens may inspire and empower health professionals to consider potential ways that limited technology access may lead to isolation. In the study conducted by Nilsson and Townsend (2011), many of the informants when asked about online use responded that without having access to the Internet they felt as though they were not true members of the state because so many things they found interesting 'slipped through their fingers'" (p. 51).

Without the skills and knowledge of how to use a PC effectively, access to the Internet becomes extremely challenging for many seniors, especially those who have not had experience with PCs in the workplace and can potentially result in the disruption of meaningful occupations for seniors. Seniors who do not have Internet skills have the potential to experience occupational deprivation from the lack of participation in their previous occupations that have gone purely online (Nilsson & Townsend, 2011). Further to this, Nilsson and Townsend (2011) identify that the Internet has the potential to enable some people to engage in their occupations, but may restrict or even prevent very old people from fully participating in society. Seniors may be occupationally marginalized, without the right to autonomy in their occupational experiences when inexperience with the Internet excludes them from family and community participation (Nilsson & Townsend, 2011). The authors further explain how this potential marginalization may be compounded and they may be further occupationally deprived when they are isolated from real or virtual community inclusion by the lack of access to or inability to use the Internet. Moreover, Nilsson and Townsend (2011) mention how in a digital age

occupational imbalance may exist as a result of a lack of these skills, very old people cannot exercise the occupational privilege of participating in a range of occupations without these skills. For those very old people who live alone and who engage in limited occupations, or who have heavy responsibilities for caregiving or home management, using the television and Internet enables them to keep up to date and gain social support from watching television. Finally, many Internet technologies are not designed with the senior user in mind (Nilsson & Townsend, 2011).

Future research should focus on identifying the consequences for seniors who do not possess Internet and computer skills. Therefore, additional devices used to access the Internet need to be researched as well, to gain and generate knowledge that can help promote opportunities for seniors continual participation in the occupations they identify with, and to determine ways to prevent occupational deprivation.

Research by Chaffin and Harlow (2005) identified the importance of studying seniors' access to the Internet. These researchers suggest that a main reason as to why computers are important for seniors who are retired is isolation (Chaffin & Harlow, 2005). Isolation often results from retirement, loss of a spouse, children living far away, moving to a retirement center, or becoming homebound due to age-related illnesses (Chaffin & Harlow, 2005). The authors suggest that access to the Internet may be a way for seniors to address the issue of isolation. Furthermore, prior research has also indicated that the use of technology, such as the Internet, fits within a larger social and cultural context (Arthanat, Simmons & Favreau, 2012). Such that, as elements of our lives move towards go "online" as part of the socialization process. For example, Facebook, Twitter, Skype,

etc. have all modified the way communication is performed with our friends, family and peers.

Pertaining to concepts of occupational justice and the preservation of occupations necessary for a meaningful life, research of Arthanat, Simmons and Favreau (2012) explored consumers of assistive technology (AT), and the meaning of occupational justice (Whiteford, 2000) related to the use of AT. The researchers proposed strategies that integrate values of occupational justice with regards to AT use. The researchers performed a content analysis of interviews with seven AT consumers. As expectations evolve to use the Internet for many daily routine occupations such as reading the newspaper, shopping, making travel arrangements, etc., those failing to adopt the Internet risk a disturbance in these occupations. For instance, a quote from one interview of a senior living in Sweden in a study conducted by Nilsson and Townsend (2011) underscores the growing disparity for seniors who do not access the internet, "you know when you are looking at the news and there is an interview that seems very interesting then they just cut the story and say that you can see the whole interview on the web, of course I cannot, I do not even have a computer" (p. 51). Many of those aforementioned daily tasks or occupations are becoming more and more available solely online from increasingly more sources. Without access to the Internet, access to various social and media consumption occupations are limited. Computers, technology and Internet competencies will open the door for seniors to connect with the world virtually and to participate and stay up to date on current events. For instance, many news articles, political stories and access to community programs now assume universal Internet access. Nilsson and Townsend (2011) identify how "marginalization may be compounded

because [seniors] may also be occupationally deprived when they are isolated from real or virtual community inclusion by the lack of access to or inability to use television remote controls, the Internet, and other everyday technologies" (p. 60). This evermore-present assumption that there is universal Internet access has now become incredibly commonplace in Northern American societies, and at the same time highly inaccurate. Nilsson and Townsend (2011) describe how seniors face occupational alienation and imbalance without access to a range of desired leisure occupations beyond self-care, and further, experience occupational deprivation and marginalization because they are deprived and marginalized from participation in leisure, especially by the complexity of everyday technologies, such as television remote controls and the Internet. Chaffin and Harlow (2005) describe how in order for seniors to perceive control in their lives and their own environment as they age, older adults are learning computer technology at a pace faster than any other age group. Computer skills and use of the Internet give them control over one of the primary threats to their physical and psychological well being: social isolation" (p. 302). Another outcome may be occupational deprivation as identified by Whiteford (2000). She described occupational deprivation as, "a state in which a person or group of people are unable to do what is necessary and meaningful in their lives due to external restrictions" (p. 200).

Whiteford (2000) in her article elaborated on the conceptual origins of occupational deprivation. Her research identified and discussed the global, contextual issues of economic reform and technological advances as they relate to occupational deprivation. Future research on the usability of the iPad is imperative to discover if the device has the

potential to be an effective and efficient means of Internet use for seniors, and further preventing outcomes such as social isolation and occupational deprivation.

Others have also indicated that a major barrier to technology adoption is perceived complexity (Wang, Rau & Salvendy, 2011), and that older adults perform better when using simpler devices (Ziefle & Bay, 2005). Further research needs to determine if the iPad, which is perceived as non-intimidating and a simple device (Werner F., Werner K., & Oberzaucher, 2012), is an effective means to alleviate the isolation and occupational deprivation experienced by seniors.

2.3 Technology Adoption

Three studies specifically looking at technology adoption were reviewed. There are many variables that influence whether a particular technology will be adopted by an individual. Among all variables influencing adoption, perceived usefulness is widely recognized to be the most important variable (Igbaria, Parasuraman, & Baroudi, 1996). The research by Igbaria, Parasuraman and Baroudi, 1996 surveyed 471 professionals and managers from 62 companies in North America to test a motivational model of microcomputer usage. Their results provided substantial support for the proposition that perceived usefulness (rather than perceived fun or social pressure) is the principal motivator in the adoption of computer technologies. Findings also demonstrated that perceived complexity is a key barrier for technological adoption. Future research involving the iPad needs to identify if its proposed simplicity is a principal motivator for the devices adoption by seniors.

More recent research by Wang, Rau and Salvendy (2011) investigated variables contributing to older adults' information technology acceptance through a qualitatively

based survey of 233 seniors aged 60-75. The survey was used to find factors explaining and predicting older adults' acceptance behaviours towards information technology. Wang, Rau and Salvendy (2011) findings are in line with the research by Igbaria, Parasuraman and Baroudi (1996) indicating that the most important factors predicting technology adoption for seniors are needs satisfaction, public acceptance, perceived usability, and support availability. Prior literature has documented the desires of seniors to access the Internet and the difficulties seniors face utilizing personal computers (PCs) (Chaffin & Harlow, 2005), however further research is required to determine whether or not alternative technologies offer a high degree of utility for seniors, and what barriers and facilitators are associated with tablet computers.

Ziefle and Bay (2005) compared two different mobile phones of varying complexities and users experiences. Older and younger novice mobile phone users specific uses of these technologies were examined using two handsets of differing complexities. The independent variables were user age (young adults ageing 20 – 35 years and, older adults ageing 50 – 64 years) and the complexity of the two mobile phones. The researchers discovered that when using the less complex phone, older adults performed significantly better than when using the complex one. Furthermore, older users demonstrated lower navigational performance than younger users with the complex phone, however their performance matched younger users' when using mobiles with low complexity. These findings were quantified by having informants perform a serious of subtasks. Ziefle and Bay (2005), reported that "when using a less complex mobile phone, older adults solved specific subtasks 14% more effectively than participants using the more complex mobile phone" (p. 384). Additionally, the researchers concluded that when using the less

complex phone, participants spent on average 40% less time on each subtask, making 50% less detour steps and disorienting less often (Ziefle & Bay, 2005, p. 381). Usability in the research of Ziefle and Bay (2005) focused on the attributes of the device, not the actual meaningfulness or utility of the device for tasks that a person actually desires. Moreover, future usability research should focus on the occupations in which the user has interest in performing and the impact of technology on participation. Without the knowledge of which specific occupations the users have desires to use the device for, a usability study cannot provide the most relevant findings for the devices actual utility. As an example, if studying the usability of the iPad amongst senior citizens, it is imperative that research first addresses which occupations seniors wish to use the device for, then to tailor a usability study to those particular occupations. This method of research is required to support an understanding of the usability of the device.

2.4 Barriers to Adoption – Physiological

In this section of the literature review four articles were included that studied the physiological challenges seniors face with respect to learning and using technologies. Studies with seniors and technology adoption often report a variety of barriers to adoption resulting from physiological changes that naturally occur during the ageing process, such as visual difficulties and some arthritis-related difficulties (Chaffin & Harlow, 2005). The research of Chaffin and Harlow (2005) identified and addressed the specific needs of older adults learning computer skills. They presented a model that highlights the unique processes used by seniors to learn computer skills. This model is beneficial to the understanding of the unique learning requirements seniors have when

learning technology, as well as provides specific assistance for the common difficulties that seniors face with the learning of technology. The researchers documented three specifics of older adult's biological architecture which have the potential to hinder seniors use of computer technologies: vision difficulties, hearing difficulties, and motor skills difficulties. Although specific to PCs, many of these complaints/difficulties listed remain relevant to the study of tablet usability.

Visual difficulties.

Normal visual changes that occur with age can pose a challenge to technological adoption (Chaffin & Harlow, 2005). These two researchers suggest, "Physical changes occur with age that degrade vision… …As a result, the retinal cells degenerate and perform less effectively" (p. 317). Further, Tomporowski (2003) indicated that the subsequent development of cataracts and macular degeneration leads to difficulties in using technologies. Macular degeneration is a condition that predominately affects older adults as a result of the natural ageing process. The process results in a loss of vision in the macula, the centre of the visual field. Macular degeneration is one of the major causes of visual impairment in older adults and can it make it difficult or near impossible to read text or recognize faces. A cataract on the other hand, is the clouding of the lens of the eye, often reduces the sharpness of images. Suitable accommodations for visually impaired seniors now include glare-protective screens; large monitors with increased font size; fewer screen icons for less confusion; and specific colors for more contrast between background and fonts (Chaffin & Harlow, 2005). Petty (2007) suggested that seniors could compensate for visual loss through high vision technology such as CCTVs, larger computer monitors and screen magnification and reading software. Provision of such

technology may prevent abandonment of valued activities such as reading and writing. Despite the importance of vision factors there is a paucity of research on the links between seniors and the use of computer technologies, from both an ergonomic perspective and an abandonment perspective. Further research needs to investigate if the text magnification features, as well as the abundance of accessibility features offered by the iPad are useful technologies for seniors with visual difficulties.

Auditory difficulties.

Chaffin and Harlow indicate that older adults are the largest population affected by hearing loss: one in three over age 60 has hearing loss, and that percentage increases to 50% in those over age 85. This decline in hearing is progressive and occurs gradually, with those who were constantly exposed to loud sounds experiencing the greatest magnitude of hearing loss (Chaffin & Harlow, 2005). This loss is first noticeable around 70 years of age is a result of degenerative changes of hair cells in the cochlea of the ear, contributing to loss of sensitivity to high-frequency sounds (Chaffin & Harlow, 2005). The ultimate result is that older adults become less able to extract information from the environment. Some of the loss of physiological function can be compensated for by other components of the information-processing system (Tomporowski, 2003). Chaffin and Harlow (2005) indicated that, “sounds from the immediate environment provide a filter to help determine what is right and what is wrong in the world surrounding seniors” (p. 317). Chaffin & Harlow suggest some accommodations that aid the hearing-impaired older adult are available. Speech systems can provide hardware and software that allow computers to capture and analyze speech. Further, these voice input and output packages improve communication skills (Chaffin & Harlow, 2005). While efficient use of

technology depends mainly on visual skills, hearing is important because there are sounds or cues emitted from the device that have the potential to be confusing or misinterpreted by seniors (Chaffin & Harlow, 2005). Previous studies have only looked at the auditory difficulties seniors experience with respect to PCs, however a tablet such as the iPad has a vast array of engineering differences compared to a PC. As a result, further research on the iPad is required to understand the realm of auditory issues that seniors experiences with tablets. As well, research must be done to determine if auditory difficulties are a barrier for seniors wishing to learn tablet computing.

Motor skill difficulties.

Motor skill functions such as fine motor control links to tasks and functions in using a computer have been studied for seniors with specific health conditions. For instance, many seniors develop arthritis, and arthritis-like symptoms at some point in their life. Chaffin and Harlow (2005) suggest that, "vulnerable to arthritis and loss of mobility as age progresses, seniors can be challenged by the dragging and clicking required to operate a computer mouse" (p. 318). This arthritic pain may occur for others who have similar motor difficulties due to other conditions. However, this is only one example of functional use of the technology and motor difficulties in other tasks needs to be explored as motor function changes. A quantitative study by Murata (2005) explored the usability of touch panel devices for seniors compared with younger adults. This study compared the usability of a touch-panel interface among young, middle-aged, and older adults. The researchers found that pointing time with a PC mouse was longer for the older adults than for the other age groups, whereas there were no significant differences in pointing time among the three age groups when a touch-panel interface was used. Additionally the

researchers offer some guidelines for the design of touch-panel interfaces and implications for users of different age groups. This research aids in the selection process for designing touch-panel interfaces and aids in the accessibility decisions. Furthermore, the findings demonstrate that pointing time with a PC mouse (the time in which it takes to navigate and click on a specified location) was significantly longer for the seniors compared with younger age groups, whereas there was no significant difference in pointing time among the older versus younger adults groups with a touch-panel interface. Further, Murata (2005) asserts how compared with a mouse, the touch panel has the advantage of simplicity - that is, it requires less learning time. Future research is needed to discover whether the touch panel interface of the iPad is a preference for seniors, as well as if it is viewed as more accessible. Additionally, the iPad's touch panel screen is far more sophisticated then the touch screen used in the research by Murata (2005), therefore further research is needed with more sophisticated, accurate and responsive touch panel devices to determine how they affect usability. In line with the research of Murata (2005) research by Greenwood, Hakin and Doyle (2006) studied the feasibility of providing rheumatoid arthritis (RA) patients a touch-screen device instead of a traditional paper version for completing a questionnaire on quality of life and outcome data. Study findings indicated that touchscreen panels had a high usability amongst seniors with RA. The study involved forty patients with RA who were instructed to complete the touch-screen and paper version of the Rheumatoid Arthritis Quality of Life Questionnaire. Participants rated in the rated ease of use and preference for the touch-screen versus the paper version. The researchers found that the participants encountered no technical problems and the touch-screen version took no longer to complete, furthermore the

touch-screen version was preferred by 64% of participants, with 33% having had no preference. Further, the touch panel was rated significantly higher for ease of use, even by computer illiterate participants. Furthermore, ninety-six per cent of participants stated a willingness to complete the touch-screen assessment in clinic again. Although this research did not specifically look at the usability of touch-screen devices with RA patients, it provides a valuable starting point for further research, especially as the popularity of touch-screen devices continues to increase.

Lastly, further research is required to examine what effect an integrated touch panel user interface (UI) will have on the motor skill difficulties experienced by seniors.

Cognitive difficulties.

Prior literature has documented a number of cognitive changes that occur with the normal ageing process. All of these cognition changes play a role in seniors' ability to use and learning various computer technologies (Chaffin & Harlow, 2005). Tomporowski (2003) indicated that overall the learning process is slower as ageing occurs. Additionally, a number of other difficulties result as cognitive changes occur with age. These changes include, the slowing of processing speed, a decline in working memory and spatial processing ability, as well as a decrease in sustained and divided attention (Chaffin & Harlow, 2005). These changes all have the potential to affect the learnability as well as the usability of various technologies for seniors, however Chaffin and Harlow indicate that despite these challenges, seniors are still very capable of learning these skills. Research indicates how as the ageing process occurs, seniors have a reduction in their abilities to hold multiple thoughts in mind, such as how to start the computer, and needing to be taught in language that they understood (Chaffin & Harlow, 2005).

Furthermore Chaffin and Harlow (2005) indicate how as a result of cognitive slowing, the senior technology learner has limited processing resources available to them, and an inability to inhibit task-irrelevant information which may have a great negative affect in computer technology usability. Chaffin and Harlow (2005) explain how there can be much greater success displayed by seniors by simply providing them with sufficient time to process events and information. Further, prior research by Chaffin and Harlow (2005) has indicated that older adults have age-related deficits in working memory, yet, seniors do have the ability to understand complex information, for example medical information, when it is clearly structured and organized, or when working-memory demands are reduced (Chaffin & Harlow, 2005).

Chaffin and Harlow (2005) express how the ability to comprehend text is also vital to cognitive learning of computer technologies by older adults. The authors indicate how, "text comprehension is relevant to computer skills in two ways: a) one must be able to comprehend the tutorials for the hardware and software, and b) one must also be able to understand information presented on the monitor screen" (Chaffin & Harlow, 2005, page 325). Despite age-related problems with perceptual speed or the speed at which mental operations are performed, the text comprehension challenge can also be overcome—if the designers of computer technologies include accommodations for senior users in their designs (Chaffin & Harlow, 2005). Chaffin and Harlow (2005) suggest these accommodations include Back and Forward buttons, or buttons that say ''Click here to begin.'' Further, Chaffin and Harlow (2005) indicate in their research that with accommodations, seniors can meet the challenge of learning computer skills.

Although an essential starting point for further research on seniors unique requirements for learning computer technologies, this research by Chaffin and Harlow (2005) is currently 8 years old, and in that time much has changed in the computing world. There has been a switch to more mobile, tablet based computing and further research needs to address the physiological requirements for seniors wishing to learn more modern computing technologies. Overall the limitation of the current knowledge base on research on the physical barriers to adopting technology is that the literature has mainly focused on PC use. Further, much of this research was completed nearly a decade ago and is now dated provided that computer technologies have changed immensely within this timespan. Thus, more current research is needed with modern computing devices, such as tablets, and should also focus on the ergonomic factors specific to the occupations seniors will be using the device for. The physical engineering design and ergonomic aspects of modern computing devices are vastly different to the computers studied in the current literature and further research is required to determine what barriers and facilitators are associated with current tablet devices. Although there has been some research on the iPad's usability, this research does not look at usability from an ergonomic or human factor viewpoint, and thus future research needs to study the iPad's usability from this field.

2.5 Barriers to Adoption – Psychological

Studies with seniors and technology adoption often report a variety of psychological factors influencing adoption. For instance, some of the commonly reported barriers include anxiety towards technology, and lack of experience and access (Wang, Rau &

Salvendy, 2011). Wang, Rau and Salvendy, (2011) investigated variables contributing to older adults' acceptance of information technology through surveys. The researchers identified factors that explain and help predict older adults' information technology acceptance behaviours, such as needs satisfaction, perceived usability, support availability, and general public acceptance. Lastly, Wang, Rau and Salvendy, (2011) indicate how more simple technologies have the potential to alleviate some of the anxieties seniors face when learning complicated technologies such as personal computers.

Technophobia

Three studies in this review address technophobia. Rosen and Weil (1992) describe technophobia as, "anxiety, negative thoughts, and attitudes towards technology, can be particularly disadvantageous with the increasing use of information technology in society" (p. 153). A study by Cameron, Marquis and Webster (2001), identified technophobia as being a common barrier towards technology adoption for seniors. Cameron, Marquis and Webster (2001) explain how younger individuals, who have grown up with this technology, are less likely to be technophobic and are prepared to adapt to rapid societal changes than older people. These studies have yet to examine the iPad and use by seniors. Currently it is unknown if the iPad's simple design makes it less intimidating (Werner F., Werner K., & Oberzaucher, 2012) and therefore better able to address technophobia issues previously associated with computers for seniors. Additional research is warranted to identify if the iPad and its design is a barrier or a facilitator for a gateway to Internet connectivity for seniors and if the iPad truly has the potential to support the adoption of technology.

2.6 Technology Abandonment

Four studies analyzing technological abandonment were reviewed. Assuming successful adoption of a particular technology, one of the most detrimental elements to successful device use is abandonment or non-use. Technology abandonment is the non-use of a device type or category after being obtained with the intent of use (Phillips & Zhao, 1993). Further, Phillips and Zhao (1993) highlight that, "a device that sits in the closet is abandoned, if an individual switched from a cane to a walker, the cane is considered abandoned. Older devices replaced with the same device type would not be considered abandoned, but older devices replaced with a different device type are not considered abandoned" (p. 38). Despite the potential usefulness and utility of computer devices, there still remains a high abandonment rate for these technologies (Tewey, Barnicle & Perr, 1994). There are a number of studies that underscore the reasons for the high abandonment rates of various technologies. One study on technological abandonment dealing with assistive technology (AT) devices by Tewey, Barnicle and Perr (1994) discovered that AT abandonment rates range from 8% to 75% and that consumers who do not feel they are involved in the selection process of the device, are more likely to discontinue use compared with individuals who feel involved (Tewey, Barnicle, & Perr, 1994).

More recently, the inductive research by Johnston and Evan (2005) discusses some variables that may influence an individual's choice to utilize AT, as well as how the manipulation of these variables can decrease the probability of AT abandonment. Johnston and Evan (2005) propose using response efficiency as a means to prevent

assistive technology abandonment, and found that with increases in response efficiency, there is a higher chance that a participant will continue using the particular assistive technology. The researchers defined response efficiency to be when an individual has the opportunity to choose between two or more responses, they will select the response that is perceived as most efficient. An individual's concept of efficiency is affected by at least four components: (a) rate of reinforcement (b) quality of reinforcement (c) response effort (d) immediacy of reinforcement. Further research, is needed to see how response efficiency influences or can promote continued use of the iPad. One of the recurring reasons provided for the discontinuance of AT is that the AT did not meet important functional needs of users (Reimer-Reiss & Wacker, 2000). Similarly, research by Phillips and Zhao (1993) outlined that "four factors that were significantly related to abandonment, lack of consideration of user opinion in selection, easy device procurement, poor device performance, and change in user needs or priorities. In order to be successful, the AT and user interactions must be deemed efficient from the perspective of the user, as well as from the perspective of the individuals who interact with the AT user" (p. 48). The existing literature on abandonment makes no references to tablets devices, thus this should be a consideration for future research on abandonment. Currently, research has yet to determine if the issues present in the current literature will apply to tablets, or if in fact the tablets might help address some the previous issues uncovered in this literature base.

2.7 Usability Research Design

The following section will review prior literature on the concepts of conducting computer usability-based research. Bernsen and Dybkjaer (2009) define system usability in its simplest form as the goal of making a system fit the bodies and minds of its users. Bernsen and Dybkjaer (2009) suggest that by using the terminology "users" the reference is primarily being made to people as "end users". Bernsen and Dybkjaer (2009) indicate how the end users are those who actually use the system for its purpose as opposed to for example the software developers, or engineers who build or maintain the system as these types of individuals will have very different usability requirements. Furthermore, Bernsen and Dybkjaer (2009) explain how the plural of "users" is important, because a system is rarely developed for a single individual. The plural form signals that it is necessary to determine who the intended users are.

Bernsen and Dybkjaer (2009) outline how along with Human Factor elements, there are many other elements that have to be considered with the study of usability, and this list is neither small, nor closed, nor finite, so its very open to interpretation. Bernsen and Dybkjaer (2009) indicate how many of these elements of usability are observationally made by small, would-be closed and finite model of usability. For example price and other costs matter to users as much as anything else. Bernsen and Dybkjaer (2009) provide the message to readers that, "if you really want to fit your system to users' minds and bodies, don't forget fitting their purses!" (page 13). Bernsen and Dybkjaer (2009) further indicate how cost is not normally considered a component of usability but still tends to make itself felt in the large majority of development processes.

Bernsen and Dybkjaer (2009) talk about other factors that must be addressed with the study of usability, functionality, ease of use, and user experience. Bernsen and Dybkjaer (2009) describe how when researching functionality one must think of a technically perfect system. The authors explain how with an interactive system, system functionality is what can be accomplished with the system through interaction (Bernsen & Dybkjaer, 2009). Bernsen and Dybkjaer (2009) describe how this can be anything the users wishes to do for any reason (work, fun, gadget fascination, whatever). Thus, functionality enables the user to produce some desired result, such as messaging friends or reading an online book, it is said that functionality, the system, is useful. Bernsen and Dybkjaer (2009) indicate that functionality enables the user to do some kind of activity which the wishes to perform for its own sake. Bernsen and Dybkjaer (2009) outline how the key to understanding functionality as a main usability issue, is that reference is not made to how, more specifically, "something can be accomplished with the system through interaction, only about that, in principle, something can be done using the system" (page 13).

Bernsen and Dybkjaer (2009) indicate how functionality is closely related to system purpose. The authors further explain how unfortunately, the relationship rarely is so close as to be deductive in nature. Bernsen and Dybkjaer (2009) explain how if this were to be the case, then system developers could have deduced the functionality the system should have from its purpose, and the users could have done the same, removing a large degree of functionality problems. Bernsen and Dybkjaer (2009) indicate how in its current state "a system functionality is what the developers have decided is necessary, important, good to have or relevant given the system's purpose" (page 13). Further, Bernsen and Dybkjaer (2009) describe how users may think different, and potentially may even have a

different understanding of system purpose compared to the developers, and they often want different functionality.

Bernsen and Dybkjaer (2009) indicate how computer system usability is special because there is a science, would-be science or, perhaps rather, a science–craftsmanship conglomerate that focuses on interactive system usability. Computers involve Graphical User Interfaces (GUIs) with the standard components Windows, Icons, Menus and Pointing as interaction ideal, meaning that the graphical representation on the display would at any time more or less faithfully reflect the current state of the user's work (Bernsen & Dybkjaer 2009). Mobile phone GUIs posed other challenges due to their small screen size and ubiquitous use (Bernsen & Dybkjaer, 2009). Further, these authors suggest that the abundant adoption of computer games and other, more leisurely-based applications mean that fitting systems to users has aspects other than ensuring easy and efficient task performance.

Bernsen and Dybkjaer (2009) indicate how the prominent human-style communication aspects of the natural and multimodal interaction that occurs with these devices mean a wide-array of natural human-interaction elements have the potential to affect the usability of these modern computing device such as (i) human perceptual functionality, such as hearing, vision and touch sensing; (ii) human central processing functionality, such as goal structures, emotions or affects and situated reasoning; and (iii) human action functionality, such as gesturing.

Bernsen and Dybkjaer (2009) refer to another element of usability, ease of use its affect of user experience. Bernsen and Dybkjaer (2009), refer to user experience as another

main element of usability research. User experience is the user's reaction to everything about the system, so it's about how the users perception, likes, thinks about, feels about, etc. the system. Bernsen and Dybkjaer (2009) describe how "a technical problem may cause frustration, a missing functionality annoyance, an ease-of-use problem more frustration, and all three together may cause the user to give up on the system, consider it unusable and describe the experience with it as a bad one" (page 14). Bernsen and Dybkjaer (2009) indicate how conversely, if everything works fine technically and functionally, and the system is easy to use, the accumulating user experience may be neutral, respectful, or even one of joy. Important as this is, and especially the accumulation part, user experience has more to it. The authors indicate how a good way to think about user experience as more than a function of the other three main factors is to think about what could be wrong with the system even though the user has no technical, functionality or ease of use problems. Bernsen and Dybkjaer (2009) indicate how this could be a whole array of different elements such as the game is boring, the conversation silly, the design ugly or the whole thing old-fashioned. Conversely, a positive user experience might simply reflect the assumption just made, i.e. that there are no technical, functionality or ease of use problems (Bernsen and Dybkjaer (2009). Finally, Bernsen and Dybkjaer (2009) indicate further how the user experience is left completely open to personal individual experience post past and present and how a positive user experiences may also be caused by other system properties, such as that the game is challenging and fun, the conversation amazing, the design cool and the whole thing a must-use-again, even though there were technical, functionality and ease-of-use problems.

2.8 HTA Methods

A HTA have been used in a variety of contexts for a full range of problems related to Human Factors. Examples range from simple procedural tasks, to the usability of word processor or even in the study of the usability of a supermarket checkout system (Hollnagel, 2008). One of the key goals of usability evaluations is to bridge the mental models between the end user and the designer through an optimal system interface (Stanton, Salmon, Walker, Baber, & Jenkins, 2005). Within the field of Human Factors, there are a variety of appropriate methods used to evaluate the usability of devices (Fok, Middleton, Fishcer & Polgar, 2010). A HTA is arguably the most widely used of all Human Factor methods available (Stanton, Salmon, Walker, Baber, & Jenkins, 2005). Fisk, Rogers, Charness, Czaja and Sharit (2009) used an HTA in combination with a human failure modes to evaluate a self-checkout system in a retail environment. These authors suggested the use of a "checklist" to identify potential problems or errors as seniors perform tasks and subtasks requiring perception, cognition and response execution and thus was the basis for incorporating the HTA and checklist method into the second Phase of the current study's method.

A recent study by Fok, Middleton, Fishcer and Polgar (2010) expanded on the work of Rogers, Charness, Czaja and Sharit (2009), and utilized a combination of a HTA and an AA to evaluate the usability of a GPS device by five seniors. An AA is based in the field of occupational therapy, and can be used to compliment a HTA. An AA provides information about human knowledge, skills and abilities required to complete tasks and subtasks effectively (Fok, Middleton, Fishcer & Polgar, 2010). Furthermore, Fok,

Middleton, Fishcer and Polgar (2010) describe how the integration of task and activity analysis (AA) offers a systematic way to study usability issues faced by seniors and the use of technologies and thus was the basis for the implementation of this method in the second phase of the current study. The implementation of a HTA and AA in the current study offered a systematic way of analyzing the performance issues and specific usability of the senior iPad users participating in this research.

2.9 A New Option – The iPad

In 2010 with the release of the iPad, the computer market saw the first massive consumer adoption of a tablet computer. This massive consumer adoption and popularity of the iPad gave rise to the first real "tablet-computing era". With the newfound mass consumer adoption of tablet computers and smartphones, the home user finally had multiple affordable options of technologies as a means to browse the Internet. In North America, senior citizens represent a great portion of the population, however seniors also represent one of the largest groups who does not regularly access the Internet (Chaffin & Harlow, 2005). Many older adult learners want to learn technology skills, and do not want to be excluded from computer training (Beisgen & Kraitchman, 2003). Currently there are more seniors adopting tablet computers (Tablet Ownership 2013, 2013), however there is currently no data pertaining to the usability of these devices for seniors. Research is only beginning to emerge on the iPad's usability in general, therefore, the research below can be considered innovative and novel.

Emerging evidence on the use of the iPad.

Research by Budiu and Nielsen (2011) explores the usability of iPad Applications with younger to middle-aged populations. The study consisted of 16 iPad users, half of which were male and half female. The study's age distribution was fairly even, with 14 users between the ages of 21–50 years, and two users older than 50. The study required participants to have experience using their iPad's for at least two months. The researcher discovered that tablets are predominantly shared devices, with the exception of those who lived alone. The iPad's shared nature contrasts with the much more personal nature of mobile phones, which are typically owned and used by single individuals. The study discovered that the most common uses of the iPad include: playing games, checking emails and social networking sites, watching videos, and reading the news. This study however is referenced to a younger population, and further research is required to determine seniors' usage. Participants also reported that they often browsed the Web and performed some shopping-related research. A common characteristic of this iPad use is that it is heavily dominated by media consumption, except for the small amount of work based production such as responding to emails, typing notes, etc. Additionally, it is important to keep in mind that usage pattern is just one aspect of a device's usability, further research should therefore also consider hardware ergonomics from a human factors domain, as well as the metaphysical aspects (i.e., thought process, is the device intimidating, etc.).

Budiu and Nielsen (2011) reported that about half the users carried the iPad with them frequently, while the other half used it mainly at home or on longer trips. The researchers discovered that participants experienced a read–tap asymmetry for some websites, with font sizes that large enough to read, however too small to enable the user to tap the

correct area accurately (Budiu & Nielsen, 2011). Additionally, the researchers identified that participants found many of the "touchable areas" within the applications as being too small, or sometimes too close together, requiring a great deal of dexterity. Participants experienced a great deal of accidental activation of touchable areas, as a result of unintended touches, which again caused trouble, particularly in applications lacking a "back button" which, resulted in users getting lost (Budiu & Nielsen, 2011). Furthermore, the informants in the study stated that they disliked typing on the touch screen and thus avoided typing intensive activities.

Budiu and Nielsen (2011), identified how many of the participants in this study could not turn the page in readings applications because they swiped in the wrong spot, which resulted in a typical conclusion that the application must be broken. The informants in this study were all younger to middle aged, it will be curious to see how swipe ambiguity affects older populations, which is what is required to obtain a fuller understanding of the iPad's usability.

Although highly useful in providing an essential framework for iPad usability research, the work by Budiu and Nielsen (2011), has a few limitations. First it does not offer a multi-dimensional approach towards usability, nor does it offer an occupational-based framework. Budiu and Nielsen (2011), research offered a purely qualitatively based account of users experience and attitudes towards the iPad. They used an interview-only based approach to studying the iPad's usability, however in order to obtain a more complete understanding of the devices usability future research should incorporate a multimodal and systematic approach with focuses on the ergonomic aspects of the iPad's hardware, as well as how users actually use the device. The study of usability of devices

is an area of study within human factors, and human factors literature suggests an effective approach involves the use of a Hierarchical task analysis (HTA) and activity analysis (AA) to evaluate the iPad's utility. An HTA breaks down a task to subtasks, from complex to constituent operational elements (operations) and presents possible plans for task and subtasks completions. An HTA provides a systematic description and graphically representation of how a task is completed and how it is organized to meet the overall objective of the task (Fok, Middleton, Fishcer & Polgar, 2010). An AA provides information about human knowledge, skills and abilities required to complete tasks and sub-tasks effectively (Crepeau, Cohn & Boyt Schell, 2003). Furthermore, a video analysis in combination with a HTA will best offer a more complete understanding of the device usability. This research by Budiu and Nielsen (2011), although very informative, looks at the device from an "application designer" point of view and lacks an approach which incorporates an occupational perspective, which looks at usability of the device through testing specific occupations which the participations state desire to use the device for.

2.10 Tablets for Seniors – An Evaluations of the Current Model (iPad) – 2012

Studies that examined the iPad and specifically older populations and tablet computing are only recently starting to emerge in peer-reviewed journals. This section of the literature review will highlight two recent studies involving the iPad and their contribution to the emerging literature.

A recent study from Austria by Werner F., Werner K., and Oberzaucher (2012), examined the usability of the iPad amongst novice senior users. This study involved 11

participants, aged 60 and older, who had limited experience with the Internet and PCs. The goal of the study was to evaluate the general usability and acceptance of the device amongst seniors. Results of the study demonstrated high acceptance and satisfaction rates amongst participants. Werner F., Werner K., and Oberzaucher (2012) examined the usability of the iPad and how seniors found the device's user interface (UI). The study involved three phases, an introductory phase, a testing phase, and lastly a qualitatively based interview phase.

During the introductory phase participants were given a short introduction on the interface, usage, and features of the device. The testing phase, involved having the participants perform a series of common tasks, such as checking for new email and composing a new email message. During the testing phase, the researchers did not influence the test participant, but in case of problems which the user could not overcome, a small hint was given. The final portion, which involved a qualitative interview, was conducted to discuss central usability aspects such as the readability of the elements on the screen, ease of use of gesture control and the virtual keyboard, and to get general feedback about the device and its features. All participants stated that the tablet in general was very easy to use, although most novice users claimed that it takes a little time to become accustomed to the handling and nuances of the device, however they claimed that "it was easier and faster than they expected because of the logical workflow and manageable functional range" (Werner F., Werner K., & Oberzaucher, 2012, p. 182). Participants highlighted as a positive attribute that "the device is not intimidating, as it does not look like a complex machine" (Werner F., Werner K., & Oberzaucher, 2012, p. 182). Further research should be conducted to identify if the iPad's simple design, makes

the device attractive to seniors, especially those without an abundance of experience with PCs. Furthermore, many of the participants noted that being able to enlarge the screen content as desired/needed gives the device exceptional readability.

Many of the participants in this study claimed that the "representation of web links can vary largely between different websites (they might look like a button, like a picture, have different text styles) therefore they are not always perceived and recognized correctly" (Werner F., Werner K., & Oberzaucher, 2012, p. 181). The researchers found that participants found simpler applications and features such as multi-finger gesture control quickly learnable and useable. Furthermore, for some users it was hard to distinguish between "back to the main screen" and "back within the web browser". While writing an e-mail worked quite well for all participants, some complained that the feedback given by the tablet when an email has been sent was not clear enough. Werner F., Werner K., and Oberzaucher (2012), recommend that there should be future focus on the development of tablet-based applications for seniors as well as initiatives to conquer the information demand of the target group.

The research by Werner F., Werner K., and Oberzaucher (2012), was some of the first research to be done involving the iPad and seniors. Approaches that study usability from the user's perspectives are needed to understand the realm of issues to support the use and uptake of devices. This research by Werner F., Werner K., and Oberzaucher (2012) provided an essential preliminary framework for further research on the iPad's usability amongst senior populations. Werner F., Werner K., and Oberzaucher (2012) used an interview only approach, which was entirely qualitatively based to study usability. Further information on the usability highlighted in this literature review may extend or

elaborate on the usability of the iPad by incorporating a multimodal and systematic approach to gain knowledge on areas such as UI interface barriers, cognitive, occupational barriers, ergonomic barriers, etc. Prior research by Werner F., Werner K., and Oberzaucher (2012) quantified usability in their research descriptively through participants oral reports of the device being absent or limited in the number of barriers to a seamless operation. Further, usability is also quantified by the degree to which the device can be successful and effectively operated by the user after only a short introduction and without any assistance. The methods performed in this research did not look at usability from a Humans Factors (HF) perspective. In an attempt to build upon the research of (Werner F., Werner K., and Oberzaucher (2012), the research in the current study will draw upon elements from a HF approach. HF literature offers multiple approaches to evaluate the usability of different technologies. One method often used is a Hierarchical task analysis (HTA). This type of approach should offer greater emphasis on uncovering specific multimodal and systematic information on the usability of tablet devices like the iPad with seniors.

2.11 Summary

Previous research suggests that seniors have the desire to use Internet technologies and to be included in computer skills trainings. (Chaffin & Harlow, 2005) However, prior literature has also identified many challenges seniors' face when learning to use traditional PCs. Further, the constant shift in North American society to digital based solutions is making the knowledge of how to use these Internet technologies evermore essential. Chaffin and Harlow (2005) identify how seniors may be disadvantaged in using

PCs to participate in a range of meaningful occupations given their lack of experience, the ergonomic difficulties, and finally their slower rate of learning new technologies. Further, literature on reasons of abandonment has indicated that the vast complexities and nuances of the PC has the potential to result in its abandonment in novice users, as the how perceived usefulness decreases with its perceived over complexity, which also contributes to a lack of confidence for seniors (Wang, Rau & Salvendy). Prior literature by Wang, Rau and Salvendy identified that as a result of a lack of technological experience, seniors have an easier time learning and are more effectively using relatively less complex technologies. Furthermore, previous literature has outlined that various physical difficulties associated with ageing make the use of a computer ergonomically challenging for older populations compared to younger populations (Chaffin & Harlow, 2005). Although studies on the iPad are only beginning to emerge, the literature that is currently available, identified that younger to middle aged populations are predominantly using their iPads to play games, check email and social networking sites, watch videos, and read the news. As evidenced by the above list, a common characteristic of this iPad usage is that it's heavily dominated by media consumption, except for the small amount of work-based production that involved in responding to emails (Budiu & Nielsen, 2011). It is important to note that this study did not deal with seniors, and that future research is required to determine what exactly seniors are using iPad's for. Additionally, the researchers discovered a read–tap asymmetry for websites, with many of the applications for the iPad having font sizes that are sized sufficiently enough to read, however are too small to enable the user to tap the correct area accurately. Further, the researchers found that participants found many of the "touchable areas" within many applications as being

too small, or sometimes too close together, requiring a great deal of dexterity. Again, this research was not conducted with seniors and future studies need to be conducted with seniors in order to obtain a fuller understanding of the devices usability. The research by Werner F., Werner K., and Oberzaucher (2012), offers some of the first academic literature that directly studied the iPads's usability with a senior population. The researchers found that participants demonstrated high acceptance and satisfaction rates with the iPad. Furthermore all participants found that the tablet in general was very easy to use, although most novice users claimed that it takes a little time to become accustomed to the handling and nuances of the device. Participants stated, "It [the iPad] was easier and faster than they expected because of the logical workflow and manageable functional range" (Werner F., Werner K., & Oberzaucher, 2012, p. 182). Participants highlighted as a positive attribute that the device is not perceived to be intimidating, and participants also stated it does not look like a complex machine (Werner F., Werner K., & Oberzaucher, 2012, p.182). Future research needs to be conducted to identify if the iPad's simple design, makes the device attractive to seniors, especially those without an abundance of experience with PCs.

With much of North America increasingly moving towards online solutions in combination with western-culture's assumption that there is universal Internet access, there is a potential for seniors to experience occupational deprivation as more and more of their daily occupations migrate to purely web-based versions. This expectation of how daily routines and instrumental occupations such as banking and communicating with others online, in combination with their challenges with PCs produce a conflict, one that academics need to research to help alleviate this injustice. Studying other forms of

Internet communication devices like the iPad now become a central issue to alleviating this occupational deprivation and will help aid seniors in their decision with regards to what may be the most suitable technology for them to adopt.

The purpose of this research was to determine what occupations senior iPad users are utilizing their iPads for, as well as what their potential usage desires might be. Further, the research sought to obtain knowledge on seniors experience with using and learning the iPad, especially with respect to usability from an ergonomic (hardware) and software (application design) perspective. This information will ultimately be analyzed and sorted to provide information to seniors with valuable insight on making informed decision on their technological purchases, as well as to provide feedback to application designers about how seniors use iPads and the common frustrations, such as the read-tap asymmetry experienced by all participants, the non intuitive illustration of select system icons, and the ambiguously identified “touchable” areas within most applications. All of these particular frustrations were experienced by all of the participants in this research and the utilization of this data in the design of their applications may potentially result in the continued use and engagement in their particular application(s) by seniors.

Chapter 3

3 Methodology

3.1 Research Design

This research involved a usability study of the iPad tablet-computing device. Usability studies seek to examine how users use devices and what factors contribute to the utility of the device in the midst of everyday activities or occupations (Hornbak, 2006). The research method was broken down into two separate phases, labeled Phase I and Phase II respectively. Given the lack of research on the use of the iPad by seniors, Phase I utilized a descriptive qualitative methodology to understand viewpoints about using the device. This phase involved an inductive method to guide the data collection and analysis. The researchers utilized a focus group method supplemented by a usability questionnaire to obtain data with respect to experiences towards the usability of the iPad with five novice iPad users. As per the recommendation of Hornbak, 2006, they indicate that researchers who conduct usability studies are well advised to use standardized questionnaires whenever possible. Such questionnaires are available both for overall satisfaction and for specific attitudes. This methodology was utilized based on the indications of Magilvy, Joan, and Thomas, E. (2009) who suggest utilizing a descriptive qualitative study design to understand process and experiences of groups of individuals using comprehensive summarization, in everyday terms, of specific events. Further, as indicated by Hornbak (2006), a major challenge to the study of usability is to extend satisfaction measures beyond post-use questionnaires, and to focus more on validation and standardization of satisfaction measures. Based on the suggestions of Hornbak (2006) a second deductive Phase involving a subtask performance was employed for validation and consistency

purposes. Furthermore, Newman and Taylor (1999) indicate that explanations of what usability means agree that it is context dependent and therefore it was imperative to employ the Phase I of the research to determine what are the participants desired uses of the device and then tailor a usability task assignment to those task.

The second phase of the research (Phase II) utilized a deductive observational method to observe how seniors actually perform specific subtasks using the iPad. The deductive phase of this usability study was based on approaches used in HF, which involved a detailed task analysis approach (Stanton, Salmon, Walker, Baber, & Jenkins, 2005) to obtain a more complete understanding of usability. The components of the detailed task analysis included a Hierarchical Task Analysis (HTA), and Activity Analysis (AA) to provide a multidimensional analysis of usability. These types of analysis are described below.

It should be noted that the study approach utilized was similar to that of mixed methods however, the complexities involved in researching usability did not allow for a narrow or isolated standpoint

The following study examined seniors who were current iPad users/owners with limited experience with the device (less than 3 months). This population was strategically chosen because the goal of the research was to obtain insight on seniors experiences with the learnability of the device and to obtain information from the prospective of an iPad learner. This study involved two phases, labeled Phase I and Phase IIa/b. Phase I consisted of a focus group designed to gain a knowledge database towards seniors experience with using and learning the iPad, especially with respect to usability from an

ergonomic (hardware) and software perspective. Another goal of this phase was to determine what specific occupations the participants were currently using their iPads for, as well as their potential desired uses. The second phase of the research involved two sections, Phase IIa and Phase IIb. Phase IIa consisted of a task performance, which was designed to obtain an actually account and analysis of how seniors use the iPad from a HF perspective. Phase IIb consisted of a one-on-one in-depth interviews from a qualitative approach, designed to obtain a follow-up account of seniors experiences learning the device as well as its usability.

3.2 Methods – Phase I

Participants.

The research study recruited participants who were seniors that were current iPad users. Inclusion criteria required that participants be 65 years of age or older, in good overall health with no major health concerns, fluent in English, have used an iPad for less than three months (total usage time). Study participation required that seniors be novice users, however requirement did not focus or have specificity particular requirements for the total duration users had owned or possessed the device. Recruitment was only concerned with the amount of time they had actually used the device (less than 3 months since they started using the iPad). Therefore, a potential participant may have owned the device for greater than 3 months, however the device may be shared with a spouse and thus, they may potentially meet the recruitment requirements because they had not actually started using the device until recently. Participants were also required to be able to provide their own transportation to and from the study location. Participants were recruited through

advertisement posters located at various strategic areas of high senior traffic (e.g., two senior recreation centers) Recruitment was implemented using a strategic "rollout" method, where initial recruitment advertising was limited to a local plaza, and then as required, additional posters were placed at two areas of high senior traffic (two additional senior activity centers). Recruitment was also completed through a verbal announcement that was made in person to a local seniors exercise group called the Retirement Research Association. This exercise group is heavily involved in various research projects at Western University and regularly participate in ongoing research at the University. Prior to study commencement and recruitment ethics approval was obtained. Additionally, participants provided informed written consent prior to participating in the research and were informed that all sessions would be video and audio recorded for reviewing and data analysis purposes (see Appendix 5 for ethics approval and Appendix 6 for the letter for information and consent). The study was comprised of two phases. Phase I involved 2 separate focus group sessions with five participants (three males and two females, 69 - 84 years old, mean age 75.6). At the completion of Phase I, each participant was asked if they would be interested in participating in the second phase of the study.

Two participants expressed interest and were recruited for Phase II of the study, which was divided into Phase IIa and Phase IIb. Phase IIa involved having participants come to the University's qualitative lab and perform four subtasks using the iPad. These four subtasks were determined from Phase I of the research, by analyzing each participant's usage patterns, and selecting an application that was common to each participant's usage behaviour. This subtask performance was then used to complete a HTA and AA to better

understand seniors use of the iPad. Phase IIb consisted of an in-depth interview that was completed after the HTA.

The sample sizes were selected based upon prior research by Magilvy, Joan, and Thomas, E. (2009) who suggest that a sample size for a qualitative descriptive research range from three to 20 participants. The sample size (N=2) for the research was selected based upon guidelines suggested by Magilvy and Thomas (2009) who suggest that a sample size for a qualitative descriptive research range from three to 20 participants. As suggested by Magilvy and Thomas (2009), the goal of a qualitative study is "to produce a rich description and in-depth understanding of the phenomenon of interest, the cultural or lived experience of people in natural settings. These authors suggest that a typical qualitative descriptive study is often smaller than in other qualitative designs and is conveniently and purposively selected as to obtain the experiences of participants. Further, the authors suggest the lower range for a novice researcher as this allows for an opportunity to practice interviewing and recording skills, become a good listener, and generate a manageable amount of data (Magilvy & Thomas, 2009).

Focus group sizes were also kept small. The first focus group session consisted of three participants, while the second focus group session consisted of 2 participants. The sample size of N=3 and N=2 respectively was chosen based on the recommendations of Magilvy and Thomas (2009) who suggest first-time researchers keep their focus group sizes small. The authors justify small focus group sizes based on the requirements of dealing with, and the logistics of running and managing a focus group. Magilvy and Thomas (2009) state that the goal of qualitative descriptive is to "to produce a rich description and in-depth understanding of the phenomenon of interest, the cultural or lived experience of

people in natural settings", and with an increase in the number of participants there would have been the risk that important data would be missed and each participants voice and experience would not have been told sufficiently told.

In addition, the sample size (N=2) was appropriate for a usability study qualified by Turner, Lewis, and Nielsen (2006), experts on usability research sample sizes. Turner, Lewis, and Nielsen (2006) indicate that with usability studies problems are often detected with the first three to five subjects. Running additional subjects during the same test is unlikely to reveal new information. Return on investment (ROI) in usability testing is maximized when testing with small groups using an iterative test-and-design methodology. Further, this research involved a highly specific population, who would be able to provide a great deal of information on a specific aspect of usability of the device.

Phase I Data Collection.

Phase I took place at Elborn College of Western University in the qualitative laboratory. This exploratory phase consisted of two focus group interview discussions with seniors who are current iPad users, but have limited experience (three months or less of total usage time). Data collection also involved having each participant complete a questionnaire booklet that consisted of 31 questions related to the iPad's perceived usability, satisfaction and individual usage specifics. The questionnaire questions were developed by the primary researcher and as a research assistant who is highly experienced in qualitative focus group methodology. The questions were in the form of either fill-in-the-blanks, short-answer or multiple-choice quantified using a Likert scale rating. The initial questions in the booklet requested demographic-type information such

as age, general usage statistics, application preferences, etc., mainly for the purposes of comparison and interpretation. Each participant was provided this questionnaire booklet upon arrival to the study location and the booklet was collected from each participant at the end of the focus group sessions. (See Appendix 3 for a sample of the demographic information questionnaire.) The questionnaire booklet served to introduce participants to themes and types of questions that will be discussed, as well as to provide participants with some time to reflect and think about what some of their answers might be, prior to the start of the focus group-based discussion. Additionally, this questionnaire booklet provided the researchers with hard-copy data to reflect back on when analyzing the focus group data for consistency and validation purposes. Each focus group was video and audio recorded for the purposes of data recollection, analysis and verification. Additionally, participants were informed that they will be asked to elaborate and discuss the questions in the booklet and they are encouraged to refer back to their answers to assist with the discussion.

During each of the focus group interview sessions, the primary researcher acted as a moderator and facilitated organized discussion. Two research assistants were also present during the interviews. The first assistant researcher partook in the focus group interviews discussion, assisting in maintaining orderly and organized discussion, but also assisted in making observational notes regarding the discussion. The second assistant researcher was located in a separate room during the duration of the focus group interviews. This separate room housed all of the audio-visual recording equipment. This assistant researcher was in charge of maintaining the seamless operation of the audio-visual recording throughout the duration of the focus group interviews. Additionally, this

researcher was also in charge of continually repositioning the cameras and focusing them on the current speaker during the focus group interviews sessions. All recordings were saved to a DVD-R disc, and then transferred onto a secure hard drive disc on a computer housed at a secure location at the University. It was essential that participants included in the research have limited experience using the iPad, because seniors who are already well versed with the device may not be able to offer the same degree of insight towards learnability due to their familiarity, comfort and confidence in using the device.

A descriptive qualitative study as guided by Magilvy, Joan, and Thomas (2009) was used to guide the data collection and analysis of this phase of the study. Based on guidelines set forth by Magilvy, Joan, and Thomas (2009), information was elicited from participants via simple questions designed to evoke responses within narrow boundaries as to facilitate analysis and reflection. Sample questions were framed for information related to main daily or weekly uses of the iPad, desired uses such as what participants would like to use the iPad for but currently are unable to, views on the expectations of others re: using the iPad, barriers and facilitators, who purchased the iPad (e.g., did the participant purchase the device or was it received as a gift), accessibility associated with iPad use, as well as some general ergonomic feedback on the fit of the device with the needs of seniors who are aging. Participants were given the opportunity to think about the various uses of the device and various sample questions were provided in a written hard copy to further assist in recollection and to allow participants to reflect, while other participants were speaking during the focus group interview sessions (see Appendix 4 for sample questions used to guide focus group interview discussion). Given the plethora of information each participant had to share, focus group interviews size was kept small (2-3

participants present during each focus group session), to ensure that each participant had ample opportunity to share his or her views and attitudes. Through focus group interview meetings, a popular task that many participants reported using the iPad for was identified and employed in Phase II of the study. The primary researcher completed the transcription of both focus group interviews, as well as both post-interviews. The transcription process was performed by reviewing all video footage multiple times and developing a complete dialogue of what each participant said to verbatim. In the transcription process, the video and audio data was handled together in order for the researchers to accurately discern the correct speaker.

Phase I Data Analysis.

Data analysis of the data in Phase I was guided by Rabiee (2004), Qualitative Focus-Group guide. The analysis of the focus group interview data was comprised of five stages, familiarization; identifying a thematic framework; indexing; charting; and lastly, mapping & interpretation. The initial process of data analysis began early, in the data collection phase, by the primary researcher using a semi-structured focus group interviews to facilitate discussion. Data analysis was also initiated in the transcription process. The primary researcher completed the transcription of both focus group interviews. The process of transcription involved reviewing the focus group interviews video footage multiple times, and then generating a complete typed dialogue of what each participant said during the meeting. Transcription was completed using the verbatim responses, however filler words, involved in natural speech, such as “ums” were removed for flow and consistency. During this process the primary researcher began to reflect on the factors relevant to the utility of iPad from the perspectives of the senior users.

Additionally throughout the process of data analysis the primary researcher regularly met with a member of the advisory team, who was a supervisor experienced in qualitative data analysis. This advisory team member also analyzed all of the transcripts for the purposes of peer review and for consistency purposes.

Additionally, all the data from the questionnaire booklet from each participant was used for the purposes of describing the sample and to compare information for consistency with the focus group discussion findings. This assisted the researchers in judging the adequacy of their interpretation of the focus group data. Initial analyses involved expanding on the data from the focus group interviews with the use of observational notes (Rabiee, 2004). The initial stage, familiarization, was achieved by having the primary researcher and one research assistant view and produce initial thought notes on the video recordings, as well as through reading and rereading the observational and summary notes until familiarization with the data was achieved (Rabiee, 2004).

The third stage, involved the development of a thematic framework through the process of writing various memo notes in margins of the observational summary notes taken during the focus group interviews, as well as on the transcript of the focus group interviews. This supported the primary researcher in identifying and producing factors through identifying and reflecting upon the common question “what is the participant saying about using the iPad?” The following process was indexing, which involved analyzing the data further, highlighting and sorting quotes with the mindset of identifying a deeper contextualized understanding. The data were re-reviewed to produce a comprehensive list and to obtain an understanding of the barriers and facilitators associated with the use of the device. The fourth stage, charting, involved lifting the

isolated quotations from their original context and re-arranging them under the newly developed thematic framework of barriers and facilitators of iPad use.

The fifth and final stage, mapping and interpreting, consisted of obtaining a more comprehensive understanding of the barriers and facilitator's seniors experience with usage of the iPad, through analysis of individual quotes. This involved an imaginative and analytical mindset, which was used in order to grasp a more complete understanding of the relationship between the quotes, and the links to the actual usage of seniors with the iPad (Rabiee, 2004). The following headings were used as a framework for interpreting and coding the data: i) Learnability Factor; ii) Attachment Factor; iii) Intuitiveness Factor; iv) Use Factor; v) Convenience Factor. A sample of the framework is provided below (table 1) to demonstrate the outcome of analysis and developing headings as a framework to support the interpretation of the data.

Table 1

Framework Headings.

Heading	Example
i)learnability factor	Participant's actual experience may show little relationship with their understanding of the term before the event.
ii) Attachment Factor	P1: I use it practically everyday, and I might not use my computer every day.
iii) Intuitiveness Factor	P1: Icons are. And on that basis they're, they're mostly pretty

	intuitive.
iv) Use Factor	P1: So, this is my first, my first look is on the iPad. And then, if I have a letter to compose, I use my computer.
v) Convenience Factor	P1: It's very convenient, and the portability factor is nice. Also fast on.

3.3 Methods – Phase II

Phase IIa Data Collection Methods.

Two participants who were recruited from Phase I were invited to participate in a hands-on laboratory based session involving the iPad. Any participant who expressed a desire to participate in the second phase of the research was selected. During this session, participants were asked to complete a task assignment, which was derived from the findings of Phase I of this study. The chosen task for the subtask performance was one with a high popularity as expressed by participants. This particular task revolved around using the "iBooks" and "Mail "applications. This subtask performance was divided into several smaller subtasks. Prior to the initiation of the task assignment, participants were given an in-depth overview of what the task required and what would be entailed. The chosen task involved having participants locate the iBooks application, purchase an iBook from the "iBooks Store", make some common reading preference adjustments, navigating through the iBook using the search function, and finally compose and send a

short email using the Mail application. It is important to note that the task performance did not require participants to share and/or enter any of their personal information. Throughout the completion of the subtasks, participants were provided oral instructions by the primary researcher, and in the event that a participant was unable to successfully complete a particular step, the primary researcher provided a guiding "hint" as to assist the participant in a non-obtrusive manner, providing only essential information to allow the participant to continue moving through the subtasks. (See Table 2 for an example of the instructions provided to the participants).

Table 2

Task Performance Instructions Provided to Participants (Sample)

Step	Instruction
1	"Wake and unlock the iPad"
2	"Open the "iBooks" Application"
3	"Navigate through the iBooks app to the iBooks Store"
4	"Search through the iBooks Store for 'Pride and Prejudice' by Jane Austin"
5	"Download the iBook"
6	"Open the recently downloaded iBook and adjust the various reading preference options to your desire"
7	"Bookmark a page in the iBook"
8	"Use the Search Function of the iBook to find a list of results pertaining to the term 'girl'"

9	"Return to the home screen of the iPad"
10	"Compose a brief email to mvoumvak@uwo.ca regarding your newly obtained iBook"
11	"Send the email"

Participants were asked to complete each of subtasks continuously, however breaks were permitted as required by the participants. During the completion of the task, participants were encouraged to think aloud, as it was important to obtain each participant's thought process throughout the task. During the task performance, the primary researcher and one research assistant noted instances where potential errors and/or barriers to successful completion occurred. Additionally, a second research assistant who was located in a separate "control room" operated the audio and video equipment that was used to record the session.

Phase IIa Data Analysis.

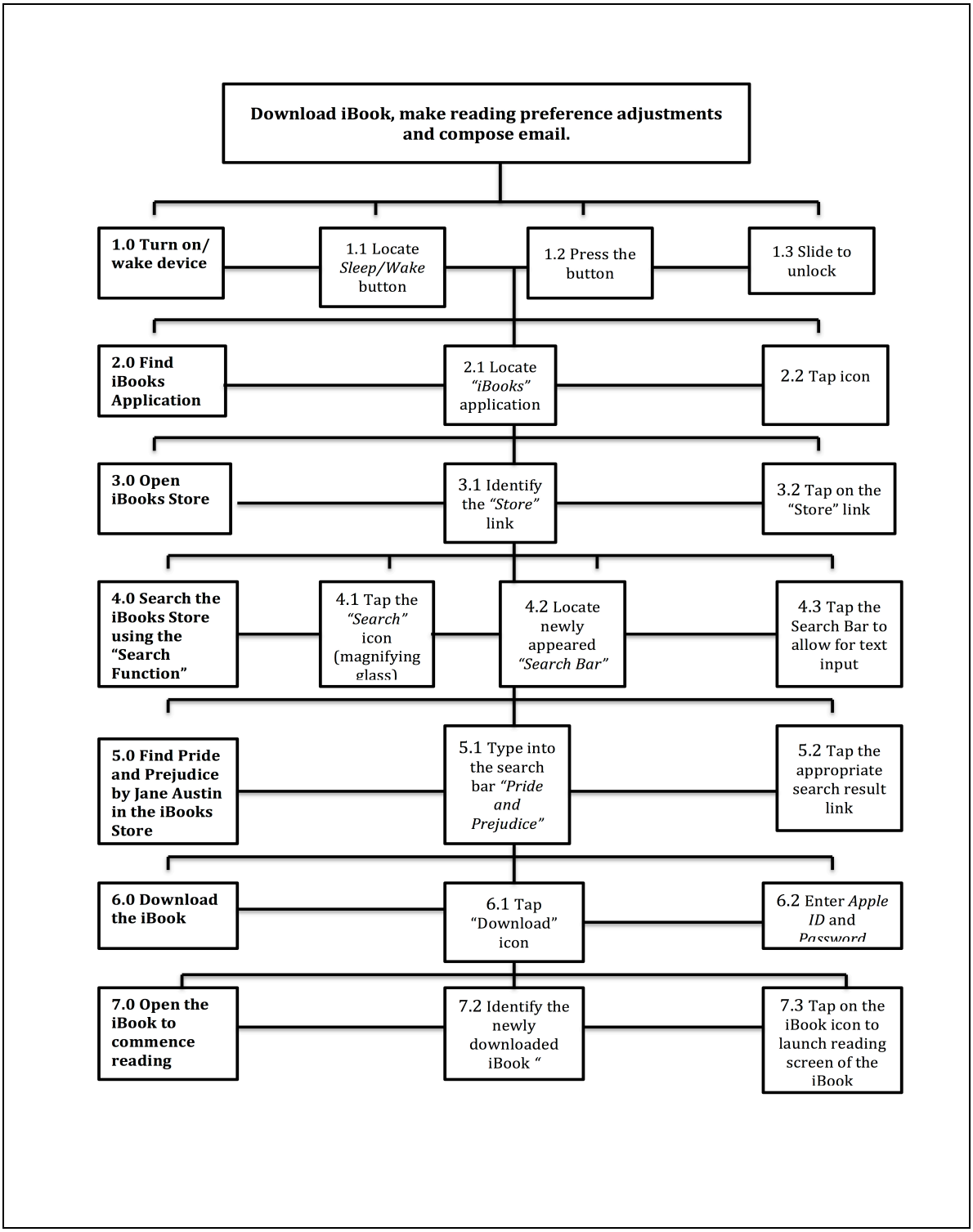
Following lab based testing, the video recordings for each participant were reviewed for the purpose of generating a HTA. A HTA offers a systematic description of how a task is preformed and how it is organized to meet the overall objective of the task (Fok, Middleton, Fishcer & Polgar, 2010). The primary researcher competed the HTA. This method involved a deductive approach to identify the overall goal of the task, and all of the various sub-tasks and conditions under which they should be carried out in order to successfully accomplish the said task. This approach offers a way of breaking down

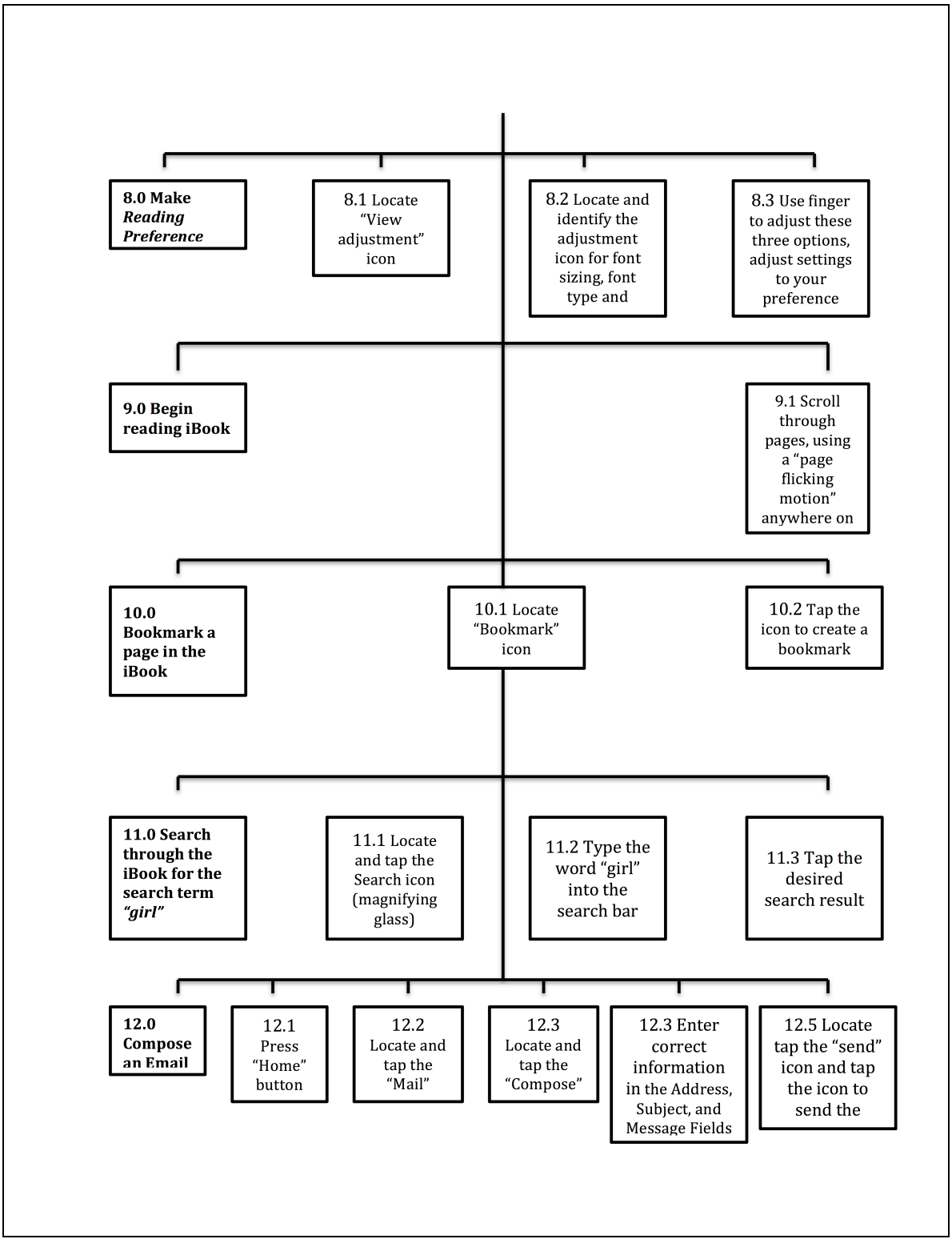
complex task operations hierarchically into various singular operations – the various physical and mental operations, as well as the conditions under which it is necessary to perform these operations (Fok, Middleton, Fishcer & Polgar, 2010). The HTA begins by stating the overall objective that the participant had to achieve. Then the objective task is broken down into a set of all possible sub-operations and the chronological order in which the user must carry them out. To complete this HTA, the primary researcher repeatedly performed the task assignment, as to determine the most efficient method (i.e., fewest steps, minimal back tracking and free of errors) of completing each subtask. After the most efficient method was determined or the "gold-standard HTA", each subtask was broken down into a list of the basic steps, button presses, and hand gestures required to complete each individual subtask. This list was then reviewed and confirmed by two research assistants. Finally, this information was extrapolated and transformed into a polished and complete HTA, in the form of a flowchart, offering the "gold standard" of how said task should be completed. (See below for an illustration of the final HTA for representation of the gold standard for the subtask). A separate HTA checklist was completed for each participant, by reviewing the video recording of the task performance multiple times and generating a detailed representation of how each participant actually completed each subtask, including all errors and backtracking that were observed. The gold standard HTA was then compared to the HTA checklist generated for each participant's performance by the primary researcher and two research assistants. Usability was quantified from these analyses in reference to the degree to which the participant's subtask performance varied from the "gold standard" completion template of the HTA ideal performance. Additionally, following the subtask performance, during

the in-depth interview, participants were questioned further about the iPad's usability and also questioned about areas of particular difficulty that were noted during their subtask performance. Questioning was performed in the following manner, "during x part of the subtask performance, you seemed to have difficulty with y, what is it about the device and/or application that made you think z was the correct action to take?" The information obtained from the in-depth interview was used to further validate the determined results of the HTA analysis. Additionally, the determined overall usability of the iPad amongst the two participants who participated in Phase II of the research was further validated and compared for consistency with the ratings from all five participants from the previous Phase of the research, from both the focus group data and the questionnaire Likert ratings. From the focus group content related to usability, all the data were reviewed across the inductive and deductive data with respect to content to elaborate on usability and further analyzed to create various "factors" related to the devices perceived usability. In line with the research of Werner F., Werner K., and Oberzaucher (2012) usability was also quantified by the degree to which participants verbally rated the usability of the iPad as being without barriers to a seamless operation.

Figure 1

HTA Gold Standard




8.0 Make *Reading Preference*
8.1 Locate "View adjustment" icon
8.2 Locate and identify the adjustment icon for font sizing, font type and
8.3 Use finger to adjust these three options, adjust settings to your preference
9.0 Begin reading iBook
9.1 Scroll through pages, using a "page flicking motion" anywhere on
10.0 Bookmark a page in the iBook
10.1 Locate "Bookmark" icon
10.2 Tap the icon to create a bookmark
11.0 Search through the iBook for the search term *"girl"*
11.1 Locate and tap the Search icon (magnifying glass)
11.2 Type the word "girl" into the search bar
11.3 Tap the desired search result
12.0 Compose an Email
12.1 Press "Home" button
12.2 Locate and tap the "Mail"
12.3 Locate and tap the "Compose"
12.3 Enter correct information in the Address, Subject, and Message Fields
12.5 Locate tap the "send" icon and tap the icon to send the

Following the HTA, an activity analysis (AA) was completed for each of the subtask operations identified within the HTA. An AA provides information about human knowledge, skills and abilities required to complete tasks and sub-tasks effectively (Crepeau, Cohn & Boyt Schell, 2003). The AA was documented for each subtask and was represented by three major components, a motor component, a cognitive component and a sensory component. Requirements from each of these components was documented for each subtask and used to supplement the HTA. This information was then added to the HTA flowchart to supplement the analysis. Two co-investigators then reviewed the completed HTA/AA flowchart to compare analyses. Areas of difference were noted and discussed, then reviewed again to gain an overall consensus on the flow to increase rigor and accuracy.

Based on the work of Fisk, Rogers, Charness, Czaja and Sharit (2009) the HTA/AA flowchart information was then used as a basis to create a "checklist", which was used to compare against how each participant's task performance varied from the "gold standard" HTA/AA developed by the primary researcher. The primary investigator then completed video analysis for both cases of seniors performing the specified subtasks, with a uniform template. The analysis yielded results that were descriptive rather than quantitative (Fok, Middleton, Fishcer & Polgar, 2010). For example specificities such as the length of time required to complete each subtask (sustained attention) were not directly measured (Fok, Middleton, Fishcer & Polgar, 2010). Additionally, variations in the performances (against the "ideal" HTA/AA) were noted in order to determine performance accuracy, efficiency, but also to obtain a greater understanding of how each participant specifically uses the device. Finally, a detailed HTA/AA checklist was completed for each participant, and

then compared against the gold standard HTA to analyze for variations in task performances for efficiency measures (see figure below).

Figure 2

Hierarchical Task Analysis (HTA) Checklist

Hierarchical Task Analysis (HTA) Checklist

1.0 Turn on device
- **1.1** Locate and identify the *Sleep/Wake* button ☐
- **1.2** Press the button ☐
- **1.3** Slide to unlock ☐

2.0 Finding iBooks Application
- **2.1** Navigate, locate and identify *"iBooks"* application ☐
- **2.2** Tap on the *"iBooks"* application icon with finger to open iBooks application ☐

3.0 Open iBooks Store
- **3.1** Navigate through the application and identify the *"Store"* link, to be redirected to the "iBooks Store" ☐
- **3.2** Tap on the "Store" link ☐

4.0 Use the Search function to search for books in the iBooks Store
- **4.1** Navigate through the iBooks Store and locate the *"Search"* icon (also identified by a magnifying glass) ☐
- **4.2** Tap on the *"Search"* icon ☐
- **4.3** Identify and locate the newly appeared *"Search Bar"* ☐
- **4.4** Tap on the search bar to allow text to be entered using the virtual keypad ☐

5.0 Find Pride and Prejudice by Jane Austin in the iBooks Store
- **5.1** Type into the search bar *"Pride and Prejudice"* using the virtual keypad in order to obtain search results from the iBooks library pertaining to this book title ☐
- **5.2** Navigate through the "search results", which are presented and tap on the appropriate search result link ☐

6.0 Download the iBook
- **6.1** Once selected and tapped on the appropriate link, locate and identify the

"Download" icon to begin downloading the selected iBook

6.2 When prompted enter *Apple ID* and *Password* using the virtual keyboard

7.0 Open the iBook to commence reading

7.1 The user will automatically be returned to the iBooks Library

7.2 Identify the newly downloaded iBook *"Pride and Prejudice by Jane Austin"*

7.3 Tap on the iBook icon to launch reading screen of the iBook

8.0 Make *Reading Preference* adjustments

8.1 Locate and identify the "View adjustment" icon (Also can be identified by an icon of an upper and lower case "A", beside each other)

8.2 Locate and identify the adjustment icon for font sizing, font type and brightness

8.3 Using finger to adjust these three options, adjust settings to your desired liking

9.0 Begin reading iBook (imagine)

9.1 To scroll through pages, use a "page flicking motion" anywhere on the virtual book

10.0 Bookmark a page in the iBook

10.1 Locate and identify "Bookmark" icon and tap the icon to create a bookmark at the desired location

11.0 Search through the iBook for the search term *"girl"*

11.1 Return to the iBook's "Library", by locating and identifying the "Library" icon, then tapping on it

11.2 Reopen selected iBook and use the in-book search function to jump to the Third Chapter of the iBook using the chapter navigation tab

11.2.1 Locate and identify the search function (Also identified by a magnifying glass icon)

11.2.2 Type into the search bar, the desired keyword

11.2.3 Using the virtual keypad type the search term *"girl"* into the search field

11.2.4 Identify and select the desire search result to transferred to that location of the iBook

12.0 Compose an Email

12.1 Return to the Home Screen of the Device by pressing the "Home button"

12.2 Navigate, locate and identify the "Mail" Application
12.3 Locate and identify the "Compose" icon (Also identified by a pen on a sheet of paper)
12.4 Tap on the icon
12.5 Compose a very short email to mvoumvak@uwo.ca about the new iBook you have just downloaded (Be sure to write and appropriate topic)
12.6 Tap on the Address Field and using the virtual keypad type the appreciate email address
12.7 Tap on the Subject Field and using the virtual keypad type the appropriate subject text
12.8 Tap on the Message Field and using the virtual keypad type the appropriate message text
12.9 Locate and identify the "Send" icon and tap the icon to send the email message

13.0 **Return to iPad home screen**

Phase IIb Data Collection Methods.

Phase IIb of the study commenced immediately after the participants completed the tasks involved in Phase IIa. This phase of the study consisted of a short one-on-one interview with each participant conducted by the primary researcher. Each interview lasted approximately 30 minutes in duration. Participants were informed that their participation was voluntary and they were free to withdraw from participation at any time. Participants were given an opportunity to reflect on the task from Phase IIa, as well as to elaborate on their thought processes throughout and challenges they faced during each subtask. Participants were asked specifically, what is it about the design of the device that lead to them to thinking "this" was the correct way of completing the subtask. Additionally, participants were given an opportunity to comment on the barriers and facilitators they face when using the iPad and provide their overall thoughts and attitudes with respect to

the device. Finally, participants were questioned with respect to their answers they had provided to some of the various questions regarding usability, utility, and satisfaction with their iPads, and question as to whether their responses remained consistent or may have changed and asked to elaborate.

Phase IIb offered an inductive, confirmatory component. This phase provided an opportunity for review of the HTA/AA for each subtask (from Phase IIa) and for the primary researcher to gain further insight from the learning's of Phase I. Each participant was asked to elaborate on the outcome and process of the task they completed immediately following the experience. Feedback was collected through semi-structured interviews (see Table 3 for the questions used to guide the confirmatory interview).

Table 3

Sample Questions Provided to Participants

No.	Sample Question
1	"What aspects of the device would you say are designed particularly well, and what aspects could be designed better?"
2	"What part of the task assignment did you find most challenging?"
3	"You seemed to have difficulty with *x*, what is it about the design of the device or application, which made you think *y*, was the correct action to take?"

4	"If you had an opportunity to meet with the designer of the device (hardware and software), and provide input towards how you personally would change the device, what would you say?"

Phase IIb Data Analysis.

Data analysis of Phase IIb followed a similar framework to that used in the data analysis of Phase I. The analysis structure and framework was identical to that used in section 3.2.3, and include the same five stages, familiarization; identifying a thematic framework; indexing; charting; and lastly, mapping & interpretation. The primary researcher completed the transcription of both interviews. The transcription process for the confirmatory interviews was performed identical to that of the focus group transcription, described in section 3.2.3. Initial analyses began through expanding on the data from the interviews with the use of observational notes (Rabiee, 2004). Additionally throughout the process of data analysis the primary researcher regularly met with a member of the advisory team, who was a supervisor experienced in qualitative data analysis. This advisory team member also analyzed all of the transcripts for the purposes of peer review and for consistency purposes.

In the second stage, which involved the development of a thematic framework, the primary researcher was supported in identifying and producing factors through identifying and reflecting upon the guiding research question: "what is the participant saying about their experience with the iPad?".

The same headings used in 3.2.3, crafted to produce a framework for interpreting and coding data from the analysis of Phase I were further elaborated: i)learnability factor; ii) Attachment Factor; iii) Intuitiveness Factor; iv) Use Factor; v) Convenience Factor.

Credibility of the Inductive Phases of Data Collection (Phase I and II).

Credibility was further maintained by employing strategies offered by Williams and Morrow (2008). These strategies supported the primary novice researcher in maintaining the viewpoints of seniors when interpreting the data.

Research Paradigm

Prior to commencing the research, the primary researcher identified his research paradigm and critically reflected on how this standpoint may influence the collection, analysis and interpretation of the data. The primary researcher's location is inline with critical constructivism in that the researcher believes that an individual's experiences shape their realities, and that all knowledge is constructed socially through experience, therefore there cannot be one true reality. Further, the researcher holds the belief that knowledge of the world is always a human and social construction. Therefore a participant having experiences with some form of technology in their life will have a different reality then an individual with no experiences with technology.

Social Validity.

Williams and Morrow (2008) define social validity as the social importance of an intervention and is evaluated by such components as the rationale for the research, the language used to communicate it, collaboration with participants, and how participants understand the research they participated in. Social validity was maintained by assessing

the focus group interviews and interview responses accurately in terms of their value and usability as voiced by the participants. This procedure helped to achieve an analysis that followed closely to what the participant intended to say, rather than solely the primary researchers own interpretation. Additionally having two co-researchers confirm the HTA and AA, that was initially suggested by the primary researcher further aided in achieving social validity. Furthermore, interview responses were parsed and reviewed according to Williams and Morrow (2008), which asserts that the interpretations should be easily understood by the reader and supported by participant quotes.

Subjectivity & Reflexivity.

The primary researcher entered the study with an expected level of subjectivity and biases due to the fact that he grew up with and was exposed to computers and technology throughout his entire life. Being a critical constructivist, maintaining that an individual's experiences shapes their realities, and that all knowledge is socially constructed through experience, the primary researcher posits that each participants reality and experience of the iPad is unique. Each participant's perceived reality with iPad use, is shaped by their prior experiences with technology of all kinds and their life experiences in general. The primary researcher entered the research acknowledging and accepting the fact that his reality with the iPad may be greatly different from that of the participants and he had grown up and used technology in a highly positive manner for his entire life. When attempting to study and analyze data from a population of individuals who had not grown-up and experienced computers from a young age, it was essential that the preconceived thoughts and ideas the primary researcher brings to the study are

acknowledged but also accounted for and also that the realities for each participant, as well as the researcher are unique social constructions.

The primary researcher also acknowledged and was aware of his subjectivity by being aware of his own thoughts and opinions towards the iPad entering the study, as well as his own preconceived notions of how seniors' use of the device is shaped by their perceived realities. The primary researcher entered the study being a regular user of the iPad for two years prior and having had mainly positive interactions with the iPad and maintaining an overall positive regard of the device. Further, through acknowledging this subjectivity the primary researcher able to enter the study with a more open-minded thought process, accepting that what he believes to be true of seniors' use of the iPad will be inevitably be shaped by his subjectivity, experiences and perceived reality. Therefore, the primary researcher and the advisory team identified that an initial exploratory phase, composed of a focus group interviews would be necessary to obtain first hand accounts of seniors actual experiences and to obtain their desired uses of the iPad.

Williams and Morrow (2008) indicate, "bias enters the picture as soon as a research question is asked in a particular way, in a particular setting, by a particular person, for a particular reason" (p. 579). The primary researcher acknowledged both the existence of and benefits of his subjectivity and bias. Prior to entering the study mental notes of preconceived notions were made and reflected upon with assistant researchers. These preconceived ideas and notions were then reflected on throughout the focus group interviews, which grounded the primary researcher to stay open to the way that seniors indicate they use the iPad.

Further, the primary researcher also attempted to manage his biases through reflexivity (Williams & Morrow, 2008). The primary researcher maintained the awareness of himself, his frame of mind entering the study, employed reflexivity and what affect this awareness had throughout the data analysis (Williams & Morrow, 2008). The primary researcher identified, as clearly as possible, what information came from the participant and what came from the researchers (Williams & Morrow, 2008).

Additionally "member checking'' was performed as a way to ensure that the primary researcher's interpretations actually honoured the meaning that was conveyed by the participants (Williams & Morrow, 2008). Findings from the focus group interviews were rechecked in the post-interview session, following the subtask performance by the two participants who agreed to be a part of the second phase of the study. The primary researcher then confirmed or disconfirmed his interpretation of what he believed the participants were trying to convey in Phase 1 of the study, also referring to the responses from the questionnaire booklet. For example, Participant 3: "It's a great little tool, and has really changed to way I work with my computer, you can just grab it and your good to go, you don't need to wait for it load up", Primary Researcher: "You were referred to as saying… in Phase I of the research, we (researchers), interpreted this to mean x, y, and z. Would this be an accurate interpretation of what you were actually trying to convey?" This process helped to achieve a more accurate understanding of the participant's views about their experiences as a tablet user. Williams and Morrow (2008), indicate that that "Participants' feedback can serve as an excellent check that the primary researcher has achieved the desired balance between the participants' voices (subjectivity) and the primary researcher' s interpretation of the meaning (reflexivity)" (p. 579). For the most

part all interpretations made by the researchers were confirmed with the two participants participating in Phase II, as the participant's responses from Phase I, were straightforward, direct and unambiguous. Thus, this member checking served to provide confirmation and validation.

Chapter 4

4 Findings and Interpretations

4.1 Overview

Adequacy of interpretation.

As suggested by Williams and Morrow (2008), direct quotes were used to exemplify the interpretations presented by the primary researcher. Lastly, methods and analytic strategies were clearly articulated, as recommended by Williams and Morrow (2008).

Phase I overview.

The findings from this exploratory study suggest that the iPad has a high usability among study participants with only minor frustrations reported. In general, participants found the device easy to use, with a high degree of utility. Obtained from the focus group data, research identified that participants experienced the iPad as being simple and non-intimidating. Participants rated the iPad as being complementary to a PC and in instances of basic computing tasks, such as checking email and browsing the Internet, the iPad had fully diminished the necessity of the PC. Further, the findings suggest that the iPad serves as a useful option for most common computing tasks, however the iPad did not totally replace the use of a PC in its entirety for the participants in this study. Results from the questionnaire booklet, indicated that 4 participants were highly satisfied with the device, with 1 participant being somewhat satisfied. Additionally, 3 participants rated the iPad as having an excellent value-to-cost ratio, while 2 participants rated the value-to-cost ratio as being good. Finally, all but 1 participant stated they would recommend the device to

iPad to other seniors. From Phase I of the research, all participants reported frequently using their iPads for emailing and messaging, playing games, viewing photos, video chatting (communication), browsing the web, and readings the news/books (in no particular order) (see Table 4 below). The majority of these tasks listed were tasks which participants had previously performed using their PC, but had migrated over to the iPad, as most felt as though they were more easily and conveniently performed using the iPad. Additionally, participants also reported a number of frustrations they experience with using the iPad, which will be described in-depth below. The analysis of focus group data suggested five major categories or factors that shaped the participants experiences with the use of their iPads. These factors included: learnability factor, Attachment Factor, Intuitiveness Factor, Use Factor, and Convenience Factor. These factors along with examples and samples of supportive quotes are elaborated below.

Table 4

Questionnaire Booklet Results

Participant # / Age	PC XP level	iPad (hours/ week)	Most used applications	Satisfaction level	iPad value rating	Primary frustration	Would recommend ?
1 / 84M	Moderate	1	Photo Web Browsing Reading Email	Somewhat satisfied	Good	Screen resolution	No
2 / 77M	High	3	Web Browsing Email Photos Reading	Very satisfied	Very good	Screen sensitivity	Yes
3 / 69F	Low	1	Email Messaging Games Reading	Very satisfied	Good	Battery life	Yes
4 / 75F	Low	10	Email Reading	Very satisfied	Very good	Battery life	Yes

5 / 73M	High	2-4	Communication Games Email Games Reading Communication	Very satisfied	Very good	Setup tutorial	Yes

4.2 Major Factors and Subfactors

The following will describe the primary factors and subfactors obtained from the focus group (Phase I) and post-interview (Phase IIb). These factors all contribute to providing an overall conceptualization of the devices usability from the participants in this study experiences with the device. In line with the work of Werner F., Werner K., and Oberzaucher (2012), usability was quantified in reference to the degree to which study participant report the device as being free of barriers to a seamless operations. Further, usability was also described by the degree to which the device can be successful and effectively operated by the user after only a short introduction (hence the recruitment requirements). Validation was done with 2 participants who participated in the second phase of the research. In Phase II, usability will be quantified by the degree to which each participant's actual subtask performance (HTA) varied from the ideal method of performing the task (HTA gold standard).

Learnability Factor.

The findings from the data analysis suggest a "Learnability Factor" as a guiding factor was used to obtain an understanding of the iPad's usability among seniors. This

learnability factor speaks to the overall process experienced by participants, as identified through the focus group data. All focus group and interview data were reviewed to generate an overview of this factor. Each participant, being relatively new users of the device, made reference to the learning process they experience using the device. Identified within this major overarching factor are the subfactors, experimentation factor, motivation factor, and annoyance factor. These subfactors provide an overall representation of the underlying elements of the learning process experienced by the participants. When participants were questioned about the learnability of the device Participant 3 responded, "Well, I mean, what would be my approach is to start to look at Safari, start looking at photos. Check out the music, just go through the whole thing." This quotation offers a clear example of the experimentation process that all participants experienced in order to begin to discover ways to use the device and learn how it operated.

Following the experimentation factor, all participants described some form of motivation factor that further pushed them to enhance their competencies with the iPad. For some participants this motivation was intrinsically based (such as a personal desire to master a new technology), and for others it was more extrinsically based, such as the drive to keep up their abilities with friends. The following quotation provides an example of the Motivation Factor,

> "Well, I'm not very computer literate. I've used a computer. My son bought me a Kobo to read. I wanted it for traveling. But for emailing I couldn't use the keypad on the Kobo with great ease. And the people we were traveling with, she had an iPad. So when I got home I bought myself an iPad. But, I mean, my son downloaded stuff on it

> for me. And I don't think it does as much as I really want it to do…….. Like I know that this can do so much more than I would ever think……. I'd like to know how you could use it, like for WordPerfect, so that when I'm somewhere I can take notes."

The participant in this example is aware of the iPads functionality from discussing the device with friends who are also iPad owners. However, she felt limited in her own ability and knowledge to take advantage of this functionality, resulting in her displaying great motivation to learn how to better use the device for her potential needs.

All the participants in the study discussed a number of frustrations with the learning process of the device, and the associated "learning pains". One participant indicated, "Well, you have to know what you want to use it for… I get frustrated because I don't know how to program it. And so I need somebody that can teach me more… I'm not sure that an iPad exactly comes ready to use because it's got to be programmed for what you want to use it for. And I don't know how to do that." In this particular example this participant was expressing her frustrations with the initial setup of the device, not necessarily the learning curve displayed after a correct initial setup. This participant purchased her iPad at a third-party retailer, which did not assist her in the initial setup of the device, or as she states "programming of the device". Furthermore, this is a clear example of the annoyance factor subfactor. Of particular interest, is the contrast of her experiences, from her initial visit during her participation in the initial focus group to her second visit and participation in the second phase, which took place the following month. After the focus group, the primary researcher assisted this participant in the proper setup of the device, as the device had initially not been properly setup, which resulted in the user constantly receiving error messages. During an interview, which occurred during

Phase II, one month after proper device setup, this participant indicated, "…that is the key right there, is that, if you go into a store to buy an iPad, it should be set up, user-friendly, for the consumer who is buying the product… so if I were going back and buying it again I would probably go to the Apple Store… I really liked it after you set it up and made it easier for me." Of particular interest is the large contrast between this participant's experiences with the device with and without the initial proper setup, and this demonstrates how the initial setup of the device can directly affect the user's experience. During the focus group sessions there was an apparent mixed consensus on the learnability, as another participant commented in direct response to the above quote, "Well, maybe I've forgotten the pain. But it didn't seem to be an enormous problem" referring to the initial setup and learning of the device. Overall, participants demonstrated mixed views towards the learning process, with some feeling unburdened by the process, while others described varying degrees of frustration with the initial learning and setup of the device.

Attachment Factor.

Observed throughout the data was a common factor of "attachment". This factor was interpreted after analysis of all the focus group and interview data. This factor was then verified during a further analysis of all focus group and interview session data for validated and consistency. The "Attachment" Factor was comprised of the subfactors, personalization factor, extension (of the hand) factor, and intimacy factor. This Attachment factor speaks to the overall sense of attachment and ownership each participant has come to develop with the device, not only in the sense of personalization and connection but also in reference to travel and where the device is brought remotely.

For example, throughout the research participants consistently made reference to the iPad as being less shared and more personal/individual as compare to a PC. Further the iPad was often contextualized in a more possessive context ("my iPad"), while the PC was contextualized simply as "the" or "our" computer" rather than "my computer" when refereed to during focus group sessions. The quotation listed below represents the sense of ownership and personalization of the iPad seem amongst the data, "Now, I've separated my financial dealings from my iPad. I wouldn't do that on my iPad. At least I hadn't considered doing it……. I've done it on the computer. I had all the other stuff, which I'd been using, and still do. I mean, I wouldn't think of using my iPad for email except to answer very quickly an email that I got, and then I could use the – I would generally go to the computer to respond". This example highlights the particular vocabulary selected by the participant which emphasizes a level of possessiveness and sense of personal ownership over the device, which evidently contrasted the connection seem with the computer. Further this finding was confirmed through member checking, that the PC is a viewed by most of the participants of this study as a more of a shared device than the iPad.

Participants often made reference to the iPad as an essential travel companion, a device that they would always have with them, especially when travelling. For example, this participant mentioned her experience travelling with the device, "I can tell you, I can't imagine taking a trip without this thing, especially abroad, if you're out of the country or you don't know the landscape." This participant referred to the level of attachment she had developed with the iPad, and referred to the device as being an essential travel

companion. This experience in using the iPad also provides a clear example of the extension factor subfactor described by participants.

Participants also described how the iPad is an intimate device. Participants offered a variety of explanations towards why they found the device to offer a more intimate experience than a PC, such as how the device can be used in a variety of intimate environments, such as on the couch, in bed, etc. Participants also described how the user interacts with the device through touch, which is arguably a more intimate form of interaction when compared to a "keyboard and mouse" interaction. Furthermore, participants offered examples of how even within applications such as video chatting, the experience was more intimate, as the faces are so close and central to the experience of the app. This quotation provides an example of the inmate experience of the device, "…So I had to go back into FaceTime again, and there she was 'Hi Nana, hi Nana' I mean it was the cutest thing. I mean it's cool. She was back in Canada, and I was sitting in the, the McDonalds and hearing and seeing her. I mean it, was, … that's exactly what we wanted it for. …So we could be in contact with family very easily, and, and we were so far away."

Intuitiveness Factor.

Data analysis suggests a common reference to an intuitiveness factor of the iPad. This factor of the intuitiveness was displayed heavily throughout the data. All participants made reference to the simple, naturalistic and automatic aspects of the iPad. This factor was identified following the analysis of all the focus group and interview data. This factor was further verified during an analysis of all focus group and interview session

data for consistency with a research assistant highly experience in qualitative data analysis. Comprising this overarching factor were the subfactors, untaught factor, a "wow" factor, and a "just works" factor. One participant remarks on the "untaught" sub factor of the device, "With a computer you can go on the Internet and get the manual. But with this, there is no manual written… That's right. You don't need it. That's the point." This participant expressed how he views the device as so intuitive and natural that the user requires no manual or instructions for successful learning and operation and how the user intuitively will know how to use it.

Another participant commented, providing an example of the "wow factor" subfactor, "…I'm amazed at folks that weren't able to deal with the computer, just absolutely washed their hands of it, it's just beyond their capability or interest, who are able to pick up an iPad and be using it in very short order. I can't imagine it being much more user friendly than it is." This quotation provides an ideal example of the "wow" factor subfactor in that he explains how friends of his with very limited or no knowledge of computers, who previously held preconceived notions regarding their lack of ability to use these devices, were able to pick up the iPad and use the device effectively much to their disbelief. These individuals' preconceived notions about their inabilities to use computer, from past experiences were challenged and new ideas were formed about their abilities. Further, this factor speaks to how the device unexpectedly reshapes users prior schemas of their abilities to use technologies.

Throughout the data, participants also made reference to a "just works" factor, referring not only to the iPad's physical design, but also to the design of the operating system and applications and how the hardware and software interact to complement each other. The

user had the option to accomplish a particular objective in a number of possible ways, and error correction is very easy as a result of the "home" button, which always returns the user back to a familiar location within the operating system. One participant stated,

> "It's [the iPad] a great introduction for folks that don't have a computer……. Friends of mine, Luddites that are friends of mine who have acquired these things, have really come out of the – they just think they're fantastic because they can now do their crossword puzzles and all that kind of stuff."

However, some participants' experiences with the device would not indicate absolute "intuitiveness". One participants remarked, "…the functions are not, don't flow as easily as I would want them to, but it's simply me, not knowing what exactly to do… Getting books, downloading books as well. Cause I think, I think, well I thought I've downloaded three books, and, but when I went to get them, they were expired, and they were gone." The participant in this particular example found some of the functions and processes of the device to be choppy and non-fluid. Although she claimed that this may be as a result of her "not knowing what exactly to do", the data remains that in this particular participant's experience the device was not completely intuitive.

Use Factor.

One of the research goals set forth by this study was to understand more about what occupations seniors use iPads for. Participants mentioned a plethora of various uses and potential usability. This factor was identified after analysis of all the focus group and interview data. The researchers then went through all of the 'uses' listed by the participants and clustered for areas of occupational use. This factor was later verified

during a further analysis of all focus group and interview session data. The most commonly reported uses of the device amongst participants in this research was staying connected with friends and family, email and messaging, browsing the web, viewing and taking photos, reading iBooks, taking notes, video chatting, games and staying up to date on current world affairs. Within this encompassing factor of the "Use Factor", a number of comprising subfactors were identified, such as a productive factor, a consumption factor, and a connection factor.

The productive subfactor refers to using the device to complete particular tasks, such as emailing youngor paying bills. One participant, describing his use, "It's a third screen. I have two screens on my computer, but I can have the manual uploaded on this thing, and I can take any information out of that and things like that. Very, very useful when you're messing around with..." The participant quoted in this example, although only having limited use with the device had become fairly comfortable with the device, and his particular use-base for the device was quite advanced. Additionally, this particular quotation provides a perfect example of the productive factor. Another participant mentioned her usage as, "Well we were in Portugal a year ago, we were sitting in the airport, and of course it's important that we can check our emails, and, and stay in touch with family and son". This participant was a slightly less technical user and her use case reflected a very common one. Finally, amongst the productive subfactor is the notation that the iPad served as a viable computing companion for all the participants for most general computing tasks, such as browsing the web, checking email, photography, games, messaging, etc. However, our research indicated that the device did not totally replace participants' desire to use a PC, with all participants reporting that they still were using a

PC from time to time, however most admitted that their PC usage has decreased since obtaining an iPad.

The consumption factor refers to using the iPad for watching movies, reading iBooks, photography, playing games, etc., and all entertainment-based tasks. A very commonly mentioned use of the iPad among the participants in this research was for reading books, one participant remarked “I've downloaded books on it, and I have, I mean books on it as well. Which, was one of the things I wanted to, rather than take two or three books with me in my suitcase. You pick a couple books, two three books on here, and, so, it's much, much easier.”

The connection factor refers to using the device to maintain personal contact with friends and family such as through messaging or video chatting. Every single participant referred to the connection factor as being a major reason for purchasing the device. One participant said she uses and obtained the device predominately for staying in contact with her family and friends, this use-base is deemed “connection” as one couple remarks, “So I had to go back into FaceTime again… I mean it, was, it was. And that's exactly what we wanted it for. …So we could be in contact with family very easily, and, we were so far away”.

Convenience Factor.

All participants made reference to a “convenience factor” of the iPad. Each participant made reference to this element of usability in a variety of ways, such as its “always-on” ability, auto sleep function, its lightweight and portability, its simplicity, etc. These aspects mentioned all make reference to the iPads ease of use and advantage over bulkier

stationary devices. Within the overarching convenience factor, are the subfactors of a seamless factor, a portability factor, and a smart factor. One participant, who had already become well versed with the iPad mentioned to the seamless factor of the device, "…Just to get on quickly and check out what's new in the global mail or whatever else I'm interested in, the newspapers, that sort of thing, scores, sport scores, you can look at very quickly. It's just a very seamless tool to get up to speed quickly (Participant 1)." This participant was referring how easily and quickly he is able to obtain information using his iPad. The seamless factor refers to how with as little time as possible, simple objectives such as reading the paper can be accomplished so quickly and easily. Further, the seamless subfactor reflects the overall interaction of the device's hardware and software, making the user experience flow naturally in a highly intuitive and predictable manner. Furthermore, all participants had experience using PCs, and when asked what advantage in particular does the iPad have over the PC, all participants mentioned its "fast-on" and portability aspects.

Each participant made reference to how a major advance of the iPad is that it allowed him or her to be mobile while still having access to a computer. Another participant commented on the smart factor, "Speed, of it. Meaning if, your, you need to get connected, you know. I can hit my emails, and then my emails pop right up, instead I go down to my computer, and I've got to go into Yahoo, and then the whole page comes up, and then put in my name, and then my I.D, and you know my password, THEN it comes up. With this, I am instantly connected to my emails, right away." This smart factor represents the impressive design of the operating system, in that it effectively determines which information would be most important to the user at a particular time and then

presents this information to the user in an efficient and productive manner. The user is presented with necessary updates and notification in a non-obtrusive manner and then if the user deems this information to be relevant, they are able to proceed with the necessary actions. Additionally, with the touch screen interface the user need only simply tap on the essential information, and has the option to take further steps when needed.

Finally, interrelated with the convenience factor is the subfactor of portability. All participants referenced the device's portability as directly influencing their satisfaction. Portability was referred to not only in reference to the iPad's lightweight design, but also as referenced by Participant 3, "its meticulous design where there is a meticulous ratio of grip space to screen ratio, resulting in nearly no unessential space". One participant mentioned, "… it's a nice little handheld, it's really easy to take this along with you." Another participant stated, "You can, almost, well fit it in my purse, so I mean, that's, makes it a big deal. And you can, the movability is very easy and you can take it anywhere." Participants reported the lightweight and portability of the device is a major advantage, giving the user a highly effective computer in the palms of their hands. Providing the user with the flexibility with respect to the location for which they can use the device, highly affects the usability of said device.

Phase IIa overview.

Phase IIa results from the subtask analyses suggest that overall the iPad was used highly effectively (very few errors were demonstrated on the HTA) amongst novice users, with participants making few errors. Of the 2 participants that participated in Phase II (Participant 2 and Participant 3), Participant 2 made 3 errors during the task performance

and required guiding hints at 1 particular occasion to ensure the task flow. Participant 3 made 4 errors, and required 2 minor guiding hints to ensure the task flow. The specific locations of errors observed with Participant 2 were within the search function of the iBooks application and within the Mail application.

The specific variations observed from participant 2's subtask performance HTA versus the Gold Standard version are as follows (see Figure 3 below), within the iBooks application, the first error was when the participant was uncertain of where to locate the "Search" tool feature (a guiding hint was required). The second error, occurred slight after where the participant typed the search terms in the incorrect field, leading to an undesired result and also the participant then inputted too many search terms into the search bar of the iBooks applications resulting in the system finding no matches to the desired search (this however was self-corrected). An error was also observed with this participant within the "Mail" application, where the participant had difficulty identifying the difference between the "Subject" and "Message" field, and attempted to type the message content into the "Subject" field rather than the appropriate location ("Message" field), this was also self-identified and corrected.

Figure 3

Participant 2 Performance: HTA Checklist

Hierarchical Task Analysis (HTA) Checklist

1.0 Turn on device
- 1.1 Locate and identify the *Sleep/Wake* button □ **Y**
- 1.2 Press the button □ **Y**
- 1.3 Slide to unlock □ **Y**

2.0 Finding iBooks Application

2.1 Navigate, locate and identify *"iBooks"* application **Y**

2.2 Tap on the *"iBooks"* application icon with finger to open iBooks application **Y**

3.0 Open iBooks Store

3.1 Navigate through the application and identify the *"Store"* link, to be redirected to the "iBooks Store" **Y**

3.2 Tap on the "Store" link **Y**

4.0 Use the Search function to search for books in the iBooks Store

4.1 Navigate through the iBooks Store and locate the *"Search"* icon (also identified by a magnifying glass) **Y**

4.2 Tap on the *"Search"* icon **Y**

4.3 Identify and locate the newly appeared *"Search Bar"* **Y (difficulty with locating "search bar" – a guiding hint was provided)**

4.4 Tap on the search bar to allow text to be entered using the virtual keypad **Y**

5.0 Find Pride and Prejudice by Jane Austin in the iBooks Store

5.1 Type into the search bar *"Pride and Prejudice"* using the virtual keypad in order to obtain search results from the iBooks library pertaining to this book title **Y** **(inputted too many search terms into the search box, resulting in the retrieval of no search results – self corrected)**

5.2 Navigate through the "search results", which are presented and tap on the appropriate search result link **Y**

6.0 Download the iBook

6.1 Once selected and tapped on the appropriate link, locate and identify the "Download" icon to begin downloading the selected iBook **Y**

6.2 When prompted enter *Apple ID* and *Password* using the virtual keyboard **(didn't ask for ID and pswrd)**

7.0 Open the iBook to commence reading

7.1 The user will automatically be returned to the iBooks Library

7.2 Identify the newly downloaded iBook *"Pride and Prejudice by Jane Austin"* **Y**

7.3 Tap on the iBook icon to launch reading screen of the iBook **Y**

8.0 Make *Reading Preference* adjustments

8.1 Locate and identify the "View adjustment" icon (Also can be identified by an icon of an upper and lower case "A", beside each other) **Y**

8.2 Locate and identify the adjustment icon for font sizing, font type and brightness **Y**

8.3 Using finger to adjust these three options, adjust settings to your desired liking **(didn't want to adjust)**

9.0 Begin reading iBook (imagine)

9.1 To scroll through pages, use a "page flicking motion" anywhere on the virtual book **Y (he did this but wasn't instructed to)**

10.0 Bookmark a page in the iBook

10.1 Locate and identify "Bookmark" icon and tap the icon to create a bookmark at the desired location **Y (slight hesitation)**

11.0 Search through the iBook for the search term *"girl"*

11.1 Return to the iBook's "Library", by locating and identifying the "Library" icon, then tapping on it **Y**

11.2 Reopen selected iBook and use the in-book search function to jump to the Third Chapter of the iBook using the chapter navigation tab **Y *(to chpt 2)***

11.2.1 Locate and identify the search function (Also identified by a magnifying glass icon) **Y *(slight hesitation)***

11.2.2 Type into the search bar, the desired keyword **Y**

11.2.3 Using the virtual keypad type the search term *"girl"* into the search field **Y**

11.2.4 Identify and select the desire search result to transferred to that location of the iBook **Y**

12.0 Compose an Email

12.1 Return to the Home Screen of the Device by pressing the "Home button" **Y**

12.2 Navigate, locate and identify the "Mail" Application **Y**

12.3 Locate and identify the "Compose" icon (Also identified by a pen on a sheet of paper) **Y (some hesitation)**

12.4 Tap on the icon **Y**

12.5 Compose a very short email to about the new iBook you have just downloaded (Be sure to write and appropriate topic) **Y**

12.6 Tap on the Address Field and using the virtual keypad type the appreciate email address **Y (Difficulty, identifying difference "subject field" box and "message field" box – self-corrected)**

12.7 Tap on the Subject Field and using the virtual keypad type the appropriate subject text **Y**

12.8 Tap on the Message Field and using the virtual keypad type the appropriate message text **Y *(for 12.6-12.8, difficult to tell where/what he was typing, but he did complete the task)***

12.9 Locate and identify the "Send" icon and tap the icon to send the email message **Y**

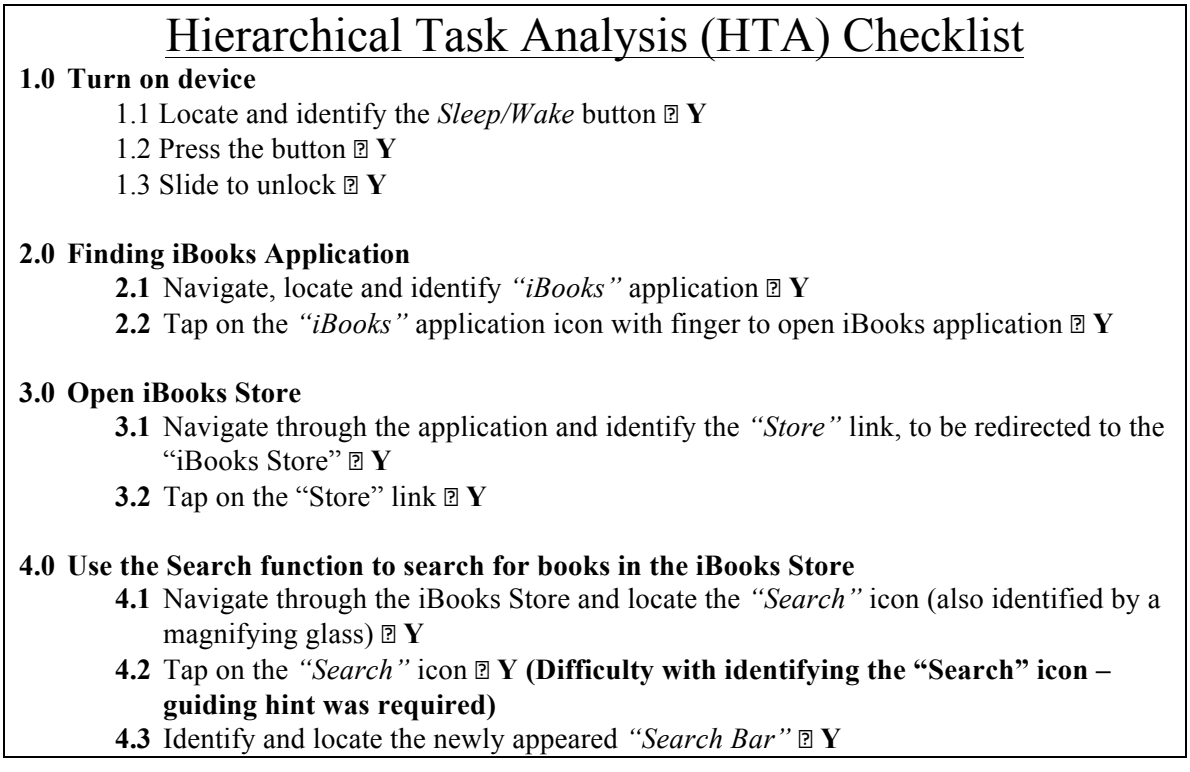
13.0 **Return to iPad home screen Y**

The specific variations observed from participant 3's subtask performance HTA versus the Gold Standard version are as follows (see Figure 4 below), participant 3 had difficulty with identifying the search icon within the iBooks Store application, this particular error required a minor guiding hint to be corrected. The next error that was observed by the

raters was within the iBooks application, where the participant displayed difficulty with identifying the View Adjustment icon and thus a guiding hint was required to progress. Next, the participant 3 demonstrated difficulty with making various preference modification such as adjusting the brightness, however this was only minor and was easily self-corrected after a short duration. The finally error that was observed during participant 3's performance was within the Mail application, where the user experienced difficulty with identifying the difference between the "Subject" and "Message" fields, however this error was minor and was quickly self-corrected by the user.

Figure 4

Participant 3 Performance: HTA Checklist



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3.1 Navigate through the application and identify the *"Store"* link, to be redirected to the "iBooks Store" **Y**

3.2 Tap on the "Store" link **Y**

4.0 Use the Search function to search for books in the iBooks Store

4.1 Navigate through the iBooks Store and locate the *"Search"* icon (also identified by a magnifying glass) **Y**

4.2 Tap on the *"Search"* icon **Y (Difficulty with identifying the "Search" icon – guiding hint was required)**

4.3 Identify and locate the newly appeared *"Search Bar"* **Y**

4.4 Tap on the search bar to allow text to be entered using the virtual keypad □ **Y**

5.0 Find Pride and Prejudice by Jane Austin in the iBooks Store

5.1 Type into the search bar *"Pride and Prejudice"* using the virtual keypad in order to obtain search results from the iBooks library pertaining to this book title □ **Y**

5.2 Navigate through the "search results", which are presented and tap on the appropriate search result link □ **Y**

6.0 Download the iBook

6.1 Once selected and tapped on the appropriate link, locate and identify the "Download" icon to begin downloading the selected iBook □ **Y**

6.2 When prompted enter *Apple ID* and *Password* using the virtual keyboard □ **(no prompt)**

7.0 Open the iBook to commence reading

7.1 The user will automatically be returned to the iBooks Library □

7.2 Identify the newly downloaded iBook *"Pride and Prejudice by Jane Austin"* □ **Y**

7.3 Tap on the iBook icon to launch reading screen of the iBook □ **Y**

8.0 Make *Reading Preference* adjustments

8.1 Locate and identify the "View adjustment" icon (Also can be identified by an icon of an upper and lower case "A", beside each other) □ **Y (Difficulty with locating the "View Adjustment" icon – guiding hint was required)**

8.2 Locate and identify the adjustment icon for font sizing, font type and brightness □ **Y (prompt given "settings")**

8.3 Using finger to adjust these three options, adjust settings to your desired liking □ **Y *(some difficulty adjusting brightness, closed adjustment settings, prompt given (reopen settings, look for slide-bar – self-corrected)***

9.0 Begin reading iBook (imagine)

9.1 To scroll through pages, use a "page flicking motion" anywhere on the virtual book □ **Y (this was done before adjusting reading preferences)**

10.0 Bookmark a page in the iBook

10.1 Locate and identify "Bookmark" icon and tap the icon to create a bookmark at the desired location □ **Y**

11.0 Search through the iBook for the search term *"girl"*

11.1 Return to the iBook's "Library", by locating and identifying the "Library" icon, then tapping on it □ **Y**

11.2 Reopen selected iBook and use the in-book search function to jump to the Third Chapter of the iBook using the chapter navigation tab □ **Y**

11.2.1 Locate and identify the search function (Also identified by a magnifying glass icon) □ **Y (some hesitation in locating search function)**

11.2.2 Type into the search bar, the desired keyword □ **Y**

11.2.3 Using the virtual keypad type the search term *"girl"* into the search field □ **Y**

11.2.4 Identify and select the desire search result to transferred to that location of the iBook □ **Y**

12.0 Compose an Email

12.1 Return to the Home Screen of the Device by pressing the "Home button" **Y** ***(second attempt, no prompt)***

12.2 Navigate, locate and identify the "Mail" Application **Y**

12.3 Locate and identify the "Compose" icon (Also identified by a pen on a sheet of paper) **Y**

12.4 Tap on the icon **Y**

12.5 Compose a very short email to mvoumvak@uwo.ca about the new iBook you have just downloaded (Be sure to write and appropriate topic) **Y**

12.6 Tap on the Address Field and using the virtual keypad type the appreciate email address **Y (Difficulty, identifying difference "subject field" box and "message field" box – self-corrected)**

12.7 Tap on the Subject Field and using the virtual keypad type the appropriate subject text **Y**

12.8 Tap on the Message Field and using the virtual keypad type the appropriate message text **Y**

12.9 Locate and identify the "Send" icon and tap the icon to send the email message **Y**

13.0 **Return to iPad home screen**

The following are some general difficulties observed by the researchers for both participants, but challenges that did prevent task completion are as follows, both participants did not easily recognize the meaning of various system icons, such as "brightness adjustment" icon, the "compose email" icon, and the "search" icon. This resulted in apparent confusion and thus a degree of hesitation and uncertainty was displayed. Both participants also displayed a degree of difficulty with error recognition and repair. This observation was most clearly observed when the specific application did not yield the expected and desired result. In many instances however, participants would attempt to use a "work-around" or alternative method, eventually leading to the desired result. When participants resorted to using a "work-around" method, the desired result was still achieved in all instances, however backtracking as well as redundant processes were required.

Study findings also indicated that participants experienced a read–tap asymmetry for websites and applications, whereas the application font size was sufficient enough for reading, yet too small to enable the user to tap the correct area accurately. During the post semi-structured interviews, participants indicated verbally that having a high availability of support was immensely important to them when initially obtaining the device, and this factor greatly influenced their initial experience with the device. Participants explained how the support availability could also originate from a variety of sources. A fellow iPad user, friends, family, and an Apple Store employee were amongst the sources listed. Finally, all participants displayed varying levels of difficulty using the search functions effectively and displayed difficultly with the correct syntax. A more detailed account of the task analysis and associated HTA will be displayed below (see Figure 5 below).

Phase IIb overview.

Results from the in-depth interview of Phase IIb, a confirmatory phase, suggested that overall the two participants did not find the subtask assignment to be overly challenging, and felt the requirements were well within their competencies. However, Participant 2 and Participant 3 reported various frustrations with the hardware and software design, such as a read-tap asymmetry mentioned by most participants during the focus group session. Paralleling the reports from Phase I of the research these particular frustrations described by the participants in Phase I were directly observed during the subtask assignment and further confirmed by Participant 2 and Participant 3 during the in-depth interview in Phase IIb. Furthermore, during the in-depth interview Participant 2 and

Participant 3 expressed how within some applications they experienced the touchable areas to be ambiguously located and not easily identified resulting in confusion in navigating around various applications.

The analysis from Phase IIb, was used to confirm and further build upon the data analysis of the data obtained from the focus groups. Further, the two participants who participated in the second phase of the research rated their satisfaction with the iPad again (1-2months) following the initial focus group. One of the participants indicated that there satisfaction levels with the device had increased, while the other participant indicated that his/her satisfaction levels had stay consistent. This rating system was verbal and participants were simply asked to directly compare how their satisfaction levels with the device had changed after another month of device use. Participants were instructed to either indicate whether their satisfaction levels had increased, decreased or remained constant after another month with the device. Finally, member checking with the two participants who participated in the second phase of the research following the subtask performances. The data obtained through the member checking process suggested that the researchers' interpretations of the focus group data adequately reflected users' experiences and conveyed what the participants were actually trying to say. There was agreement between the researchers' interpretation and the participant's evaluation of this interpretation.

Figure 5

Hierarchical Task Analysis (HTA) and Activity Analysis (AA) of selected subtasks using the Apple iPad

Hierarchical Task Analysis (HTA) and Activity Analysis (AA) of selected subtasks using the Apple iPad

Note:

- Black text represents HTA representations
- Blue text denotes AA representations

1.0 Turn on device

1.1 Locate and identify the *Sleep/Wake* button

1.2 Press the button

- **Motor:** *locate target, shoulder elevation, arm extension, press button with finger to activate target. Shoulder strength and stability, wrist and hand strength and dexterity. Core stability/ seated balance and endurance.*
- **Cognitive:** *Mapping – interpretation of buttons*
- **Sensory:** *Vision – locate target - acuity*

2.0 Finding iBooks Application

2.1 Navigate, locate and identify *"iBooks"* application

2.2 Tap on the *"iBooks"* application icon with finger to open iBooks application

- **Motor:** *locate target, shoulder elevation, arm extension, swipe screen with finger and tap screen with finger to activate target*
- *Shoulder strength and stability, wrist and finger strength and dexterity. Core stability/ seated balance and endurance.*
- **Cognitive:** *sustained attention / read and interpret onscreen text / judgment and interpretation of feedback*
- **Sensory:** *Vision – acuity, contrast sensitivity*

3.0 Open iBooks Store

3.1 Navigate through the application and identify the *"Store"* link, to be redirected to the "iBooks Store"

3.2 Tap on the "Store" link

- **Motor:** *locate target, shoulder elevation, arm extension, tap screen with finger to activate target. Shoulder strength and stability, wrist and finger strength and dexterity. Core stability/ seated balance and endurance.*
- **Cognitive:** *sustained attention / read and interpret onscreen text / Judgment and interpretation of feedback*
- **Sensory:** *Vision – acuity, contrast sensitivity*

4.0 Use the Search function to search for books in the iBooks Store

4.1 Navigate through the iBooks Store and locate the *"Search"* icon (also identified by a magnifying glass)

4.2 Tap on the *"Search"* icon
4.3 Identify and locate the newly appeared *"Search Bar"*
4.4 Tap on the search bar to allow text to be entered using the virtual keypad

- **Motor:** *locate target, shoulder elevation, arm extension, tap screen with finger to activate target. Shoulder strength and stability, wrist and finger strength and dexterity. Core stability/ seated balance and endurance.*
- **Cognitive:** *sustained attention / Mapping- interpretation of abstract symbols / Judgment and interpretation of feedback*
- **Sensory:** *Vision – acuity, contrast sensitivity*

5.0 Find Pride and Prejudice by Jane Austin in the iBooks Store

5.1 Type into the search bar *"Pride and Prejudice"* using the virtual keypad in order to obtain search results from the iBooks library pertaining to this book title
5.2 Navigate through the "search results", which are presented and tap on the appropriate search result link

- **Motor:** *locate target, shoulder elevation, arm extension, tap screen with finger to activate target. Finger mobility for taping on screen keypad.*
- *Shoulder strength and stability, wrist and finger strength and dexterity. Core stability/ seated balance and endurance.*
- **Cognitive:** *sustained attention / read and interpret on screen text / accurate spelling capabilities / Judgment and interpretation of feedback*
- **Sensory:** *Vision – acuity, contrast sensitivity*

6.0 Download the iBook

6.1 Once selected and tapped on the appropriate link, locate and identify the "Download" icon to begin downloading the selected iBook
6.2 When prompted enter *Apple ID* and *Password* using the virtual keyboard

- **Motor:** *locate target, shoulder elevation, arm extension, tap screen with finger to activate target. Finger mobility for taping on screen keypad.*
- *Shoulder strength and stability, wrist and finger strength and dexterity. Core stability/ seated balance and endurance.*
- **Cognitive:** *sustained attention / read and interpret on screen text / accurate spelling capabilities / Judgment and interpretation of feedback*
- **Sensory:** *Vision – acuity, contrast sensitivity*

7.0 Open the iBook to commence reading

7.1 The user will automatically be returned to the iBooks Library
7.2 Identify the newly downloaded iBook *"Pride and Prejudice by Jane Austin"*

7.3 Tap on the iBook icon to launch reading screen of the iBook

- **Motor:** *locate target, reach, tap screen with finger, swipe screen with finger to change page. Shoulder strength and stability, wrist and finger strength and dexterity. Core stability/ seated balance and endurance.*
- **Cognitive:** *sustained attention / read and interpret on screen text / Judgment and interpretation of feedback*
- **Sensory:** *Vision – acuity, contrast sensitivity*

8.0 Make *Reading Preference* adjustments

8.1 Locate and identify the "View adjustment" icon (Also can be identified by an icon of an upper and lower case "A", beside each other)

8.2 Locate and identify the adjustment icon for font sizing, font type and brightness

8.3 Using finger to adjust these three options, adjust settings to your desired liking

- **Motor:** *locate target, reach, press screen with finger to activate target*
- *Shoulder strength and stability, wrist and finger strength and dexterity. Core stability/ seated balance and endurance.*
- **Cognitive:** *sustained attention / Mapping- interpretation of abstract symbols / Judgment and interpretation of feedback*
- **Sensory:** *Vision – acuity, contrast sensitivity*

9.0 Begin reading iBook (imagine)

9.1 To scroll through pages, use a "page flicking motion" anywhere on the virtual book

- **Motor:** *locate targets, swipe with finger to change iBook page.*
- *Shoulder strength and stability, wrist and finger strength and dexterity. Core stability/ seated balance and endurance.*
- **Cognitive:** *sustained attention*
- **Sensory:** *Vision – acuity, contrast sensitivity*

10.0 Bookmark a page in the iBook

10.1 Locate and identify "Bookmark" icon and tap the icon to create a bookmark at the desired location

- **Motor:** *locate target, reach, press with finger to activate target*
- *Shoulder strength and stability, wrist and finger strength and dexterity. Core stability/ seated balance and endurance.*
- **Cognitive:** *sustained attention / Mapping- interpretation of abstract symbols / Judgment and interpretation of feedback*
- **Sensory:** *Vision – acuity, contrast sensitivity*

11.0 Search through the iBook for the search term *"girl"*

11.1 Return to the iBook's "Library", by locating and identifying the "Library" icon, then tapping on it

11.2 Reopen selected iBook and use the in-book search function to jump to the Third Chapter of the iBook using the chapter navigation tab

11.2.1 Locate and identify the search function (Also identified by a magnifying glass icon)

11.2.2 Type into the search bar, the desired keyword

11.2.3 Using the virtual keypad type the search term *"girl"* into the search field

11.2.4 Identify and select the desire search result to transferred to that location of the iBook

- **Motor:** *locate target, shoulder elevation, arm extension, tap screen with finger to activate target. Finger mobility for taping on screen keypad.*
- *Shoulder strength and stability, wrist and finger strength and dexterity. Core stability/ seated balance and endurance.*
- **Cognitive:** *sustained attention / read and interpret on screen text / accurate spelling capabilities / Judgment and interpretation of feedback*
- **Sensory:** *Vision – acuity, contrast sensitivity*

12.0 Compose an Email

12.1 Return to the Home Screen of the Device by pressing the "Home button"

12.2 Navigate, locate and identify the "Mail" Application

12.3 Locate and identify the "Compose" icon (Also identified by a pen on a sheet of paper)

12.4 Tap on the icon

12.5 Compose a very short email to about the new iBook you have just downloaded (Be sure to write and appropriate topic)

12.6 Tap on the Address Field and using the virtual keypad type the appreciate email address

12.7 Tap on the Subject Field and using the virtual keypad type the appropriate subject text

12.8 Tap on the Message Field and using the virtual keypad type the appropriate message text

12.9 Locate and identify the "Send" icon and tap the icon to send the email message

- **Motor:** *locate target, shoulder elevation, arm extension, tap screen with finger to activate target. Finger mobility for taping on screen keypad.*
- *Shoulder strength and stability, wrist and finger strength and dexterity. Core stability/ seated balance and endurance.*
- **Cognitive:** *sustained attention / read and interpret on screen text / accurate spelling capabilities / Judgment and interpretation of feedback*

- **Sensory:** *Vision – acuity, contrast sensitivity*

13.0 Return to iPad home screen

4.3 Task Performance Analysis

The following describes the Findings and Interpretations of Phase IIa of the research. The following were the key use difficulties observed from the participants as part of AA/HTA identified by the raters; difficulty with error recognition and repair, difficulty with identifying, recognizing and locating operating system icons, and difficulties using the search function within applications effectively.

Error recognition and repair.

The most common issue in the successful use of the device was difficulty with error recognition and repair. This observation was most apparent when an error was made and the resulting response was not an expected one. In various instances, participants did not recognize that they had made an error and consequently, then had to perform a number of backtracking and less efficient maneuvers to achieve the desired goal. However, all participants were able to either successfully repair the error or use a workaround method in nearly all instances. Described by both participants during the post semi-structured interviews were the "intelligent" design aspects of the device is that it allows for a number of alternative methods to accomplish a specific objective, thus if the user does not employ the most efficient (or preferred) method, or if the user makes an error, they can still achieve their desired goal. Further, it was observed through the subtask performances that the success rate of using a trail-and-error method with the iPad's OS

design is extremely high and when participants resorted to this method of execution, they nearly always achieved the desired goal, however with a decrease in efficiency. Additionally, most applications follow a familiar workflow and user interface, such that familiar strategies, usually will achieve desired results regardless of what application the user is in. There also is a logical and intuitive manner of swiping, sliding and scrolling between applications, which rendered the trial and error method highly effective, even within unfamiliar applications. This finding was most clearly observed by when even though both participants took differing detour steps towards arriving at the completion of the subtask, they still both were able to arrive at the task goal.

Operating system icon images.

There were instances of a mismatch between the operating system's icon image depiction and the user's envisioned icon image depiction. An example of this was the operating system's icon for adjusting brightness, which two participants had trouble locating. These participants did not find the designers chosen icon for increasing the brightness to be intuitive and resultantly experienced difficulty locating the correct icon. There were a few other instances of mismatch between the participants envisioned icon and the designers actual icon, such as the icon for selecting a specific location of an iBook and the compose icon in the email application. However there were no other commonalities displayed amongst the participants of this study.

Search function.

Finally, with all participants there were instances of difficultly with using the search function effectively within apps. All participants wanted to type too many search terms or

phrases into the search bar, resulting in the search becoming too specific and limiting the search results. This was done to the point where the rejected potential desirable results. For example, when searching the iBooks store for the book Pride and Prejudice by Jane Austin, all participants would attempt to type “Pride and Prejudice by Jane Austin” into the search bar, resulting in very few search results being produced, to the degree of rejecting search results of the actual desired iBook. This confusion and difficultly with employing the correct search syntax was displayed amongst all participants and would have prevented the task from continuing if the participants were not provided with a guiding hint from the primary researcher.

Chapter 5

5 Discussion.

Findings from this study suggest that the iPad had high usability (high ease of use and utility factor) amongst study participants. The following chapter will discuss the main implications of this research, its contribution to current usability literature, and finally its relevance to advancing the current knowledge database on the utility of the iPad. This chapter will contrast the findings of this research with prior literature on seniors experience with the usability of other technological devices, a contrast with other usability research featuring the iPad, and finally specific views and attitudes seniors demonstrate towards the iPad.

General findings from the questionnaire indicated that participants' demonstrated high acceptance and satisfaction rates with the device, with only minor frustrations reported. These findings are consistent with two earlier iPad-specific usability studies conducted by Werner F., Werner K., and Oberzaucher (2012) and Budiu and Nielsen (2011). Participants in both of these studies also reported high satisfaction rates and overall positive responses to the device's usability. There was also one finding of contrast in the current study, which found the iPad to be predominantly a personal and less shared device, which contrasts the work of Budiu and Nielsen (2011), who found that the iPad was commonly shared throughout a household. This particular difference may be a result of the number of individuals in the typical household of a senior versus a younger population. However, this is anecdotal because the data on the number of individuals per household was not specified or focuses on in either study.

Additional findings from this research suggest that the iPad served as a viable computing companion for all the participants for most general computing tasks, such as browsing the web, checking email, photography, games, messaging, etc. However, this research indicated that the device did not totally replace participant's desire to use a PC, with all participants reporting that they still were using a PC from time to time, however most admitted that their PC usage has decreased since obtaining an iPad.

There was a consensus amongst all participants that the iPad was a very easy device to use. Even participants with only limited PC experience found the iPad exceptionally easy to use and all but one participant stated that they would recommend the iPad to their friends and family. Additionally, participants stated that a major positive aspect of the iPad is that it does not appear to be overly complicated or intimating. These particular findings are consistent with the research of Wang, Rau and Salvendy (2011), and Igbaria, Parasuraman and Baroudi (1996), who looked at the usability of other forms of information technology such as PCs amongst senior users. Wang, Rau and Salvendy (2011) identified that a lack of confidence amongst participants learning to use a novel device was associated with abandonment of a particular technology. Both aforementioned studies identified that a major barrier to technology adoption is perceived complexity and that device complexity is negatively related to adoption. Based on the results from this study on how participants' initially perceived the iPad, the findings from the HTA analysis and prior literature on perceived complexity and abandonment, it is reasonable to surmise that the iPad's perceived simplicity may potentially increase participant's confidence and self-efficacy with operating the device from introduction, and therefore may be related to lower abandonment rates. However, due to the limited duration the iPad

has been available on the market, abandonment type research will be a topic for further exploration in potential future research.

Prior literature indicates that older adults perform better when using simpler devices as oppose to complex ones (Ziefle & Bay 2005). In the research conducted by Ziefle and Bay (2005) with mobile phones of varying complexities, seniors performed significantly better using the less complex model. The findings identified that participants experienced the iPad as being simple and non-intimidating. Furthermore, when compared to a PC, the iPad would be considered to be simpler and less feature-rich. This perceived simplicity of the device, and high acceptance rates suggest the iPad may be a highly suitable device option for seniors with limited technology experience.

The successful adoption of the iPad has potential to facilitate more engagement in valued social activities requiring the use of the Internet such being more easily connected with friends and family, being more immersed and allowing for fuller engagement in prior occupations now moved to more online-based mediums (such as many news outlets, banking features, shopping options, etc.), being able to engage in other social activities with friends and family such as online games and photo sharing. The facilitation of increased social engagement may potentially alleviate occupational isolation and occupational deprivation experienced by seniors who as a direct result of limited computer knowledge and intimidation of these technologies would otherwise be limited from participation in general. Given the high usability of the iPad observed in this research and the non-intimidating perception of the iPad, the device may have use in future studies with seniors and technology in further researching the prevention of social isolation and deprivation. At the very least, the iPad provides senior consumers with

additional device selection options, which directly aids in reducing the barriers to technological adoption (financial, physical and psychological) for those who currently do not own Internet technologies, reducing this potential for occupational isolation and deprivation. Lastly, future research on occupational deprivation and the internet might examine whether seniors with no PC experience, who are wishing to use the Internet can effectively use the iPad, as well as if the iPad is a more appropriate option than an PC for this population.

Identified in the HTA and post-interview of the second phase of the research, results demonstrated high usability and satisfaction rates amongst the two study participants when performing the specific tasks which participants had mentioned a particular desire for in Phase I of the research. However, participants also reported various frustrations with the hardware and software design. Consistent with the findings of Budiu and Nielsen (2011) our results indicated that participants experienced a read–tap asymmetry for websites and applications, whereas the application font size was sufficient enough for reading, yet too small to enable the user to tap the correct area accurately. Furthermore, within some applications our participants also experienced the touchable areas to be ambiguously located and not easily identified. Lastly, another similarity with the research of Budiu and Nielsen (2011) was the difficult participants displayed with swiping through pages in reading-based applications because they would swipe in the wrong spot, which resulted in a typical conclusion that the application must be broken. These commonalities in difficulties users experience with the iPad in this study and the research of Budiu and Nielsen (2011), which involved research a much younger population, suggest that these difficulties are in fact not necessarily age-related but a common user issue.

5.1 Adding to Current Literature

Recruitment requirements for this study specified that participants were required to have no more than three months experience using the device and thus the device was still novel to them and learning was still required. Research by Werner F., Werner K., and Oberzaucher (2012) examined the usability of the iPad amongst senior participants who had no experience with the iPad. Their study offered insight towards seniors initial impressions and experience with the device, however did not address learnability. The research conducted in the current study offered insight towards seniors' experiences with learning the device and thus contributes and helps build upon the research of Werner F., Werner K., and Oberzaucher (2012) by providing insight towards usability following initial device introduction.

Of the factors identified in this research, there are many commonalities with the prior research of Werner F., Werner K., and Oberzaucher (2012). Of particular similarity are the Learning, Use, and Intuitiveness factors. With respect to the learnability factor, the results in this research display a high degree of similarity to the research of Werner F., Werner K., and Oberzaucher (2012) with respect to the learnability of the device. Taken from the research paper of Werner F., Werner K., and Oberzaucher (2012), "When you've exercised a bit, it's easy – you just have to learn what happens when you press on a certain item. 'You just try and hope that it's right and most of the time it's right.'" This quotation parallels the experimentation subfactor displayed in this research in the sense

that error detection and repair was performed effectively by participants solely through trail-and-error and experimentation.

The Use Factor displayed in this research also closely resembles the experiences of the participants in the research of Werner F., Werner K., and Oberzaucher (2012). In their research they outline that although all the experienced Internet users indicated that the tablet was very easy to use, only half of those users preferred to use a tablet instead of a common PC. It was stated that some tasks are more complicated to perform using a touch screen and that the integrated e-mail-client was not as intuitively usable as the one they were used to. It was emphasized, as a positive aspect that starting an application works very easy and faster than on a PC. When you tap on an application on the iPad, it launches immediately (Werner F., Werner K., & Oberzaucher 2012). .These findings are in line with the productive subfactor identified in this research, outlining how participants had migrated some of their computing occupations over to the iPad, however the iPad did not totally eliminate the need /desire to use a PC altogether. This common theme of which occupations are and which occupations are not being migrated over to the iPad is of particular saliency, future research would benefit from identifying the nuances and specifics of this factor.

Finally, experiences by participants similar to those represented in this research by the Intuitiveness Factor, where closely related to the findings of Werner F., Werner K., and Oberzaucher (2012), and the participant's experiences towards the iPad in their research. In the research of Werner F., Werner K., and Oberzaucher (2012), all participants stated that the tablet in general was very easy to use, although most novice users claimed that it takes a little time to become accustomed to the handling and nuances of the device,

however they claimed that “it was easier and faster than they expected because of the logical workflow and manageable functional range” (Werner F., Werner K., & Oberzaucher, 2012). This is directly in line with the experiences of the participants in this research with respect to device intuitiveness. This quotation is in direct relation to the “just works” subfactor as experienced by the participants in this research. From the research of Werner F., Werner K., and Oberzaucher (2012) “Especially the intuitive usage of the so called “pincer gesture” – a gesture using index finger and thumb to enlarge areas on the screen - has been astounding. Some participants even used this gesture as a solution to enlarge small web links on the screen without being told that it could be used for this purpose.” This quotation further highlights the similarities in the two studies with respect to the intuitiveness factor. The researchers found that participants found simpler applications and features such as multi-finger gesture control quickly learnable and useable by the study participants. The following discussion will specifically look at two factors, the Convenience Factor and the Use Factors. Both of these subfactors refer to the importance of satisfying the users’ needs through high utility and perceived support availability. These findings coincide with and elaborate further the findings of Cameron, Marquis and Webster (2001), who discovered that, “satisfying the user needs” and “support availability” are amongst the most important factors to influence device adoption.

In the research performed outlined in this study, both the Convenience Factor and the Use Factor subfactors describe how the iPad has enhanced or provided additional value to the user’s computing experience by allowing users the ability to complete many of their computing desires in variety of more casual locations (couch, bed, kitchen). This finding

is of particular value because this is a finding that other literature has not addressed to date and contributes to the knowledge of how seniors use their iPads. Further, the Use Factor subfactor refers directly to how the device was rated as having a high usability by allowing for access to desired information updates (email, social media, stocks, weather) and more consolidated and efficiently then a desktop computer. Both of these factors directly relate to satisfying the users' needs in a variety of their desired social or daily occupations. Further, demonstrated through the adoption subfactor, is how participants viewed the access to potential support that was available to them from various resources, such as the Apple Store, or other IPad users such as friends and family, etc. Research results indicated that having a high availability of support was immensely important to them, and was highly influential on their initial experience with the device. This particular finding is directly in-line with the research of Cameron, Marquis and Webster (2001), and demonstrates that both these factors are common with the adoption of various devices.

This two-part investigation of the usability of the iPad obtained first-hand accounts of what seniors iPad users currently use their iPads for, as well as what their usage desires include. Prior research has examined the usability of the iPad with seniors who had no prior iPad experience (Werner F., Werner K., & Oberzaucher, 2012). This population is not appropriate for studying what seniors currently use the iPad for, and their future usage desires. Additionally, other usability research with iPad owners (Budiu & Nielsen, 2011) has incorporated younger populations, however to the best of our knowledge no research has examined a population of new senior age iPad users. Furthermore, this investigation gained direct insight towards the occupations senior iPad users are currently

using their devices for, as well as their future desires. Furthermore, it is important to note that this was only a small sample size, however the users that participated in the study incorporated a range of occupations and places where seniors use and conduct their occupations has expanded beyond the typical home work station.

This research contributes to the current literature on specific iPad usage break down, as it identified many commonalities with the earlier research of Budiu and Nielsen (2011) performed with a younger population. The results from this research contribute to the current literature as it offers a window into the usability of the iPad from a senior population. This research identified that seniors' iPad usage is very similar to that of younger populations, with the usage being heavily dominated by consumption. This research identified browsing the web, emailing, reading news, social networking, and games were the most common occupations of the iPad. These findings demonstrate a high degree of symmetry to Budiu and Nielsen (2011), who identified that playing games, checking emails and social networking sites, watching videos, and reading the news, who the primary occupations of younger iPad users. Both studies found that participants usage patterns, despite a large disparity in age, was dominated highly by social and leisure application based occupations, which suggests that the social-related usage of the device as well as social media based usage may not be limited to younger populations. Lastly, as mentioned above, specific frustrations and difficulties experienced by the senior iPad users in our research were identical to those experienced by younger iPad users in the research of Budiu and Nielsen (2011). These specific frustrations and difficulties include, a read-tap asymmetry within many applications, ambiguous touchable areas within some applications, finally, participants also experienced a great

deal of incidental activation of touchable areas within applications, as a result of unintended touches. Furthermore, the informants in the study stated that they disliked typing on the touch screen and thus avoided typing intensive activities.

In summary the use of both qualitative and quantitative methodologies was integral to this study's design and execution. Both approaches were needed to gain a more in-depth understanding of usability During Phase I, the qualitative component, which took place in the form of two focus groups, participants discussed the usability elements of the iPad, as well as listing particular occupations in which they use / had desires to use the iPad for. During the succeeding phase of the research, participants were asked to complete a set of subtask performances, based on specific occupations, which participants had in Phase I. These subtask performances were video and audio recorded, then broken down into their basic cognitive and physical/motor elements using a HTA to represent the data. This approach resulted in a deep description and analysis of how the participant actually uses a device. The information obtained from the quantitative component provided a multi-dimensional analysis of the actual use of the device using a HTA and AA. This design is a user-prioritized approach to the study of usability because it puts the actual desired occupations at the forefront of the investigation (Fok, Middleton, Fishcer & Polgar, 2010).

The results from this phase indicated that each participant was able to successfully complete each subtask. Furthermore, all participants indicated that the subtask performances as not overly difficult. These results coincide with the research of Ziefle and Bay (2005) who studied mobile phones of varying complexities. Similar Ziefle and Bay (2005) results indicated that when using the less complex phone, senior informants

performed significantly better than when using the complex one. Ziefle and Bay (2005) quantified performance by the number of subtasks participants solved using both of the phones. When using a less complex mobile phone, older adults solved specific subtasks 14% more effectively than while using the more complex mobile phone" (p. 384). Additionally, the researchers concluded that when using the less complex phone, participants spent on average 40% less time on each subtask, making 50% less detour steps and disorienting less often (Ziefle & Bay, 2005, p. 381). Although this research did not offer a direct comparison, participants perceived the iPad to be non-complex and to exhibit a high level of usability in lab-based situations.

5.2 Implications

Provides insight towards how seniors learn and use the iPad.

This research is the first to study the usability of the iPad amongst novice senior iPad users. Prior literature has examined the usability of the iPad amongst younger populations (non senior) with limited iPad experience (Budiu & Nielsen, 2011). Thus, this research was able to expand on the current literature, by examining a unique population, a population who provided valuable insight on the learnability of the device. These findings on the learnability of the iPad in our research are consistent with the learnability of seniors with mobile phones of varying complexities (Ziefle & Bay, 2005). Additionally, this research builds upon the current knowledge database on how seniors learn various technologies by offering insight on the iPad device. For instance, this research found that seniors approach learning the device in an exploratory nature, which

to a large degree is primarily done through a trial and error method. Furthermore, support availability is amongst the most important factors for facilitating a positive initial learning experience. Most participants expressed the benefits and significance of having some form of assistance for the initial setup of the device, as most participants described that the device did not come out of the box ready to use, as the initial setup was not intuitive or user friendly. Lastly, having support availability was most critical for the initial device setup.

Feedback for application designers.

The quantitative component of this research incorporated methodologies derived from a human factors (HF) perspective, and included an AA which provided knowledge towards the physical and cognitive processes required to complete each subtask. The lab subtask performances were video recorded for a more detailed and precise account. This information is potentially invaluable for iPad application designers/ engineers as this data provides insight on how seniors actually use the iPad, as well as the common errors / frustrations seniors experience with the device such as a read-tap asymmetry within some applications, ambiguous touchable area within many reading applications, and finally incidental activation of touchable areas within many applications. This sort of information is essential to the creation and modification of current applications, as well as to optimize the user interface (UI) of applications for seniors, with unique needs.

From an Occupational Science perspective the knowledge gained through this research provides valuable information for senior citizens wishing to engage in occupations using technology such as an IPad. The ease of use of the iPad demonstrated by the participants

in this study may provide support for the adoption and the use of the Internet for accessing information, socializing etc. on a PC alternative. For many seniors who have not grown up in this "technology-era" and have little to no experience with computers, there are immense social and political pressure from our digital society to "get online" as the assumption of universal internet access has become common place. With this inaccurate assumption of universal Internet use, those who are limited/ unable to use or access the Internet have the potential to experience much occupational deprivation and alienation.

Many of these seniors wish to adopt the use of the Internet, however with limited understanding of computers this seemingly rudimentary tasks can be quite arduous. Where previously there was only one computing device (the PC) that could be used to access the Internet, consumers now have a number of options available. For users wishing to accomplish only basic computing tasks, such as browsing the Internet, email, shopping, banking, etc. the selection of a PC might not be the most appropriate option, as with its increased functionality is an associated increased complexity. Unfortunately, there is little to no research done on the iPad investigating whether the iPad truly is a preferred and well-received option. This research may assist seniors in making a more informed choice as to what computer device would be most suitable based on their needs and experience level. By having more computing options available to seniors to participate in these online-only and online-migrating occupations there is less chance for occupational deprivation, as greater choices help to remove barriers to entry for Internet adoption. With the vast amount of devices available to consumers, the selection of a suitable computer can be an incredibly challenging task. This research not only offers

insights into the learnability of the iPad amongst seniors, but also first-hand accounts of this process and advice from seniors who were currently in the process of learning the device and potential uses. The research also analyzed how the device was received and experienced by senior users and whether or not they would recommend the device, especially to individuals with no computing experience. The results from this research suggest that the iPad may be a viable option for seniors wishing to adopt the use of the Internet, especially those with limited experience with computers and/or those looking for additional options. Finally, the results from this research provide a knowledgebase to hardware and UI designers to augment their current designs to be ever more user-friendly, especially from a senior citizens perspective – a rapidly growing iPad demographic (iPad Use to Nearly Double This Year, 2012).

Specifically, current findings indicated that participants experienced a read–tap asymmetry for many websites and applications, with many applications having font sizes that were sized sufficiently enough to read, yet too small to enable the user to tap the correct area accurately. Another common difficulty expressed by participants was within reading-dominated applications. Throughout these applications, participants found the touchable areas to be ambiguously located and not easily identified, such that participants regularly had to employ a trial and error method of execution. Finally, participants also experienced difficulties swiping through pages in reading-based applications where they would regularly swipe in the wrong spot, which resulted in a typical conclusion that the application must be broken. Participants would also inadvertently turn the pages, as the touchable areas were perceived as being ambiguous. This information on how seniors specifically interact with the user interface of the application and the interface's spatial

design can be modified to correspond to seniors usability. Furthermore, the majority of these frustrations were not limited to a senior population as many of these frustrations were also displayed with much younger populations (Budiu & Nielsen, 2011).

Recommendations and guidance from seniors.

Recruitment requirements specified that participants have less than 3 months experience using the iPad, so that participants would be in the learning process of device adoption, and also their experiences with the device would be based around the learnability of the device. Participants' insights are also beneficial to other seniors who may be debating purchasing an iPad, and also for seniors with no computer experience, who are looking to get online. Some specific recommendations suggested by study participants were that seniors should purchase the iPad directly from Apple at one of their locations as they offer complementary initial setup of the device, and will also assist in device orientation. Additionally, most participants suggested that users should freely explore/ play with the device and initially employ a trial and error method until familiarization and a comfort level is obtained. Furthermore, participants also suggested that users maintain persistence and determination with working through the initial learning phase of the device, as these specific frustrations are common to all users. Lastly, participants suggested that by simply "playing around" with the device, users would become more experienced and proficient and realize that the design of the iPad allows for a variety of methods to complete a task.

5.3 Strengths and Limitations, and Future Research

Strengths.

There are a number of areas of particular strength in this research. First, the study incorporated both qualitative and quantitative methodologies, with the quantitative portion of the research allowing for a deeper contextualization and understanding of the qualitative portion. Furthermore, the quantitative component of the research provided a HTA of how each participant used the iPad. In addition, this is the first study to conduct an analysis of how each individual participant used the device, every step required to complete the subtask (cognitive and physical-motor), and also differences in efficiency. The researchers also choose a population that was specific to seniors who were currently learning the iPad. This highly specific population allowed for a specific understanding of the devices learnability and how the participants suggest this can be optimized.

Limitations.

As no research is without limitations, this study had a few limitations in particular which are important to reflect upon. One of the limitations of this research is the low participant numbers. This research included 5 participants and knowledge on the usability was constrained to the participants and thus cannot be generalized. One of factors underscoring the few participant inclusion was the degree time frame and challenges in recruitment Unfortunately the study was forced to continue with a sample size of 5 due to a lack of interest in participation and the time constraints associated with a Master's Degree, which prevented a longer recruitment phase duration.

Future Research.

Future research could examine participants who are currently in the learning phase of the device for a longer duration of time, examining the learnability at various stages over a 6 month period and study how time effects the perceived usability of the device. To expand an understanding of usability research in this field, future research would benefit by incorporating additional subtask performances such as a web-browsing task and photo-related task. The research in this study focused on one particular task, and the results from examining another task may provide additional valuable information on iPad usability as well provide essential ergonomic feedback, and provide a different perspective. Finally, the research would also have benefitted from incorporating participants with a larger diversity in experience levels with other technologies (PCs). For instance, futures prospective designs might include participants who have never used an iPad or a PC, and initially provide them with a couple of days to take the iPad home and explore the device, prior to inviting them into the lab to complete the task performance and examine the usability of the device from a complete computer novice. This type of research could provide valuable information on the usability of the iPad and has great real-life implications as it provides essential information for seniors with no PC experience looking to finally be online.

Conclusion.

The preceeding research examined seniors who were current iPad users/owners with limited experience with the device (less than 3 months). Thus this population was strategically chosen because of the research goal to obtain insight on senior's experiences with the learnability of the device and to obtain usability data from the perspective of an

iPad learner. The other research goal was to obtain first hand usability accounts from seniors with respect to using and learning the iPad, especially with respect to usability from an ergonomic (hardware) and software perspective. Additionally, the study sought to identify specific occupations the participants were currently using their iPads for, as well as their potential desired uses. Through direct observation of participants utilizing the device in a lab setting, the researchers obtained data that provided validation and consistency to the interpretations made from the focus group data on the devices usability. This multi-method approach is, the first of its kind to offer both a qualitative and quantitative (HF) perspective towards usability on the device. The high usability observed amongst participants is consistent with prior research done with iPad with varied population. Further, the participants in this research demonstrated high acceptance and satisfaction rates with the iPad, with only minor frustrations reported. The findings suggest that the iPad serves as a useful option for most common computing tasks, however the iPad did not totally replace the use of a PC for the participants in this study. Further, the perception of the iPad amongst participants as being less intimidating and more simple than a PC, may increase the users self-efficacy with respect to their ability to the learn the device, resulting in an overall positive experience from introduction. Study participants rated the iPad as being complementary to a PC and in instances of basic computing tasks, such as checking email and browsing the Internet, the iPad had fully diminished the necessity of the PC. Again, as stated earlier these data are only reflective of a small sample size (N=5) and offers an introduction on the iPad's usability amongst a senior population. Future research will benefit greatly from investigating similar research questions with a larger sample size for greater validation. Future research would also

benefit from incorporating various populations, such as seniors who have greater experience with the device, and seniors who have never used the device and/or a PC.

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Appendices

Appendix 1

Instructions Provided to Participants During Task Performance

Step	**Instruction**
1	"Wake and unlock the iPad"
2	"Open the "iBooks" Application"
3	"Navigate through the iBooks app to the iBooks Store"
4	"Search through the iBooks Store for 'Pride and Prejudice' by Jane Austin"
5	"Download the iBook"
6	"Open the recently downloaded iBook and adjust the various reading preference options to your desire"
7	"Bookmark a page in the iBook"
8	"Use the Search Function of the iBook to find a list of results pertaining to the term 'girl'"
9	"Return to the home screen of the iPad"
10	"Compose a brief email to regarding your newly obtained iBook"
11	"Send the email"

Appendix 2

Sample Questions Used to Guide Post-Interview

No.	Sample Question
1	"What aspects of the device would you say are designed particularly well, and what aspects could be designed better?"
2	"What part of the task assignment did you find most challenging?"
3	"You seemed to have difficulty with *x*, what is it about the design of the device or application, which made you think *y*, was the correct action to take?"
4	"If you had an opportunity to meet with the designer of the device (hardware and software), and provide input towards how you personally would change the device, what would you say?"

Appendix 3

Questionnaire Booklet

Phase I: Focus Group - Participant Information & Questions

1. Today's date: _____
2. City in which you live: _____
3. Sex: o Male o Female

4. Age: _____

5. Highest level of education attained:
   - o Grade School
   - o Some High School
   - o High School Graduate
   - o Trade School
   - o Some College/University
   - o College Diploma/Certificate
   - o University Degree
   - o Postgraduate Degree
   - o Other_____

6. Your experience level with the iPad
   - o < 1 month
   - o 1-2 months
   - o 3-4 months
   - o > 4 months

7. Most used iPad Application? _____

8. Most desirable iPad Application? _____

9. Primary use of the iPad? _____

10. Roughly how many hours per week do you spend using the iPad? _____

11. In a typical week, where do you most often use the iPad?
    - o Bed
    - o Table
    - o Living Room
    - o Bathroom
    - o In the Car
    - o Couch
    - o Outside

12. How often do you take your iPad outside the house?

    - o Almost every time

o Rarely
o Only on longer trips
o Only on Vacation

13. Which iPad do you own?
    o Original iPad
    o iPad 2
    o iPad 3
    o iPad 4

14. How many iPads are in your household? _____

15. Was your iPad usage increased or decreased following your initial experimentation period? _____

16. Has your iPad become your primary computer, or do you use your Laptop or Desktop more often? _____

17. Roughly how many Apps have you downloaded? _____

18. Do you read books on your iPad? _____

19. Do you share your iPad?
    o Yes, with at least one other person
    o No, I am the exclusive user

20. In a typical week, what activities do you use your iPad for? Check all that apply
    o Browsing the internet
    o Emailing/ Messaging
    o Photos
    o Games
    o Reading
    o Banking
    o Music
    o Managing banking or paying bills
    o Other (Please describe) _____

21. Overall how satisfied are you with the iPad?
    o Very satisfied
    o Somewhat satisfied
    o Neither satisfied or dissatisfied
    o Somewhat dissatisfied
    o Very dissatisfied

22. What is it that you would most like to change about the iPad?
    - o Battery life
    - o Design
    - o Screen Resolution (size/clarity)
    - o Camera Resolution (quality)
    - o Weight
    - o Software
    - o Other _____

23. Overall how would you rate the iPad's value for the cost?
    - o Poor
    - o Fair
    - o Good
    - o Very Good
    - o Excellent

24. Would you recommend the iPad to other seniors? _____

25. What would you like to be able to use your iPad for, but currently is unavailable?

    _____

26. What was your reasoning for purchasing an iPad?

    _____

Appendix 4

Focus Group Guiding Questions

Focus Group Guiding Questions

Initial Questions

i. *3 things they use it for*
ii. *3 things they like about it*
iii. *3 things they dislike about it*

General Guiding Questions

1. *What was your reasoning for purchasing an iPad?*
2. *Overall how would you rate the iPad's value for the cost?*
3. *Was your iPad usage increased or decreased following your initial experimentation period?*
4. *Has your iPad become your primary computer, or do you use your Laptop or Desktop more often? Can you give an example of how you have changed the use of your Desktop now that you have and iPad?*
5.
6. *What is it that you would most like to change about the iPad?*
7. *What would you like to be able to use your iPad for, but currently is unavailable?*
8. *What advice would you give to other seniors who are considering using an I-pad?*
9. *Would you recommend the iPad to other seniors? if so can you tell me what it is that you would recommend?*

10. When you first got your iPad, how did you go about figuring out how to use it?

11. Being a new researcher, I would like to give an education point, what are some things about the iPad that you would like to be able to use it for?

12. *LASTLY, if you were going to give advice to other seniors about learning and using the iPad, what would you say?*

Appendix 5

Ethics Approval Form

Western Research

Research Ethics

Use of Human Participants - Ethics Approval Notice

Principal Investigator: Dr. Lynn Shaw
File Number:102872
Review Level: Delegated
Approved Local Adult Participants:15
Approved Local Minor Participants:0
Protocol Title: Examination of the Usability of the iPad among Older Adult Consumers
Department & Institution: Health Sciences\Occupational Therapy,Western University
Sponsor:
Ethics Approval Date: September 06, 2012 **Expiry Date:**August 31, 2013
Documents Reviewed & Approved & Documents Received for Information:

Document Name	Comments	Version Date
Western University Protocol		
Letter of Information & Consent		2012/08/22
Letter of Information & Consent		2012/08/22
Advertisement		

This is to notify you that The University of Western Ontario Research Ethics Board for Health Sciences Research Involving Human Subjects (HSREB) which is organized and operates according to the Tri-Council Policy Statement: Ethical Conduct of Research Involving Humans and the Health Canada/ICH Good Clinical Practice Practices: Consolidated Guidelines; and the applicable laws and regulations of Ontario has reviewed and granted approval to the above referenced revision(s) or amendment(s) on the approval date noted above. The membership of this REB also complies with the membership requirements for REB's as defined in Division 5 of the Food and Drug Regulations.

The ethics approval for this study shall remain valid until the expiry date noted above assuming timely and acceptable responses to the HSREB's periodic requests for surveillance and monitoring information. If you require an updated approval notice prior to that time you must request it using the University of Western Ontario Updated Approval Request Form.

Members of the HSREB who are named as investigators in research studies, or declare a conflict of interest, do not participate in discussion related to, nor vote on, such studies when they are presented to the HSREB.

The Chair of the HSREB is Dr. Joseph Gilbert. The HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

Ethics Officer to Contact for Further Information

Janice Sutherland	Grace Kelly	Shamel Walcott

This is an official document. Please retain the original in your files.

Appendix 6

Letter of Information and Consent Forms

Examination of the Usability of the iPad among Older Adult Consumers: Phase I

INVESTIGATORS:

Dr. Lynn Shaw, PhD

Dr. Jeffrey Holmes, PhD

Dr. Jan Polgar, PhD

Michael Voumvakis MSc Student

You are invited to participate in a study designed to examine the usability of the iPad among seniors. In this study we will explore both why and how seniors who have limited experience with the iPad, utilize this technology.

Background

Since it release in early 2010 consumers are increasingly turning to the iPad to meet their personal and professional computing needs. Although several press releases have highlighted the benefits of using an iPad over that of a traditional laptop or desktop computer, to date there remains no empirical research outlining usability issues that older adults encounter when operating the iPad.

Inclusion and Exclusion Criteria

We plan to test a total of 15 participants. In order to be eligible for participation, you must be 65 years of age or older, in good overall health with no major health concerns, fluent in written and spoken English, and have minimal experience with using an iPad (i.e., less than three months).

Description of Research

If you agree to participate in this study, you will be asked to partake in one of three focus groups, each comprised of five participants. The focus group will take place in Elborn College, at Western University, and will take approximately 90 minutes to complete. During the focus group you will be asked questions about your experiences with using the iPad. For example, you will be asked to describe how you currently use the iPad, if there are purposes for which you would like to use the iPad but currently do not, and to discuss any factors that you perceive as being barriers or facilitators. You will also be asked to complete a short questionnaire to gather information such as your age, how often

you use the iPad, if you purchased the iPad for yourself, or if it was received as a gift. The focus group will be video recorded and the dialogue from the session will be typed into an electronic document that will later be summarized and analysed for content. Following the focus group, you will be provided with an opportunity to review and comment on the accuracy and completeness of the summary and interpretation of the data.

Potential Benefits

You will not experience any direct benefit from participating in this research project. You may however, receive indirect benefit in the form of knowledge gained about the iPad. In addition, this study may provide valuable information regarding how older adults utilize the iPad, which may ultimately help in developing strategies that may lead to reduced levels of device abandonment.

Potential Risks or Discomforts

There are no known risks to participating in this study.

Voluntary Participation and Protection of Information

Your participation in this research project is voluntary. You may refuse to participate, refuse to answer any questions, and you may withdraw your participation at any time with no effect on your future participation in university-sponsored activities. If you withdraw your participation in the study before the conclusion of data collection, your data will be destroyed. In order to assure complete confidentiality, no identifying information will be attached to the data collected in this study. The only record of your

name that will be retained will be on the attached consent form, and this information will be stored in a locked file cabinet, within the work practice lab, a locked laboratory within the School of Occupational Therapy. This information will not be linked, in any way, with the study information. If the results of this study are published, your name will not be used, and no information that discloses your identity will be released or published without your explicit consent to the disclosure. Identifying information collected during the course of this study will not be retained, and information will be destroyed upon completion of the study by a professional shredding company. Only the researchers directly involved with this study will have access to any information that would reveal your identity. The one exception is where the representatives of Western Universities Non Medical Research Ethics Board may contact you or require access to your study-related records to monitor the conduct of the research.

You will not receive remuneration for participation in this study. However if you drove to the experiment today, we will provide you with a parking voucher for your vehicle, or if you took public transit today, we will reimburse you the value of a standard round-trip bus ticket. You will also be provided with refreshments (e.g., water, coffee, juice, baked goods) while you participate in the study.

Western
UNIVERSITY · CANADA

Examination of the Usability of the iPad among Older Adult Consumers: Phase I

Please sign this form to indicate that you agree with the following statement:

I have read the Letter of Information, have had the nature of the study explained to me, and I agree to participate. All questions have been answered to my satisfaction.

Participant (Printed Name):

_____

Participant (Signature):

_____

Person Obtaining Informed Consent (Printed Name):

_____

Person Obtaining Informed Consent (Signature):

_____

Date: _____

Please initial here indicating you have read the above page _____

Examination of the Usability of the IPad among Older Adult Consumers: Phase II

Western
UNIVERSITY · CANADA

INVESTIGATORS:

Dr. Lynn Shaw, PhD

Dr. Jeffrey Holmes, PhD

Dr. Jan Polgar, PhD

Michael Voumvakis MSc Student

You are invited to participate in a study designed to examine the usability of the iPad among older adults. In this study we will explore why and how seniors who have limited experience with the iPad, utilize this technology.

Background

Since it release in early 2010 consumers are increasingly turning to the iPad to meet their personal and professional computing needs. Although several press releases have highlighted the benefits of using an iPad over that of a traditional laptop or desktop computer, to date there remains no empirical research outlining usability issues that older adults encounter when operating the iPad.

Inclusion and Exclusion Criteria

We plan to test a total of 5 participants. In order to be eligible for participation, you must be 65 years of age or older, in good overall health with no major health concerns, fluent

in written and spoken English, own and have minimal experience with using an iPad (i.e., less than three months).

Description of Research

All testing will take place in the Qualitative Research Suite, room 2xxx located in Elborn College, Western University. The tasks involved will take approximately ? minutes to complete, and should involve no risks or discomforts beyond those normally experienced by you while operating your iPad. If you agree to participate, we will ask you your birth date, which will be used solely for the purpose of computing your age in years and months, and will then be discarded.

You will be asked to complete three tasks using an iPad. While performing each task you will be encouraged to think aloud. Following the completion of the tasks you will be asked to share your feedback regarding the usability of the iPad, and to provide your overall thoughts and attitudes with respect to the device. This information will be gathered by way of a semi-structured interview conducted by the primary researcher. Both the completion of tasks and the semi-structured interview will be video-recorded.

Potential Benefits

You will not experience any direct benefit from participating in this research project. You may however, receive indirect benefit in the form of knowledge gained about the iPad. In addition, this study may provide valuable information regarding how older adults utilize the iPad, which may ultimately help in developing strategies that may lead to reduced levels of device abandonment.

Potential Risks or Discomforts

There is a small potential that you will become anxious or frustrated if you find it difficult to complete, or are unable to complete one of the tasks.

Voluntary Participation and Protection of Information

Your participation in this research project is voluntary. You may refuse to participate, refuse to answer any questions, and you may withdraw your participation at any time with no effect on your future participation in university-sponsored activities. If you withdraw your participation in the study before the conclusion of data collection, your data will be destroyed. In order to assure complete confidentiality, no identifying information will be attached to the data collected in this study. The only record of your name that will be retained will be on the attached consent form, and this information will be stored in a locked file cabinet, within the work practice lab, a locked laboratory within the School of Occupational Therapy. This information will not be linked, in any way, with the study information. If the results of this study are published, your name will not be used, and no information that discloses your identity will be released or published without your explicit consent to the disclosure. Identifying information collected during the course of this study will not be retained, and information will be destroyed upon completion of the study by a professional shredding company. Only the researchers directly involved with this study will have access to any information that would reveal your identity. The one exception is where the representatives from Western Universities Non Medical Research Ethics Board may contact you or require access to your study-related records to monitor the conduct of the research.

You will not receive remuneration for participation in this study. However if you drove to the experiment today, we will provide you with a parking voucher for your vehicle, or if you took public transit today, we will reimburse you the value of a standard round-trip bus ticket. You will also be provided with refreshments (e.g., water, coffee, juice, baked goods) while you participate in the study.

Examination of the Usability of the IPad among Older Adult Consumers: Phase II

Please sign this form to indicate that you agree with the following statement:

I have read the Letter of Information, have had the nature of the study explained to me, and I agree to participate. All questions have been answered to my satisfaction.

Participant (Printed Name):

_____

Participant (Signature):

_____

Person Obtaining Informed Consent (Printed Name):

_____

Person Obtaining Informed Consent (Signature):

_____

Date: _____

Please initial here indicating you have read the above page _____

Curriculum Vitae

Related Work Experience	Teaching Assistant The University of Western Ontario 2011-2013