Older Adult Gamers: Digital Game Genres and the Perceived Benefits of Gameplay

by

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Abstract

In this rapidly aging society, successful aging is drawing the attention of not only older adults but also of researchers who want to help the older population to improve or maintain their well-being. The digital game is a promising technology that could assist in successful aging. This survey study profiled older adults on background characteristics, various aspects of the digital games that they played as well as on the amount of time spent playing games and on the perceived benefits of digital game playing. 875 older adults, over the age of 55, were recruited from shopping malls, community centers, and seniors' centers in the Greater Vancouver area. However, only the data of the 463 older adults who played digital games were analyzed. Certain types of digital games were found to have significant associations with some of the background characteristics of older adults. Significant associations were found among the different types of digital games that older adults played, the amount of time they spent playing games, and the perceived benefits of playing digital games. These results revealed a number of new findings regarding the types of digital games that older adults play and the identification of new areas of future research.

Keywords: Digital games; older adults; genres of digital games

Dedication

I would like to dedicate this thesis to my parents, my aunt and my uncle, who love me and have supported me in my pursuit of my master's degree.

I also dedicate this to the ones I love and the ones who love me.

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1. Introduction

The older adults' population has been the world's fastest growing age group in the past decade and will grow even faster worldwide in the coming decades (United Nations, 2013). This can be attributed to two reasons: a longer life span and a low fertility that dropped below the replacement rate (Statistics Canada, 2011). An aging population may lead to a limited labour supply in many countries, which may have a negative impact on these countries' economies (McDaniel & Rozanova, 2011). Moreover, a majority of developing countries has found that a high poverty rate accompanies rapid growth in the population of older adults (Bloom, Canning, & Fink, 2010). Canada is no exception to this trend toward an older population, and it was projected to be home to almost as many senior citizens as children in 2016 (Statistics Canada, 2011).

Let's do some simple math. The life expectancy of Canadians is about 85 years, and the average retirement age is about 65 years (Statistics Canada, 2011). This means that people tend to live, on average, for another 20 years. Consequently, a common concern for older adults, across the globe, involves how they can maintain an independent, healthy, and satisfying life (Bowling, 2007a).

Previous research has identified chronic disease and declines in physical functions as being significant determinants of successful aging (Schulz & Heckhausen, 1996; Williams, 1963). In so doing, there is a tendency to focus on only the physical dimension. A long life expectancy (Butler & Gleason, 1985) and working after normal retirement age (Perls, Silver, & Lauerman, 1999) are two one-dimensional definitions of successful aging that have been found in previous studies. Recent research, however, advocates that successful aging should be a multidimensional concept (Bowling, 2007b; Cosco, Prina, Perales, Stephan, & Brayne, 2014; Rowe & Kahn, 1997). One of the earliest multidimensional concepts of successful aging can be found in Rowe and Kahn's 1997 paper, known as *Successful Aging*. They recommended that there be three main considerations when evaluating successful aging: physical health without diseases and disabilities, good physical and cognitive functioning, and active social engagement. After reviewing

170 papers on this topic, Bowling and Dieppe (2005) suggested that successful aging be continuously and comprehensively assessed, beginning at earlier life stages. Older adults who participated in a survey conducted by Bowling & Dieppe (2005) reported three factors that they believed to be most important in achieving successful aging including physical health and the absence of disease; mental and cognitive health; and social interactions.

In order to help older adults achieve successful aging, many researchers have investigated the potential benefits of technology use among older adults in relation to such areas as physical functioning, cognitive abilities and social engagement (Cresci, Yarandi, & Morrell, 2010; Chopik, 2016; Sum, Mathews, Hughes, & Campbell, 2008). The pervasive use of technology in today's society has a widespread influence on the daily lives of individuals, including older adults. While many believe that older adults have difficulty accepting new technologies because they have spent the majority of their lives without a household computer, older adults, aged 55-to-64, lead the way with 94% computer ownership (Entertainment Software Association of Canada, 2016). Meanwhile, the statistic for Canadian adults, in general, is 90% computer ownership. Research conducted by Broady, Chan, and Caputi (2010) found that not only were the attitudes of younger and older adults towards computers the same, but their experiences in using computers as well as other associated technologies were also similar. Hence, age seems to have limited effects on people's acceptance of new technologies. Providing sufficient training and building a supportive and friendly environment may matter more in terms of increasing one's acceptance of new technologies.

Though their attitudes towards technologies are identical to younger adults, older users often experience frustration when using technologies such as the computer, Internet and e-mail, which can be attributed to their lack of technological knowledge and skills (Gatto & Tak, 2008) as well as to their having difficulties or special needs when using technology (Apted, Kay, & Quigley, 2006). Giving older adults enough time and encouragement to allow them to become familiar with a technology and supporting them appropriately will help them to overcome these frustrations (Broady et al., 2010). When designing software or any other kind of technological innovation for the general public, designers must also consider the challenges experienced by seniors when they use it (Apted et al., 2006).

Many studies have found that computers and the Internet are beneficial in assisting older adults in maintaining an independent life and with broadening their

horizons, improving physical and mental health, decreasing depression and social loneliness, and increasing self-confidence (Cresci et al., 2010; Fokkema & Knipscheer, 2007; Gatto & Tak, 2008). Due to the growing ownership of computers and smart devices, digital games have gradually replaced traditional games in society (Kowert, Vogelgesang, Festl, & Quandt, 2015). Recent studies, in this field, are now examining how to improve the well-being of older members, and research in this area is becoming increasingly popular.

Ultimately, the majority of digital games on the market are designed for children and young adults, with developers not really thinking about the needs of seniors when it comes to playing digital games (Mahmud, Mubin, Shahid, & Martens, 2010). Even though the oldest members of the "official" Baby Boomer generation, having birthdates between 1946 and 1964, started to step into their 60s about ten years ago, less attention has been paid to this particular audience segment by the digital games field (Pearce, 2008). Still, Brand and Todhunter (2015), revealed that the population segment of adults aged over 50 was the fastest growing age group in the digital games market. Moreover, it is inspiring to see increasing interest and awareness of the importance of digital games among researchers and game designers as they investigate the perceived benefits of playing digital games for seniors (Kaufman, 2013b).

Toril, Reales, and Ballesteros (2014) believe that the digital game is a promising tool in maintaining cognitive functioning among older adults and that it can replace traditional, paper-and-pencil training methods. Digital games hold many advantages over traditional methods in that players are attracted to and motivated to play these games, the games are entertaining, and they can be provided at competitive prices. In their study investigating the potential use of augmented games to improve gaming experience, Mahmud et al. (2010) found that older participants preferred to play the game on tablets over its paper version, because of the former's more immersive and engaging environment. In another intervention study, the results showed that older adults in the Wii group performed better than the traditional game group on four measurable categories (self-esteem, loneliness, physical activity and level of positive or negative effect) after the intervention (Jung, Li, Janissa, Gladys, & Lee, 2009).

As mentioned before, physical health is considered an important indicator of successful aging. Digital games have the potential to be used as a tool to promote the good health of older adults. Exergames, which are designed to help players

reinforce and maintain their physical fitness activities, are gaining researchers' attention. Agmon, Perry, Phelan, Demiris, and Nguyen's (2011) preliminary findings suggest that Wii Fit could physically benefit older participants. Similar findings, showing that players experience improvements in physical functions such as balance after playing Wii sports, have been found in the literature (Maillot, Perrot, & Hartley, 2012; Nitz, Kuys, Isles, & Fu, 2010). Results from several studies also indicate that the therapeutic value of exergames was not only limited to physical but also to cognitive improvements in function. Participants were found to experience less depression (Rosenberg et al., 2010) and to show significant improvements in cognitive performance, mental health-related quality of life, executive control, and processing speed (Maillot et al., 2012).

Maintaining good cognitive functioning is of great concern to older adults. Age-related cognitive decline normally refers to the deficits experienced by older adults in terms of cognitive functions such as memory, reaction speed, and multitasking, among others (Whitlock, McLaughlin, & Allaire, 2012). Though it is widely recognized that cognitive declines result naturally from aging and that previous levels of performance cannot be regained, results of many studies showed that appropriately using a digital game as a training and therapeutic intervention tool can decelerate declining trends in cognitive functions (Allaire et al., 2013; Boot et al., 2013; Torres, 2011; Whitlock et al., 2012).

Results from earlier research have revealed that older adults experience enhanced reaction time, processing speed, eye-to-hand coordination, and motor ability after playing arcade games (Dustman, Emmerson, Steinhaus, Shearer, & Dustman, 1992; Goldstein et al., 1997; Whitcomb, 1990). Anguera et al. (2013) found that participants, who suffered from deficits in multitasking and other forms of cognitive control, experienced improvements in cognitive abilities such as working memory and sustained attention after participating in a customized video game. In addition, seniors also showed significant improvements in selective visual attention after playing *Tetris* and *Medal of Honor*, a first-person shooter game (Belchior et al., 2013). The results of another study on the impact of perceptual training on working memory in older adults showed that participants who took the training by playing a game, called *Sweep Seeker*, received better scores in working memory tasks (Berry et al., 2010). Although doubtful of the long-term cognitive benefits of digital game interventions for older people, Salthouse (2006) agreed that digital game-playing was

often enjoyable and that it might contribute to a higher quality of life among older adults.

Investigations into the impact of games on the social and emotional aspects of older adults' lives have resulted in significant findings. Studies have found that after playing digital games, older adults report a better self-concept, improved quality of life (Torres, 2011), enhanced life satisfaction (Wang, Lockee, & Burton, 2011), increased social interaction with their peers (Gerling, Schulte, & Masuch, 2011), and a decrease in loneliness (Kahlbaugh, Sperandio, Carlson, & Hauselt, 2011; Schell, Hausknecht, Zhang, & Kaufman, 2015). Alongside their potential contribution to emotional well-being, many digital games also have intrinsic social features like playing with family members or other people. It is important for seniors to obtain the necessary support and social connection from their family and community (Lewis, 2011). In a study, participants reported that they felt more socially connected after playing casual video games (Whitbourne, Ellenberg, & Akimoto, 2013). Older players who enjoyed digital games recommended these games to their families and friends, thereby contributing to greater interaction and goodwill within their social circles (Khoo, Merritt, & Cheok, 2009). Enhancing family bonding and social interaction is one of the key motivators in encouraging seniors to play digital games (Abeele & Schutter, 2010).

Playing digital games can also potentially assist older adults in improving their knowledge and skills in terms of computers, the Internet, and game playing (Ijsselsteijn, Nap, de Kort, & Poels, 2007; Wang & Burton, 2010; Wang et al., 2011). Statistics from the *Entertainment Software Association of Canada (ESAC) 2016 Essential Facts Reports* indicated that the average age of game players in the United States was 35 years old and that 26% of gamers were aged 50 and over. In 2007, the number was 24.2%. The average age of game players in Australia was 33 in 2015, rising from 24 years old in 2005 (Brand & Todhunter, 2015). The same trend was also found in terms of the average age of gamers in Canada, which has also increased in comparison to previous years (Entertainment Software Association of Canada, 2015). A major contributing factor to this worldwide trend was the increase in older adults who play digital games. The proportion of older digital gamers is expected to increase in the coming decades.

However, this age segment has been neglected by the digital game market (Ijsselsteijn et al., 2007). Current digital games in the market are mainly targeting adolescents and young adults (Mahmud et al., 2010). Only a few studies have

investigated older adults' game preferences and whether the types of digital games played by older adults have an impact on the perceived benefits of playing. From previous studies in this field, the typical types of digital games played by older gamers were reported to be casual games such as puzzle games, quiz games and card games (Belchior et al., 2013; Pratchett, 2005). Several studies also found that older adults show little interest in realistic first-person-shooting games when compared to younger generations who enjoy these games (Festl, Scharkow, & Quandt, 2013; McKay & Maki, 2010).

The purpose of investigating older gamers' background characteristics and the types of digital games that older adults prefer to play is to optimize the benefits of playing among this population segment. Researchers found that playing a specially designed digital game improved older adults' cognitive abilities even though these seniors suffered from age-related deficits in attention and visuospatial ability and despite their reporting low satisfaction after playing the game (Tong, Chignell, Lam, Tierney, & Lee, 2014).

1.1 Purpose

The purpose of this study was to identify the types of digital games that older adults in Canada play and how they related to the demographic background characteristics of this population segment such as gender, age, living arrangement and education; the amount of time that older adults have spent playing digital games; and the perceived benefits gained from playing digital games. In addition, the connections between the amount of time spent playing and perceived benefits were also examined. It is important to investigate the players' demographic characteristics; the amount of time they spend playing; the potential factors that may affect older adults' preference for digital games; and also whether game preferences have any impact on perceived benefits. Most studies in this field have investigated the potential benefits of one specific game for older gamers, but very few studies have focused on the different types of digital games and their impacts. The findings of this study can inform future research that examines older adults and the types of digital games that they are playing.

1.2 Research Questions

1. Which types of digital games are being played by older adults in Canada?
2. Is there an association between the types of digital games played by older adults and their background characteristics (e.g., sex, age, living alone or with others)?
3. Is there an association between the types of digital games played and the days per week and hours per day spent in playing digital games?
4. Are there associations among the benefits reported by older adults, the types of digital games played, and the amount of time spent in playing digital games?

2. Literature Review

2.1 Challenges in an Aging Society

The world is undergoing a dramatic demographic restructuring of its population. In almost every country, the number of newborns in the population is decreasing. Meanwhile the proportion of older adults is growing rapidly; we are witnessing a significant demographic shift as the proportion of people who are over the age of 65 increases. This steady shift in population, beginning at the end of the 1960s, is due to two contributing factors: sub-replacement fertility levels and longer life expectancy (Statistics Canada, 2011). Over the coming decades, older adults will continue to increase as a proportion of the global population. The population of older adults (aged 60 years and over) increased from 9.2%, in 1990, to 11.7%, in 2013; it will reach a predicted 21.1% increase by 2050 (United Nations, 2013). The aging population has significant social and economic implications for many nations. The economic consequences and risks that result from an aging population may include a reduction in labour supply because of a decrease in the proportion of the population who are of working age (McDaniel & Rozanova, 2011); a negative influence on welfare related to increased longevity in life expectancy and a decrease in income (Bloom et al., 2010); and associated costs related to the prevalence of high poverty among seniors in most developing countries (United Nations, 2013). In terms of developed countries, Canada is among those that are facing the challenges associated with an aging population. The number of older adults in Canada is rising along with the median age of its population (Newbold & Wilson, 2010). Statistics show that the number of Canadians aged 65 and older has continued to increase and is close to 5 million (Statistics Canada, 2011). The 2011 census showed that 13.5% of the population living in Metro Vancouver are senior citizens. In addition, Statistics Canada (2011) predicted that the country will be home to as many senior citizens as children in the next census.

The life expectancy, at age 65, is about 85 in Canada. Older adults can expect to enjoy 20 years of leisure time after retirement. An important challenge for

this population segment, families, and society is providing support to older adults in being able to remain independent, healthy, and positive during this period. Since older adults want to maintain their independence and have a positive outlook for their lives (Bowling & Dieppe, 2005) and because there is greater societal awareness of the importance of supporting older adults in the maintenance of their physical and mental health, an interest on how to support successful aging has been observed within society and among academics.

2.2 Successful Aging

Earlier research on successful aging mainly focuses on a single dimension, either physical or psychological (Butt & Beiser, 1987; Schulz & Heckhausen, 1996; Williams, 1963). Butler and Gleason (1985) gave successful aging a one-dimensional definition of "living a long time". Another one-dimensional definition of successful aging was defined by Peris et al. (1999) as "working after usual retirement age". Unlike these traditional views, the most recent research has expanded upon the concept of successful aging through the use of a more systemic and multidisciplinary approach, cutting across cognitive, psychological, and physical fields.

Rowe and Kahn (1997) developed the first multidimensional model to describe the concept of successful aging. This consists of three principal components:

- The avoidance of disease and the disabilities caused by disease;
- The maintenance of high physical and cognitive functioning;
- And, the active engagement of seniors in social and productive activities.

Because successful aging is a multidimensional concept, which cuts across disciplines, differences in disciplinary focus in terms of successful aging can be seen. Bowling and Dieppe (2005) conducted a systematic literature review of about 170 papers related to successful aging. They found that biomedical models generally considered normal physical and cognitive functioning and being disease-free as successful aging, while social-psychological models also include levels of life satisfaction and of engagement in social activities as having an effect on successful aging as well. All models of successful aging aim to help seniors in staying positive and active throughout their lives. Consequently, successful aging cannot be easily assessed as either having or not having been achieved. Rather, successful aging

must be viewed on a continuum and its assessment must be informed by a more comprehensive perspective (Bowling & Dieppe, 2005). This recommendation is supported by results from a national survey, conducted by Bowling and Dieppe (2005), with 854 randomly sampled participants who were aged 50 or more in Britain. The aim of the survey was to investigate what older adults consider to be a successful life and to identify the three factors that are of greatest import in this respect. These three factors were identified as being physical health and the absence of disease (67%), cognitive functioning and good mental health (47%), and social engagement and communication (36%). In another study, based on the analysis of interview data, Lewis (2011) recommended that older adults actively engage with family and community members and that their receiving of support, which contributes to their feeling a sense of usefulness and purpose, should be included in the definition of successful aging. Older adults who have strong relationships with family and friends and who know how to maintain good social interactions are at less risk of experiencing mental health problems (Singh & Misra, 2009).

Since numerous factors of successful aging are interrelated, it is believed that cognitive functions and social factors are as important as physical health in the achievement of successful aging (Bowling & Dieppe, 2005). After systematically examining 75 empirical studies regarding the concept of successful aging across different disciplines including medicine, sociology and psychology, Bowling (2007b) suggested that a model of successful aging be multidimensional and that it consider variations in cultural values and differences in social environments. The results collected from two large participant-based cohorts of older adults, who were aged 65 and over, showed that their perceptions of successful aging fell into four dimensions – physical, mental, functional, and social (Phelan, Anderson, LaCroix, & Larson, 2004). The results indicate that successful aging is multidimensional and more complex than indicated by the one-dimensional definitions found in previously published literature (Butler & Gleason, 1985; Perls, Silver, & Lauerman, 1999). In contrast to a one-dimensional model (Cosco et al., 2014), using a multidimensional model to define successful aging provides for greater opportunity to diagnose those issues that prevent seniors from defining themselves as having those experiences that they would deem as being part of “successful” aging.

Advances in modern medicine and interventions, which target physical, cognitive and social training, assist not only in the reduction of health risks and

physical disabilities in old age, but they also contribute to more successful aging. Many researchers have found that technology-based interventions contribute to significant performance improvements in "successful aging," and research indicates that technology shows promise in being a tool for helping older adults experience less depression, enhancing their cognitive ability, and becoming more socially active (Eisdorfer et al., 2003; McConatha, McConatha, Deaner, & Dermigny, 1995; White et al., 2002).

2.3 Older Adults and Technology

Older people are perceived as not being receptive to new technologies, because most older adults have spent the majority of their lives without computers (Aison, Davis, Milner, & Targum, 2002). However, the pervasive use of technology in daily life has made it impossible for older people to not be influenced by technology. It is important that older adults be made aware of and begin to understand the potential benefits of using new technologies.

Over the past decades, many studies were conducted to examine the relationship between older adults and new technologies because of increased awareness of the positive effects that technologies have on seniors, including physical functioning; mental health; and social engagement. The study performed by Baack et al. (1991) compared the attitude towards computers of 235 young adults (mean age of 22.4 years) with the attitude of 184 older adults (mean age of 73.6 years) and found the there were no significant differences between the two study groups. Inasmuch as the older adults were less eager to participate in interactive activities using a computer, they did realize the value of computers and other technologies and did not express much anxiety while using a computer (Baack et al., 1991). The factors that hindered or encouraged older adults in their use of a computer were more or less the same as those that affected younger people (Broady et al., 2010). Hence, not taking age into account, all those who are learning about a new technology should receive sufficient training in a supportive and positive manner; doing so should be viewed as the main way by which to increase a person's acceptance of new technologies (Baack et al., 1991; Broady et al., 2010).

A qualitative study conducted by Gatto and Tak (2008), which examined the benefits and barriers of using computers, Internet, and e-mail among 58 older adults, found that people in this population segment experienced frustration when using

these technologies. They found that lacking technological knowledge and skills hindered older adults' from enjoying this experience. Hence, while designing software and other technologies for older adults, designers should be made aware that a generous amount of time should be allotted to older adults in providing them with the necessary skills to use the technology. In addition, providing older adults with appropriate encouragement and a user-friendly environment when using technology will be helpful in further encouraging them to continue using the technology such that they can derive benefits from its use (Broady et al., 2010). Prior to releasing technological innovations, it is suggested that the technology be tested with older adults first, since they may have special needs or challenges when using the innovation, especially when compared to younger users. For instance, a study conducted to evaluate SharePic, a digital photograph sharing application for desktop computers, found that older adults who had tried the application reported that they had difficulties with the two-handed gesture required to use it, whereas the same gesture was not an issue that was reported by younger users (Apted et al., 2006).

The use of computers and the Internet could be a way by which seniors can maintain their independence and broaden their horizons (Cresci et al., 2010). Information technology has the potential to help seniors to maintain and expand their social interactions with their family, friends, and community, thereby providing a means for facilitating essential social support, which they need in their daily lives. The benefits provided by technologies such as online banking, communication via social media, health status monitoring, remote health consultancy, and intelligent housing assistance can all be used to improve older adults' physical and mental well-being and to provide them with a better quality of life (Cresci et al., 2010). A cross-sectional study examining the benefits of using technology among 591 older adults demonstrated that using social technology could be physically and emotionally beneficial for older adults. Older adults with higher social technology use are more likely to report being in a better state of health, to have fewer chronic diseases, to experience greater personal well-being and less feelings of depression (Chopik, 2016). Similar results were found in a study in which 222 Australian older adults participated and completed an online questionnaire on their Internet usage. Researchers found that Internet usage among the elderly could be classified into five main functions: the use of the Internet for information/knowledge acquisition, interpersonal communication, commercial purposes, entertainment, and developing new friendships, all of which were found to be associated with lower social and emotional anxiety. In particular, greater Internet usage for communicating with family

members and friends was associated with less social loneliness (Sum et al., 2008). Fokkema and Knipscheer (2007) carried out an experiment to examine the effectiveness of using electronic communication tools in reducing the feeling of loneliness among older adults. Post-intervention, a significant association was found between greater use of electronic communication tools and a reduction in loneliness. The qualitative results indicated that older adults often used the computer and Internet to pass the time and to rid themselves of feelings of loneliness. Furthermore, an interesting and unexpected finding in this study was that older adults' self-confidence was improved after the intervention (Fokkema & Knipscheer, 2007). These findings strongly support the assertion that greater usage of the computer and Internet among older adults helps to reduce their feelings of loneliness. Moreover, Gatto and Tak (2008) also stated several other benefits that older adults who participated in their study reported. These benefits included the joy of connecting with friends and family via email, digital entertainment activities like gaming, searching information related to personal interests, travel, daily life, and online shopping. They were satisfied with the availability and convenience of searching for information using technology, and some of the older adults stated that they could not or would not want to live without it.

The main reason for encouraging the use of new technology among older adults is not only to help them extend the duration of their lives, in terms of providing them with tools that support their physical well-being or reduce health risks, but also to improve the quality of life for this segment of the population. A promising technology in this regard is the digital game.

2.4 Older Adults and Digital Games

Digital games are electronic games that involve human interaction with computers or other devices, operating using different interfaces, which can provide visual and auditory feedback. Digital games are now gradually replacing traditional games (Kowert et al., 2015). Most educational psychology research on digital games has focused on finding potential negative outcomes for children and adolescents, brought about by playing commercial digital games (Allaire et al., 2013). These studies are especially concerned about investigating violent games and possible adverse effects on cognition and behaviour such as their potential role in leading to aggressive behaviour (Anderson & Bushman, 2001). On the other hand, the marketing of video games on the Internet or TV, which primarily targets the younger

generation, may lead the public to hold the stereotypical view that digital games are fangless fancies that are only suitable for young gamers. Although there are many games available for children and young adults, few game developers consider the real needs of seniors (Mahmud et al., 2010). As an underrepresented digital gamer group, seniors seem to be a market population that has been forgotten by game designers, digital game publishing companies, and even by researchers who often do not consider seniors in digital gaming research (Nap, Kort, & IJsselsteijn, 2009; Pearce, 2008).

However, the aging population is beginning to draw the attention of the digital gaming industry and academics. There is a rise in awareness and interest, among game designers and researchers, to consider the potential positive roles that digital games can play in terms of facilitating significant physical and social benefits across the lifespan (Kaufman, 2013a). After all, people are more likely to engage in entertaining, enjoyable (Nied & Franklin, 2002) and meaningful activities (Brown, McGuire, & Voelkl, 2008; Rowe & Kahn, 1997). Furthermore, digital games may have unique features, such as comprehensive and flexible scenarios, that can be specifically designed in consideration of cognitive abilities including working memory, perception, attention and social communication with other players (Whitlock et al., 2012). Wang and Burton (2010) claimed that massively multiplayer online role-playing games have motivational elements that can engage and maintain older adults' attention and decrease their anxiety over using technology.

Digital games may bring about greater benefits to older adults than paper version games or traditional games. In a study investigating the potential of augmented games to enhance the gaming experiences of children and seniors, the study revealed that older participants rated the electronic desktop version of the game as being more immersive and engaging than the paper version (Mahmud et al., 2010). In another study, conducted by Jung et al. (2009), results showed that the group of participants that used the digital gaming console Wii had significantly higher scores than the control group, using traditional games, on four measures (measures of the level of positive or negative affect, self-esteem, loneliness, and physical activity of participants) after the intervention. The findings of this study indicated that playing Wii could improve the overall psychological and physical well-being of older adults. Furthermore, Studenski et al. (2010) conducted the first study on the potential use of interactive dance games to improve older adults' physical activity, and they found that interactive dance games were attractive to many older adults and may

help them achieve their physical activity goals. All of these findings reveal the potential positive use of digital games in improving older adults' physical and psychological health in terms of entertainment, physical enhancement, and interpersonal connection. These attributes of digital games make their widespread adoption among older adults promising.

2.4.1 Positive Benefits of Digital Games

Physical

Though it is not the focus of this survey to explore the relationships between digital games and older adults' physical health, whether using digital games can promote physical heath in older adults draws increasing attention in academic research, as good physical health is a major criterion of successful aging. Research in this regard includes examining what exergames can achieve in terms of promoting older adults' physical health. Exergames are designed to help players reinforce and maintain their physical activity. In addition to the widespread availability of these games, which can be played at home, game players are able to engage in exergames independently after being given simple instructions and user guides.

In a study by Agmon et al. (2011), which investigated the potential use of exergame Wii Fit to improve balance in older adults, the preliminary findings showed that exergames can bring physical benefits to older adults. Nitz et al. (2010) found an improvement in balance and lower limb muscle strength for female participants, between the ages of 30 and 60 years, after participating in weekly, 30-minute sessions for 10 weeks using Wii Fit. The potential therapeutic value of exergames may not be limited to physical abilities but may extend to cognitive ones as well. In a study that examined the outcomes of seniors with subsyndromal depression (SSD) playing Wii Sports, the results showed a significant improvement in participants with regard to cognitive performance, depressive symptoms and mental health-related quality of life (Rosenberg et al., 2010). Maillot et al. (2012) found that older adults in training groups who completed two 1-hour exergames sessions per week for 12 weeks (a total of 24 hours in training) improved not only in game performance but also in measures of physical and cognitive functions, such as executive control and processing speed. These findings suggest that exergame training may be an effective tool for promoting physical and cognitive health among older adults.

Cognitive

In a rapidly aging society, people are understandably keen on living a long and successful life with their cognitive capabilities intact. Age-related cognitive decline refers to the phenomenon whereby older adults show deficits in many areas of cognitive performance such as multitasking, memory, and spatial manipulation, etc. (Whitlock et al., 2012). Mild cognitive impairment affects 10%-25% of people aged 70 and above (Naqvi, Liberman, Rosenberg, Alston, & Straus, 2013). Cognitive decline is the defining feature of Alzheimer's disease and other dementias. These declines often signal their onset (James, Wilson, Barnes, & Bennett, 2011). Even healthy members of the older population may witness the physiological declines that are associated with aging (Cheng et al., 2015). The prevention of cognitive decline is an important concern for many older adults. Though much research supports that physical and cognitive declines are natural results of aging and are non-reversible, some research results from neuroscience suggest that these declines can be decelerated by using technologies in appropriate training and therapeutic interventions. One technology that they believe may have this function is the digital game (Allaire et al., 2013; Basak, Boot, Voss, & Kramer, 2008; Torres, 2011; Whitlock et al., 2012).

Earlier research investigated the effects that playing arcade-type video games had on the cognitive abilities of older adults; these studies began in the early 1980s when playing video games became a household activity. The results showed that participants in these studies improved in terms of their reaction time (Goldstein et al., 1997; Whitcomb, 1990), speed (Dustman et al., 1992), perceptual-motor skills such as eye-hand coordination, and dexterity and fine motor ability (Whitcomb, 1990). Improved memory and self-confidence were also beneficial outcomes, observed after older adults played digital games (Whitcomb, 1990).

Nowadays, research examining the cognitive effects of digital-game playing on older adults is still minimal but gaining popularity. In their study, Anguera et al. (2013) provided neural and behavioural evidence that a customized and interactive-rich video game can be used as an effective therapeutic tool for older adults who suffer from the inability to multitask and from cognitive control deficits, by enhancing their cognitive abilities such as interference resolution, working memory and sustained attention. Fuyuno (2007) reported on an investigative study, conducted by Kawashima and concerning whether mental exercises have positive effects on cognitive functions in elderly people who had been diagnosed with Alzheimer and dementia. Kawashima and his team found that after taking intervention training, the

group of older adults showed better test scores in two widely used tests - the Mini-Mental State Examination (MMSE) and the Frontal Assessment Battery (FAB) in contrast to the scores they obtained six months before, prior to the training. The scores were also considerably higher compared to the ones of the control group in which the elderly received no training (Fuyuno, 2007). Kawashima and his colleagues have introduced this “learning therapy” method to many nursing homes across Japan. The success that he achieved using this method led to an opportunity to work with Nintendo. The company believed that his method could be implemented through a stimulating game, which could help improve elderly people’s functioning skills (Fuyuno, 2007). This game was considered popular in the market with its sales reaching 400 million yen, in 2006, which is a year after its launch. Miller (2005) reported on a study of 95 healthy older adults, with an average age of 80, who participated in a trial. The results indicated that those who played HiFi, which is a game that was designed to stimulate brain function during game playing, and played this game for an hour per day over a period of 8 weeks improved their scores on tests of memory and attention.

In another study, Belchior et al. (2013) found that by playing a first-person-shooter game (*Medal of Honor*), a significant improvement in selective visual attention was witnessed among 58 seniors. Their study also found that playing *Tetris* could greatly enhance senior participants’ selective visual attention, although this was not observed in another study, conducted by Green and Bavelier (2003), with younger adults as participants.

With increased research on whether certain kinds of mental training will help prevent age-related mental decline, the results of many reports suggest that customized cognitive training and other interventions do have significant effects in helping older adults with their cognitive abilities. Appropriate training can immediately benefit elderly people’s performance in trained tasks as well as in untrained tasks (Naqvi et al., 2013). Berry et al. (2010) conducted a study on a group of older adults who played 10 hours of *Sweep Seeker*, which is an independent module of the *InSight* software package released by Posit Science. The results showed that older adults who participated in the training performed better than participants in the control group on the trained perceptual and working memory tasks, which provided support for using perceptual discrimination training to improve the working memory of older adults. Berry et al. (2010) also found that participants even performed better on untrained perceptual tasks, thereby providing evidence that the benefits

associated with training on perceptual tasks can transfer and lead to improvements in the performance of untrained perceptual ability tasks. All these research results support the widespread belief that consistent engagement in well-designed cognitive training and interventions will maintain older adults' cognitive capacities and may also help them prevent age-related cognitive decline (Zygouris & Tsolaki, 2015).

However, many neuroscientists are sceptical of the claim that games designed for mental training can help elderly people halt mental aging. Salthouse (2006) doubted that these studies provided concrete evidence to demonstrate the association between cognitive training and mental performance with increased age, and he also found that the researchers had optimistically interpreted the outcomes of the short-term trainings or interventions and their beneficial effects on the elderly's long-term life. However, Salthouse (2006) did not reject the other advantages that digital games may bring to older adults such as that "the activities are often enjoyable"; thus, playing digital games may contribute to successful aging in terms of higher quality of life.

Social and Emotional

Gaming is widely considered to be a promising way to promote social interaction and provide entertainment, and it is also used as a promising tool to increase quality of life, especially for seniors who have plenty of leisure time after retirement. In a study, conducted to determine whether digital games have positive cognitive effects on the elderly, Torres (2011) found that seniors who participated in the study had a better self-concept as well as experienced an improved quality of life and enhanced cognitive functioning after the digital game training. In another study that was conducted by Gerling, Schulte, and Masuch (2011), the potential effects of the game *SilverPromenade*, a promising leisure activity for frail and elderly people in nursing homes, was evaluated. The results indicated that playing the game was an accessible activity for these older adults and that it could significantly increase the social interactions among the senior players. Most importantly, the study results also showed that the game *SilverPromenade* was a very enjoyable activity that could help raise their quality of life. Further suggestions were given by the authors on how suitable digital games could be introduced into nursing homes to enrich the lives of elderly residents and encourage seniors to maintain active lives by playing digital games, thereby enhancing the social interactions among players (Gerling et al., 2011). In their study that examined whether playing Massive Multiplayer Online Role Playing Games (MMORPGs) could improve social and emotional well-being among

older adults, Zhang and Kaufman (2016) also suggested that playing MMORPGs had great potential in increasing older adults' social interactions and supporting them in maintaining their physiological health.

Many older adults enjoy traditional or digital games in terms of socializing with others, including family members, friends or people outside of their social network. Playing games can facilitate the generation of topics of interest that can open the lines of communication among a group of people, can decrease social distance while playing with strangers, and can contribute to an intimate and enjoyable environment when with family. Though many digital games can be played alone, sometimes it is their multiple-player feature that is the selling point that attracts gamers. In a survey that was conducted by Nielsen Interactive Entertainment (2008), which investigated consumer attitudes and usage of video games across 15 European countries, statistics showed that, overall, eight out of ten parents reported themselves to be active gamers and that they played video games with their child/children. Roughly half of the parents reported that the reason why they played digital games with their children was because they considered game playing to be a fun activity for all family members or because playing video games allowed them to spend more time with their children (Nielsen Interactive Entertainment, 2008). The need for social bonding through game playing is fundamentally an important motivator for individuals in encouraging them to engage in digital games playing, and its importance is only expected to grow with age. Casual video games, which are free and integrated into social media and social networking sites, are gaining popularity among adults, especially among older adults aged over 50, who reported feeling more socially connected as a result of playing casual video games (Whitbourne et al., 2013). Wang and Burton (2010) also indicated that playing massively multiple online role-playing games (MMORPGs) may decrease older adults' feeling of loneliness and social disconnection from family and friends.

Some researchers believe that, compared to physical and mental health, social connection and support from family and the community make a more significant contribution to seniors' conceptions of successful aging and that this type of connection requires more attention from society (Lewis, 2011). Allaire et al. (2013) found that older adults are actually embracing digital gaming contrary to the popular belief that seniors are reluctant to play digital games. The study's results highlight that older adults who play digital games, even occasionally, perform better than elderly non-gamers on some psychological functioning tests (e.g. well-being, affect,

depression, and social functioning), which could reflect successful aging. In a study, conducted by Schell et al. (2015), a group of seniors showed improvements in social connectedness and a decrease in loneliness, both in qualitative and quantitative analyses, after they had played the Wii Bowling game. Kahlbaugh et al. (2011) also found that playing Wii sports could bring to older adults greater social connections, fewer feelings of loneliness, a sense of achievement and an optimistic attitude. Older adults also showed improvement in life satisfaction after playing digital games (Wang et al., 2011).

Intergenerational

Researchers have found that online games can help players obtain longer and better communications with their pre-existing social ties and their family members if they play the game together (Shen & Williams, 2010). Due to this fact, it is no wonder that being able to interact socially with others is considered to be a main motivation for many seniors who play digital games (Abeele & Schutter, 2010).

Among the kinds of social interactions, enhancing communication and interaction skills between older adults and younger generations is a personal and social need that is becoming more common. The results of a study by Meshel and MCGlynn (2004) showed that, after intergenerational contact, the attitudes of adolescents toward older people and older people toward adolescents improved. In addition, older adults showed a significant improvement in their life satisfaction. Hence, there is potential in using technologies in facilitating intergenerational interactions.

Over the past few years, an emerging interest in intergenerational games has been observed. This kind of game aims to increase the interactions and communications between different age cohorts. Social isolation among the members of the older generation has been found to be a significant problem among older adults who live alone, without the company of their children or grandchildren. Digital intergenerational gaming has provided great opportunities to improve the computer-mediated interactions between younger and older generations. Besides being used as a therapeutic tool, Ijsselsteijn et al. (2007) stated that the research results of their study indicate that digital games can also offer benefits of enhancing the communication between different age cohorts while they are playing games, especially between grandparents and grandchildren.

However, different age groups have distinct requirements for game design; therefore, game designers are facing great challenges when making intergenerational games for children and seniors (Mahmud et al., 2010). In an intergenerational case study, which evaluated the gaming experience of children and seniors when they play a game together, Mahmud et al. (2010) found that older adults show great eagerness to play with their grandchildren, and they keep an open mind in terms of playing with their peers, too. However, their grandchildren stated a preference for playing with their friends of the same age, although they do not reject playing with their grandparents as long they can play the games they like. The results revealed that when designing a single intergenerational game for both children and seniors, designers should consider how game elements, themes, game types and play rules meet the requirements of both generations. Khoo et al. (2009) presented steps for designing an intergenerational gaming system that utilized user-centered design approaches, and the results showed widespread acceptance across the different age groups of players, especially among older players who gave the maximum rating available and who indicated that they had fun interacting with other players.

Education and Learning

Over the past decades, a number of researchers have been dedicated to investigating the effectiveness of games in education and learning (Zemliansky & Wilcox, 2010). In the late 1960s, using games in educational fields was starting to gain popularity (Boocock & Schild, 1968). From then, the growth of research in this area has never stopped, i.e., researchers sought to examine how the learning process occurred during the playing of digital games as well as investigate the educational objectives that could be achieved in the process (DeVries & Edwards, 1973; Kafai & Burke, 2015; Kaufman, Sauvé, & Renaud, 2011; Ruben, 1999; Virvou, Katsio, & Manos, 2005). Numerous research studies have shown that educational games have great potential to improve learning motivation (Papastergiou, 2009; Tüzün, Yılmaz-Soylu, Karakuş, İnal, & Kızılkaya, 2009; Yang, 2012), increase skills such as problem solving (Yang, 2012), promote knowledge acquisition (Kanthan & Senger, 2011; Papastergiou, 2009), and enhance satisfaction and engagement (Kanthan & Senger, 2011; Tüzün et al., 2009) among learners.

People acquire knowledge, make changes in their lives, develop attitudes and values about their living environment during the learning process, and this is an essential process at any age. The world is changing rapidly due to the innovation of

all kinds of high-tech products. Significant social and economic changes require that older adults place more effort in keeping abreast with trends in innovation that are emerging in society. In a research survey, older adults responded to the question of why they still wanted to continue learning by answering that they learned in order to keep up with new developments in their surroundings, to strengthen their mind, foster personal growth, and to experience the joy of learning new things (Harris Interactive Inc., 2000). These findings were supported by both the quantitative and qualitative analyses of the study. The results showed that the purpose of later-life learning was to enrich one's knowledge base and to "keep up to date with society" (Tam, 2016).

Purdie and Boulton-Lewis (2003) suggested that continued engagement in education and learning is a key factor in maintaining one's health along physical, mental and social dimensions. Research has shown that education and learning help older adults enjoy and hold positive attitudes towards life as they age, facilitate social connection, allow them to adapt to changes in their environment, and contribute to improvements in their life satisfaction (Ardelt, 2000; Dench & Regan, 2000; Tam, 2016). Older adults also believed that lifelong learning could help them stay physically and mentally healthy (Tam, 2016).

Education and learning can be formal, non-formal, and informal (Colardyn & Bjornavold, 2004; Dib, 1988). These concepts can be briefly summarized as:

- Formal learning: learning that occurs in well-organized and structured settings such as formal education in institutes and training in companies. Normally, this type of learning is conducted within a certain curriculum and program and leads to formal recognition of learning, for instance, certificates, educational degrees, or diplomas.
- Non-formal learning: learning that may not be arranged by an institution but embedded in planned activities, involving learning goals and based on particular learning approaches.
- Informal learning: learning resulting from daily activities, which is not intentionally organized for learning; informal learning often refers to experiential or accidental learning.

(Bjornavold, 2000; Eaton, 2010)

Older adults are motivated to participate in informal education and learning for many different reasons. Some of them want to fulfill their dreams of going to college or university (Tam, 2016). Many believe that formal education is an excellent

way for them to upgrade their current working skills or to acquire the new knowledge and skills that they need to keep their jobs (DiSilvestro, 2013). However, many studies have reported barriers to older adults' participating in formal education. The most common barriers to formal education mentioned by older adults include: lack of time to return to school (Lakin, Mullane, & Robinson, 2008), expensive tuition fees (DiSilvestro, 2013; Purdie & Boulton-Lewis, 2003; Tam, 2016), and declines in health and cognitive abilities, such as difficulties with memory (Purdie & Boulton-Lewis, 2003; Tam, 2016).

Compared to formal education and learning, informal learning is more flexible in schedule and format. Because it is not necessary to be present at specific lectures, informal learning can occur in daily activities related to family, community, and work. Hence, informal education and learning may be a great opportunity for older adults to overcome the barriers to participation associated with formal education, mentioned above. Though the learning preferences of older adults are diverse, there are older adults who prefer learning informally, by reading, learning by doing, or just participating in activities (Tam, 2016). This finding, derived from a qualitative analysis of data, indicates that many older adults do not want to learn under pressure and competition but that they prefer to learn in a recreational way. Playing educational games, as an entertaining activity that is free from pressure, can be a good way for older adults to learn in informal settings.

Digital games have many features, including interactivity (Charlier, Remmele, & Whitton, 2012; Hong, Cheng, Hwang, Lee, & Chang, 2009) and visualization (Amory, Naicker, Vincent, & Adams, 1999), that support older adults in learning efficiently. Digital games have great potential as a tool for promoting learning among older adults (Czaja & Sharit, 2013) and also as a form of social and educational enrichment for them (Hollander & Plummer, 1986). As mentioned before, playing certain kinds of digital games helps older adults in enhancing their social, emotional, physical, and cognitive well-being, and these positive changes can be regarded as informal learning.

Education for older adults should include the use of technology (Boulton-Lewis, 2010). One of the most frequently cited needs of older adults is learning technical skills, including how to use a computer (Purdie & Boulton-Lewis, 2003; Tam, 2016). Several research studies have examined the educational benefits of playing digital games for older adults in terms of learning about computers and other technologies, and these studies have found that playing digital games has the

potential to improve older adults' technological skills, including their computer skills (Ijsselsteijn et al., 2007; Wang & Burton, 2010; Wang et al., 2011).

2.4.2 Senior Gamers and What Games They Play

Demographic

According to the *Entertainment Software Association of Canada (ESAC) 2016 Essential Facts Report*, the average age of a Canadian game player is 36 years old (Entertainment Software Association of Canada, 2016). Entertainment Software Association's (ESA) *2013 Essential Facts About the Computer and Video Game Industry* found that nearly half of adults over 50 played games. In Australia, research indicated that the average age of individuals who played digital games was 33 in 2015. The average age has increased in nine years, from the original 24 years old, in 2005. The significant contributor to this change was the greater population of older players who were able to access and play digital games in Australia. Further, 49% of older adults who were over the age of 50 as well as with 39% of those aged 65 and over reported playing digital games (Brand & Todhunter, 2015). The proportion of older adults who play digital games in this age group is predicted to grow significantly over the next decade, as games are increasingly used in education and health fields when working with older adults.

In 1983, Nintendo released its Family Computer in Japan. This release revitalized the North American video game market. Since then, 30 years have passed, and the majority of its target age group of young adults are now 50 years in age or older. Recent statistics reveal a very different profile of digital game players in Canada. People from different age groups can now easily access digital games because of the proliferation of these games and devices, especially less time-intensive leisure games on mobile devices. Consequently, everyone in this modern society can be a digital game player. According to the statistics released by the non-profit organization Entertainment Software Association of Canada (2015), 19 million Canadians are gamers which amounts to 54% of the total population. Although the average age of Canadian gamers is 33 years old, we see that the average age is increasing when compared to previous years. The proportion of older digital gamers is expected to grow over the next few decades. Ijsselsteijn and his colleagues (2007) all agree that senior gamers have not received enough attention from the digital games industry and researchers, which seems to be a missed opportunity since digital games are viewed as a promising tool for enhancing seniors' leisure time,

increasing their opportunities for socialization, and reducing seniors' isolation, depression and cognitive decline. However, as mentioned before, a growing body of research from many fields indicates that digital games have significant potential in helping seniors with successful aging, which further increases the interest of public institutions in developing more digital games that can benefit seniors.

Types of digital games seniors play

Although statistics show that the population of senior gamers is steadily growing, there is relatively little research about them. Only a few studies have investigated the types of games that seniors play, and it is unclear what relationships exist between the characteristics of seniors and the game genres. The majority of older adult gamers are categorized as casual gamers (Zheng, Hill, & Gardner, 2013), since most of the games that the elderly report that they play are casual games (e.g., card games, puzzle games). The study, conducted by the BBC (Pratchett, 2005), showed that for the age group between 51 and 65 years, UK gamers prefer to play puzzle, quiz and board games. In their study, which investigated senior gamers' preferences, motivations and needs, Nap et al. (2009) found that seniors who participated in the research only played a limited variety of games, and they intended to play only those particular types of digital games for months or even years. Unlike male senior gamers who preferred more real-world graphics, female seniors intended to play casual games with cartoon-like graphics (Nap et al., 2009).

In a study, which sought to determine the attitudes of older adults toward shooter video games, most of the participants (10 out of 16 seniors) indicated that they would not like to play a realistic first-person-shooting game after the researchers showed them the video clip of the game. Of the six seniors who tried out the game, three demonstrated their unwillingness to play the game again (McKay & Maki, 2010). Compared to this game, the acceptance of a non-violent cartoon first-person-shooting game and a fixed-shooter game are much higher (McKay & Maki, 2010). Although these three types of games have been shown to be equally effective in improving visual processing ability, Mckay and Maki (2010) believe the results of the study illustrate that in comparison to the realistic first-person-shooting game, which contains violent scenes and surreal audio effects of wild gunfire and shooting, a cartoon first-person-shooting game is more likely to be accepted and enjoyed by the senior gamers. The results of a cross-sectional survey study also indicates that unlike adolescents, older gamers do not prefer first-person shooter games (Festl et al., 2013).

Results of the study that was conducted by Wollersheim et al. (2010), which aimed to investigate whether playing a Wii video game has physical and psychosocial effects on older female players, indicated that game preference might be different among seniors depending upon their background characteristics, personality, and previous experience. In the study, participants who played tennis before, in the real life, preferred to play tennis as well in the Wii Sports Resort, and participants who reported themselves as energetic-type persons liked to play sword fighting and boxing games (Wollersheim et al., 2010). This interpretation is bolstered by evidence from a study by Theng, Chua, and Pham (2012), who found that participants indicated their preference for the bowling game over other Wii games because of their having watched bowling on TV or having played bowling with friends or families. An elderly participant in an intergenerational case study also stated, during an interview, that digital games featuring cards were more enjoyable for him, since he had been playing cards for the last 30 years (Mahmud et al., 2010).

Why Conduct Research on Different Types of Digital Games

Digital games are a new technology that may have some features that are incompatible with the needs of seniors (McLaughlin, Gandy, Allaire, & Whitlock, 2012). Tong et al. (2014) found that some elderly participants who suffered from deficits in focused attention and visuospatial ability found it difficult to play a game, which was designed by the researchers. Consequently, they recommended that the game characteristics be adjusted based upon the capabilities of the user so that satisfying levels of game play could be achieved (Tong et al., 2014). Ackerman, Kanfer, and Calderwood (2010) conducted an experiment to determine whether a Brain Fitness game, Wii Big Brain Academy, could help a group of elderly adults, between the ages of 50 and 71, to perform better on game tasks and to show improvement in domain knowledge by scoring higher on the designed tests. They found that 49 out of 78 participants said that they are not going to play the Wii Big Brain Academy software again after the study, and this assertion was made even before the research team obtained the study results.

McLaughlin et al. (2012) introduced the model of motivated choice, which posited that motivation and barriers are of significance to seniors in terms of making the decision to accept a new technology. For seniors, if the benefits they receive from a new technology can outweigh the costs, they are willing to become adopters. If a digital game does not hold any enduring attraction for seniors, even though it

may improve their cognitive abilities, they may lose the motivation over time and be reluctant to put their effort into playing the game.

The potential benefits of digital games regarding the improvement of seniors' cognitive abilities have been discussed before. In a similar and interesting way, age-related changes in cognitive functioning are also able to affect the requirements of the digital games' interface design (Ijsselsteijn et al., 2007), which indicate that background characteristics such as age may have influence on the degree to which seniors prefer different games. Results from a study conducted by Marston (2013) indicated that game content can have a great impact on older adults' experience of flow and gameplay. After playing three Wii Sports – golf, tennis, and boxing, several older participants reported unclear game graphics and difficulties in recognizing targets due to declines in visual ability.

In a study by Belchior et al. (2013), the researchers observed that after being trained to play the video games *Medal of Honor* and *Tetris*, senior participants' selective attention improved. However, senior gamers learned the required gaming skills for *Tetris* more easily and found it easier to actively engage in playing *Tetris*. The results indicate that compared to the first-person-shooting game, a puzzle-like game may be more attractive to senior gamers (Belchior et al., 2013). In their study investigating problematic computer game use among different age groups, Festl et al. (2013) found that, generally, older adults had lower preference levels for role-playing games and first-person shooter games relative to adolescents and younger adults. Even in the same type of digital games, older adults showed noticeable game preferences after they tried all of them. Seven older adults participated in the study that was conducted by Agmon et al. (2011) to assess the potential of Wii Fit exergames in improving older adults' balance. They reported their game preference after playing four Wii Fit exergames, namely *Basic Step*, *Soccer Heading*, *Ski Slalom* and *Table Tilt*. Preliminary findings indicated that Wii Fit exergames improved balance in older adults but that an obvious game preference was detected after interviewing these participants. All participants showed their preference for ski slalom and table tilt due to their ease in understanding the scoring rules and their perceptible progress while playing. The researchers also found that five of the seven participants felt frustrated when playing and passing a soccer ball since the fast pace of the game hindered them from being able to make the right decisions when playing and because they hardly saw improvements in their scores for the game (Agmon et al., 2011). The fast pace of some digital games may awaken the sense of

competition among younger generations. However, for older adults whose reaction speed has declined, they may find these kinds of games frustrating, thereby decreasing their desire and willingness to play more.

Although the study results of Boot et al. (2013) contrast with those of previous studies, which stated that video game interventions can improve cognitive abilities (Basak et al., 2008; Nouchi et al., 2012), the data of this study provided valuable insights into what types of digital games the elderly are willing to play and why. The findings indicate that even if some digital games have been designed to help older adults maintain their health, their game preferences would hinder them from accepting these games.

Therefore, before designing digital games for seniors, it is critical for the researchers and game designers to know which types of digital games seniors are playing, whether the seniors' background information like gender, age, and education, etc. will affect their choice of digital games and the perceived benefits associated with playing digital games (Gerling, Schulte, Smeddinck, & Masuch, 2012). Ijsselsteijn et al. (2007) called for more well-controlled studies to be implemented such that the effects of different types of digital games on different groups of elderly game players, with various hypothesized benefits, could be examined.

2.5 Previous Study using the Survey

This study is mainly based on the analysis of the data collected from a survey, which consists, in part, of a four-year project led by Dr. David Kaufman, which examines whether using digital games enhances older adults' quality of life. Cognitive, psychological and social-emotional aspects of quality of life were considered. A total of 1211 older adults (55 years and older) participated in and completed the survey. They were recruited from shopping malls, assisted living and community centers, nursing homes and other public places in Greater Vancouver, Quebec City, Greater Montreal, and the Ottawa region. In this study, only data collected from Greater Vancouver was used in the analysis.

After a preliminary analysis of the survey data, Kaufman (2013a) found some interesting results which demonstrate that a large number of older adults play digital games regularly, and most players reported that they experienced several benefits of

playing digital games, such as mental exercise and fun. The main difficulty that they reported during the game was that certain digital games were too complicated, but this was only reported by 21% of the participants. Kaufman, Sauve, Renaud, and Duplaa (2014) found that compared to the older adults who rated their playing skills of digital games as “beginner”, those older adults who rated themselves as “intermediate” players reported dramatically higher improvements in cognitive skills, including focusing attention; reasoning; problem solving; and reaction speed. All these initiatory results show the promising use of digital games as an entertaining and progressive activity for enhancing seniors’ quality of life and they call for further investigation of the survey’s data set and for more studies in this area.

3. Methodology

This study was a cross-sectional survey aimed at understanding older adults' experiences of playing digital games and their opinions towards them. It covered various questions including senior respondents' characteristics, experiences of playing digital games, patterns of playing, and opinions about digital games.

3.1 Respondents

The population targeted in the survey was older adults who played digital games. In this study, older adults referred to individuals who were aged 55 and over. Across Canada, a total of 1211 older adults completed the survey, but only the data that was collected within Greater Vancouver area (n=875) was used in this study. Furthermore, only 463 respondents who reported they had played digital games at some point within the past year were included in the data analysis procedures. Among these 463 respondents, 283 of them were female (61.1%), 173 were male (37.4%), and 7 respondents (1.5%) did not want to reveal their gender. 195 respondents (42.1%) were between the ages of 55 and 64; 168 (36.3%) were between the age of 65 and 74; and 82 (17.7%) were aged 75 years and over. 18 respondents (3.9%) did not want to reveal their age.

More data on the demographic characteristics of the respondents, who played digital games, can be found below in Section 4.

3.2 Research Instrument

The method of study was predicated upon a print-based questionnaire that targeted the population of older adults, aged 55 and over. The questionnaire was created by Dr. David Kaufman and his team in 2012-13 and was thoroughly reviewed by peers. Most of the questions in the questionnaire were closed, with a minority being open-ended questions (e.g., "Which digital games have you played?") in order

to get a better understanding of the issues that could help with further analysis. The first section asked participants about their leisure and their non-digital game playing activities. Respondents who reported that they had played digital games in the past year (*n*=463) then completed the section on digital games.

The questionnaire focused primarily on the respondents' background information, gaming/recreational activities and habits, with whom they played, frequency, social involvement in the game, and the perceived benefits of playing digital games. The survey took approximately 15 minutes for respondents to complete.

Table 1. Sources of Questions in Survey

Type of Questions	Sources Designed From
Background Information	Questions were influenced by generic survey questions.
Patterns of Use	Pew, Video Games: Adults are Players Too (2008)
Playing with others	Pew (2008) – Teens, Video Games and Civics
Social/Psychological	Eldergames (2006), Wollersheim et al. (2010), Khoo & Cheok (2008), Jung et al. (2009), De Schutter (2011)
Cognitive	Gamberini et al. (2006), Buiza et al. (2009), Gamberini et al. (2008), Wollersheim et al. (2010)
Educational/Skills	Gamberini et al. (2008), Wollersheim et al. (2010)

Questions in the questionnaire were developed from sources such as previous surveys, academic research and scholarly discussions. Table 1 shows the primary sources used to develop some of the questions in the survey. The construct and face validity was established by having a team of five faculty researchers, a postdoctoral scholar and three graduate students review the multiple drafts of the questionnaire as it was being developed. It was then pilot tested with six older adults and three graduate students. The reliability coefficients (alpha) for the cognitive benefits scale (7 items) and social-emotional benefits (5 items) were .81 and .77 respectively.

Data was collected across Canada, in both English-speaking and French-speaking regions. An English version and a French version of the questionnaire

were respectively developed for English-speaking and French-speaking older adults (The English version of the questionnaire is attached in Appendix A).

3.3 Methods of Recruitment and Procedures

The survey was administered to individuals over the age of 55 in shopping malls, local community centers, nursing homes and seniors' centers in Greater Vancouver. All respondents remained anonymous when completing the survey in order to protect the identity and personal information of each respondent. There were no risks to older adults who responded to the survey. Permission from management was acquired to publicly recruit older adults to participate. A recruitment letter was also sent to potential organizations, via email, to ask for their permission to survey their clients/residents. Respondents received a $5 gift card as compensation for their involvement.

3.4 Data Analysis

The data was collected, cleaned, coded and entered into SPSS 21, which was used to statistically analyze the collected data. Since it was not mandatory for the participants to answer all the questions in the survey, the number of respondents who answered various questions was slightly different.

The survey data was analyzed using SPSS 21, and descriptive statistics were run on variables including demographic characteristics, duration of play, and perceived benefits after playing digital games, etc. Due to the nature of the research questions, the first part of the survey on games and leisure activities (questions 1 to 7) was not included in the data. This section was reported in another study (Mortenson, Johnson, Kaufman, & Sixsmith, in press), but was not relevant to the interests of this thesis. After certain data was eliminated from these questions, frequency analyses was run on the rest of the variables to identify data errors, unequal group sizes and the need for recoding variables for better analysis. This study, focused specifically on the top 6 types of digital games and their relationships to the benefits perceived by older adults. Although questions 17, 18, 19, 20 and 21 are related to the topic, they were not included in the final data analyses. Questions 16, 30 and 33 were not included due to their irrelevance.

- Question 16: Which of the following devices did you use to play digital games? (select all that apply)
- Question 17: Have you played role-playing games online with other payers? (e.g., World of Warcraft, Everquest)
- Question 18: Have you played social games online with other players? (e.g., bridge, chess, scrabble, Facebook games)
- Question 19: Have you met new people while playing these online games?
- Question 20: Have you played digital games (select all that apply)
- Question 21: With whom have you played digital games (select all that apply)
- Question 30: Country
- Question 33: Where do you live

Since there were extremely unequal group sizes for some variables in terms of response categories, these variables were recoded into newly developed variables, consisting of categories that were different from the original ones on the questionnaire. Although there was an underlying interval scale in question 11 and 12, the sample was not normally distributed for these two questions. If preserving the original distribution, more than 20% of the expected counts were less than 5 when running the chi-square tests with tables larger than 2x2. Table 2 provides a summary of the variables that were recoded into new variables with different response categories, based on the original ones in the questionnaire.

Table 2. Recoded Variables

Questions	**Response Categories**							
Question 11. During the past month, how many days per week on average have you played digital games?	0	1	2	3	4	5	6	7
Question 11. Recoded	Eliminated			1-4			5-6	7
Question 12. During the past month, when you played digital games, how many hours per day on average did you play?	1 hr or less	2-3 hrs		4-5 hrs		6-8 hrs	More than 8 hrs	
Question 12. Recoded	1 hr or less			2 hrs or more				

Question 24. In your opinion, has playing digital games increased or decreased the following: (social & emotional)	Increased		No difference		Decreased	
Question 24. Recoded	Increased		No difference*			
Question 25. In your opinion, has playing digital games increased or decreased the following: (cognitive)	Increased		No difference		Decreased	
Question 25. Recoded	Increased		No difference*			
Question 26. In your opinion, has playing digital games increased or decreased the following: (technological skills)	Increased		No difference		Decreased	
Question 26. Recoded	Increased		No difference*			
Question 28. Age	55-59	60-64	65-69	70-74	80-89	90 and over
Question 28. Recoded	55-64		65-74		75 and over	
Question 29. Primary language	English		French		Other	
Question 29 Recoded	English		Other			
Question 31. What is your ethnic group?	Caucasian	Asian	African-American		Aboriginal	Other
Question 31. Recoded	Caucasian		Other			
Question 32. Living arrangement	Alone		In a couple	With family	With others	
Question 32. Recoded	Alone		With others			
Question 34. Level of education completed	More than 8 categories					
Question 34. Recoded.	High school or less		College or 2-year degree		Postgraduate	
Question 35. Are you retired?	Yes		No		Never worked	
Question 35. Recoded	Yes		No			
Question 36. Describe your working situation at the present time.	Not working		Working part-time (paid or voluntary)		Working full-time (paid or voluntary)	

Question 36. Recoded	Not working	Working

Cross-tabulations were conducted to investigate the significant relationships between specific variables. Demographic characteristics (sex, age, language, ethnic group, living arrangement, retirement status, working status), opinions on the benefits of playing digital games (social and emotional aspects, cognitive aspects and technological skills aspects), and the amount of time spent playing digital games were cross-tabulated with types of digital games (arcade, strategy, puzzle, word, sport and card/board/tile games). Also, cross-tabulations were run between amount of time spent playing and opinions on the benefits of playing digital games.

The Chi-squared statistic was calculated for statistical significance. The level of significance was set at p=0.05 and was reported as *significant at the 0.05 level, **significant at the 0.01 level, ***significant at the 0.001 level in Section 4.

3.5 Categorizing Digital Games

On the survey, respondents could write down up to three digital games that they had played (See Q15. “Which digital games have you played, whether alone or with others?”). Among the 463 older adults who reported that they had played digital games in the past year, all wrote down at least one digital game that they had played. All their responses on the survey were coded into two variables: the respondent’s answer and a variable that classified each game into a category. Every individual game that the older adult reported was carefully assessed by researchers and assigned to a category. There were 14 identified game categories (namely, Arcade, Adventure, Fighting, Shooter, Simulation, Role-Playing, Strategy, Puzzle, Word, Trivia, Sport, Educational, Card/Board/Tile, and Others). Researchers assigned a “0” to a respondent for each of these variables if the respondent did not report any games that fell into any of these categories. A “1” was assigned if any of his listed games could be put into these categories; i.e., if a senior reported three digital games, with two of them being arcade games and the last one being a word game, then the researcher would assign a 1 in arcade game category and a 1 in the word game category. Meanwhile, all other categories would be assigned a 0. Table 3 lists all 14 categories of digital games and data on how many respondents reported that they had played each type of digital game.

Table 3. 14 categories of digital games played

Game Category	Frequency (*n*)	Percent (%)
Arcade*	34	7.3
Adventure	6	1.3
Fighting	1	0.2
Shooter	13	2.8
Simulation	7	1.5
Role-Playing	4	0.9
Strategy*	74	16.0
Puzzle*	216	46.7
Word*	58	12.5
Trivia	4	0.9
Sport*	18	3.9
Educational	4	0.9
Card/Board/Tile*	133	28.7
Others	95	20.5
Total	667	

***Only these game categories are included in further data analysis procedures**

Game Categories with at least 18 responses were used for further data analysis. The final selection of games categories included: arcade (*n*=34); strategies (*n*=74); puzzle (*n*=216); word (*n*=58); sport (*n*=18); Card/Board/Tile (*n*=133). Due to its ambiguous definition, the “other” category was excluded from further analysis, though it had 95 respondents.

4. Results

This study mainly focused on the digital games that older adults play, so the first part of the survey on leisure activities and non-digital games was not included in this study. In total, there were 875 respondents, but only 463 older adults reported that they played digital games. So only the survey data of these 463 respondents were analyzed for this study. The goal of this research was to answer the following four questions about the types of digital games that older adults played in Canada.

1. Which types of digital games are played by older adults in Canada?
2. Is there an association between types of digital games played by older adults and their background characteristics? (e.g., sex, age, living alone or with others)
3. Is there an association between the types of digital games played and the days per week and hours per day spent in playing digital games?
4. Is there an association between the benefits reported by older adults and the types of digital games played and the amount of time spent in playing digital games?

Table 4 is a summary of all the variables that were included in the data analysis in order to answer these four research questions.

Table 4. Summary of variables that were used in data analyses

Variables	Variables
DEMOGRAPHICS	**SOCIAL & EMOTIONAL**
Q27 – Sex	Q24A – Developing new friendships
Q28 – Age	Q24B – Connecting with current friend
Q29 – Language	Q24C – Connecting with family
Q31 – Ethnic group	Q24D – Connecting with various age groups

Q32 – Living arrangement	Q24E – Developing self-confidence
Q34 – Education	Q24F – Dealing with loneliness
Q35 – Retirement status	Q24G – Dealing with depression
Q36 – Working Status	**COGNITIVE**
TYPES OF DIGITAL GAMES	Q25A – Focusing attention
Q15 – Arcade	Q25B – Memory
Q15 – Strategy	Q25C – Reasoning
Q15 – Puzzle	Q25D – Problem Solving
Q15 – Word	Q25E – Speed in reacting/responding
Q15 – Sport	**TECHNOLOGICAL SKILLS**
Q15 – Card/Board/Tile	Q26A – Computer skills
AMOUNT OF TIME SPENT IN PLAYING	Q26B – Internet skills
Q11 – Days per week on average played	Q26C – Digital game-playing skills
Q12 – Hours per day on average played	

4.1 Research Question 1: Which types of digital games are being played by older adults in Canada?

Frequencies and descriptive statistics were used to answer this research question. In the survey, older adults had the option to list three digital games that they had played, either alone or with others. Some of them listed only one or two games, while others listed three digital games that they had played before. Respondents reported almost a hundred different games. To better analyze which types of digital games older adults in Canada played, the games that respondents had reported that they had played were categorized into 14 types of digital games. Table 5 lists the 14 types of games and the most common games in each category. As this was an open-ended question, some older adults simply listed a generic category of digital games like cards games, puzzle games, etc. Some of the digital

games that were listed by respondents, such as “Wii” or “casino games, were found to be different from the other groupings of games; consequently, these were sorted into the “other” category.

Table 5. 14 types of games and most common games in each type

Types of games	Typical Games
Arcade	Angry Bird, Diamond Dash, Super Mario, Catch a Cat…
Adventure	Crow, Star Trek Fighters, Action Games, Alone…
Fighting	Kick Box
Shooter	Medal of Honor, Shooter Game, Halo…
Simulation	Farm Town, F1 Racing, Star Wars, Sin City…
Role-Playing	World of Warcraft, Diablo III, Dungeon Siege, Beowulf…
Strategy	Risk, Rummy Cub, Chess, Yahtzee…
Puzzle	Tetris, Sudoku, (Spider) Solitaire, Hidden Objects…
Word	Scrabble, W.E.L.D.E.R., Spelling Puzzles…
Trivia	Trivial Pursuit, Password, Trivia Quizzes, Jeopardy…
Sport	Wii Bowling, Wii Sports, World Golf Tour (on Computer)…
Educational	Dora the Explorer, Sustainability Games, Mathematics…
Card/Board/Tile	Mahjong, Bridge, Poker, Blackjack…
Others	Wii, Casino Games…

In Section 3, Table 3 displays 14 types of digital games that older adults have reported playing. To make the results more reliable, those game types with a frequency of less than 15 were excluded from further analysis. See Table 6 for the six categories that comprise the types of digital games that are played by older adults in Canada.

Table 6. Top six types of digital games older adults played

Game Category	Frequency (n)	Percent (%)

Arcade	34	7.3
Strategy	74	16.0
Puzzle	216	46.7
Word	58	12.5
Sport	18	3.9
Card/Board/Tile	133	28.7
Total*	533	

* Older adults could choose more than one option. So, the total number of responses is greater than the total number of respondents, and the sum total of the percentages for the game categories is greater than 100%. %.

For this study, the most common type of digital game, which older adults played, was puzzle games with 216 (46.7% of 463) respondents. Card/Board/Tile games were second highest in terms of frequency, with more than a quarter of older adults listing these types of games types of games on the survey. It is not surprising to see that many respondents chose casual games, which can be played for a duration of 1 to 20 minutes (Brand & Todhunter, 2015), such as Sudoku in the puzzle games category and Blackjack in the card games category. Previous research has found that casual games were the most common choices among people who are part of the older adults' group (BBC, 2005; De Schutter, 2011). There were 18 respondents who reported that they played sports games. The number of respondents for this category may be higher as some had reported that they played Wii games, which may include Wii sports and possibly other types of sports games developed for digital game consoles (e.g., Xbox). These ambiguities resulted in the decision to categorize all Wii into the "Other" category.

4.2 Research Question 2: Is there an association between types of digital games played by older adults and their background characteristics? (e.g., sex, age, living alone or with others)

4.2.1 Demographic characteristics

Frequencies were run on the questionnaire's demographic variables, including: sex, age, language, ethnic group, living arrangement, education level, retirement status, and working status. Table 7 shows the background information for the survey's respondents, and it also displays the frequencies for each demographic variable.

Table 7. Demographic characteristics of older adults who reported playing digital games

Demographics	Category	Frequency (*n*)	Percent (%)
Sex	Female	283	62.1
	Male	173	37.9
	Total	456	100.0
Age	55-64	195	43.8
	65-74	168	37.8
	75 and over	82	18.4
	Total	445	100.0
Language	English	397	86.7
	Other	61	13.3
	Total	458	100.0
Ethnic Group	Caucasian	287	62.8
	Other	170	37.2
	Total	457	100.0
Living Arrangement	Alone	154	33.7
	With others	303	66.3
	Total	457	100.0
Retired	No	102	22.4
	Yes	353	77.6
	Total	455	100.0
Working Status	Not working	272	61.0
	Working	174	39.0
	Total	446	100.0
Education	High School or less	131	28.6
	College or 2-year degree	155	33.8
	Postgraduate	172	37.6
	Total	458	100.0

Almost two-thirds of the respondents were females (females = 62.1%, males = 37.9%). A large difference in the number of respondents between the age groups of 55-64 (*n*=195, 43.8%) and 65-74 (*n*=168, 37.8%) was not found, but the number of participants who were more than 75 years old was slightly lower (*n*=82, 18.4%). Most of the respondents were native English speakers (*n*=397, 85.7%) while more than

10% of the respondents spoke other languages as their native language such as Mandarin/Chinese (*n*=49, 10.4%), Japanese (*n*=8, 1.7%), Cantonese (*n*=5, 1.1%) and German (*n*=4, 0.9%), etc. A large number of respondents were Caucasians (*n*=287, 62.8%) while 170 (37.2%) respondents came from other ethnic groups such as Asians (*n*=148, 32%) and Aboriginals (*n*=11, 2.4%), etc.

The majority of the respondents lived with others (*n*=303, 66.3%), either as part of a couple, as a part of a family, or as part of a group of friends. The other 254 older adults (33.7%) reported that they were living alone. More than a quarter of participants had a high-school education or its equivalent (*n*=102, 22.3%) or less (n=29, 6.3%). 33.8% had a college degree (*n*=106, 23.1%) or a 2-year degree (n=49, 10.7%). 172 respondents (37.6%) reported having post–secondary education or higher; these included 4-year degrees (*n*=78, 17%), professional designations (*n*=42, 9.2%), master's degrees (*n*=43, 9.4%) and doctoral degrees (*n*=9, 2%).

It was not surprising that this age group was comprised mostly of respondents who were retired (*n*=353, 77.6%) and 22.4% (*n*=102) who were not. However, 174 respondents (39%) reported that they were still working full-time or part-time. It may be because some of them were working in a casual or a volunteer environment.

In total, 180 comparisons were conducted and among them, 51 were found to be significant. The results reported, below, only include comparisons that were statistically significant (*p*=0.05). To obtain a full report of all comparisons, please contact the author of this thesis.

4.2.2 Sex and Age with Types of Games

Table 8. Significant associations between the types of games and sex

	Sex			Chi-square tests	
	Male	**Female**	**Total**	**Chi-square**	**p-value**
Strategy	43 (24.9%)	29 (10.2%)	72 (15.8%)	17.232	.000***
Puzzle	52 (30.1%)	163 (57.6%)	215 (47.1%)	32.678	.000***
Word	7 (4.0%)	51 (18.0%)	58 (12.7%)	18.888	.000***
Sport	11 (6.4%)	6 (2.1%)	17 (3.7%)	5.373	.020*

*Significant at the .05 level; **significant at the .01 level; ***significant at the .001 level

Table 8 shows the gender differences in the types of games that the respondents reported that they played. For puzzle games and word games, the proportion of female respondents was higher than those of male respondents for each game type. 57.6% (*n*=163) of females reported that they played puzzle games when compared to 30.1% (*n*= 52) of males, and 18% (*n*=51) of females reported that they played word games compared to only 4% (*n*=7) of males. The data indicate that females were more likely to play causal games such as puzzles or word games than males. In contrast, male respondents tend to play more strategy games and sports games than female respondents. The data show that 24.9% (*n*=43) of males reported that they played strategy games compared to only 10.2% (*n*=29) of females. Whereas 6.4% (*n*=11) of males reported that they played sports games, only 2.1% (*n*=6) of females did likewise.

No significant association has been found between sex and arcade or card/board/tile games.

Table 9. Significant associations between the types of games and age

	Age				Chi-square tests	
	55-64	**65-74**	**75+**	**Total**	**Chi-square**	**p-value**
Arcade	19 (9.7%)	13 (7.7%)	1 (1.2%)	33 (7.4%)	7.15	.046*
Puzzle	87 (44.6%)	74 (44.0%)	49 (59.8%)	210 (47.2%)	6.38	.041*
Card/Board/Tile	50 (25.6%)	61 (36.3%)	19 (23.2%)	130 (29.2%)	6.742	.034*

*Significant at the .05 level; **significant at the .01 level; ***significant at the .001 level

Table 9 shows the relationship between age and the types of games that respondents reported that they played. There were three types of games that were found to be significantly associated with age, namely, arcade; puzzle; and card/board/tile games. For arcade games, 9.7% (*n*=19) of older adults, aged 55 to 64, reported that they played arcade games. They are closely followed by 7.7% (*n*=13) of older adults, aged 65 to 74. Only 1 (1.2%) respondent, who was 75 or older, said that he played arcade games. For puzzle games, the proportion of older adults who are aged 55 to 64 is quite similar to the proportion of older adults who are aged 65 to 74 (44.6%, *n*=87; 44.0%, *n*=74, respectively). Interestingly, the proportion of older adults who are aged 75 and older (59.8%, *n*=49) is greater than the proportion of the other two age groups. The proportion of older adults, aged 65 to 74, who played card/board/tile games (36.3%, n=61) is greater than the proportion of

older adults who are aged 55 to 64 and older adults who are aged 75 and older (25.6%, *n*=50; 23.2%, *n*=19, respectively).

In this study, the types of games that were found not to be significantly associated with age were strategy, word, and sport games.

4.2.3 Language and Ethnic Group with Types of Games

Table 10. Significant associations between types of games and language

	Language			Chi-square tests	
	English	**Other***	**Total**	**Chi-square**	**p-value**
Puzzle	197 (49.6%)	18 (29.5%)	215 (46.9%)	8.589	.003**
Word	56 (14.1%)	2 (3.3%)	58 (12.7%)	5.604	.018*
Card/Board/Tile	103 (25.9%)	30 (49.2%)	133 (29.0%)	13.854	.000***

*Note. Languages in "Other " category include, Mandarin (Chinese), Japanese, Cantonese, German, and Korean, etc.

*Significant at the .05 level; **significant at the .01 level; ***significant at the .001 level

Table 10 shows the language differences in the types of games that respondents reported that they played. A higher proportion of older adults whose native language is English can be seen in the puzzle and word games categories (49.6%, *n*=197; 14.1%, *n*=56, respectively) when compared to the data for older adults whose first language is not English (29.5%, *n*=18; 3.3%, *n*=2 respectively). There is a higher proportion of older adults whose primary language is not English in card/board/tile category (49.2%, *n*=30), compared to older adults who spoke English as their primary language (25.9%, *n*=103).

In this study, the types of games that were found not to be significantly associated with language were arcade, strategy, and sport games.

Table 11. Significant associations between types of games and ethnic group

	Ethnic Group			Chi-square tests	
	Caucasian	**Other***	**Total**	**Chi-square**	**p-value**
Puzzle	167 (58.2%)	48 (28.2%)	215 (47.0%)	38.448	.000***
Word	51 (17.8%)	7 (4.1%)	58 (12.7%)	17.958	.000***

Card/Board/Tile	62 (21.6%)	70 (41.2%)	132 (28.9%)	19.913	.000***

*Note. Ethnic groups in "Other" category include, Asian, Aboriginal, African-American, etc.

*Significant at the .05 level; **significant at the .01 level; ***significant at the .001 level

Table 11 shows the ethnic group differences in the types of games that respondents reported that they played. Based on the proportion cells, Caucasian respondents appear to play more puzzle games and word games, with 58.2% (*n*=167) of Caucasian respondents reporting that they played a puzzle game compared to only 28.2% (*n*=48) of respondents from other ethic groups, and 17.8% (*n*=51) of Caucasian respondents reporting that they played a word game compared to only 4.1% (*n*=7) of respondents from other ethic groups. However, respondents from other ethnic groups appear to play more card/board/tile games than Caucasian respondents, with 41.2% (*n*=70) of respondents from other ethnic groups reporting that they played a card/board/tile game compared to only 21.6% (*n*=62) of Caucasian respondents.

The types of games that were found to have no significant association with ethnic groups, in this study, were arcade, strategy, and sport games.

4.2.4 Living Arrangement, Retirement Status, and Working Status with Types of Games

Table 12. Significant associations between types of games and living arrangement

	Living Arrangement			Chi-square tests	
	Alone	**With Others***	**Total**	**Chi-square**	**p-value**
Word	31 (20.1%)	27 (8.9%)	58 (12.7%)	11.598	.001***
Card/Board/Tile	34 (22.1%)	96 (31.7%)	130 (28.4%)	4.628	.031*

*Note. "With Others" include: living in as a couple, living with family and living with others

*Significant at the .05 level; **significant at the .01 level; ***significant at the .001 level

Table 12 shows the living arrangement differences in the types of games that respondents reported they played. Only Word games and card/board/tile games were found to have a significant association with living arrangement. The proportion of respondents who are living alone and who played word games (20.1%, *n*=31) is greater than the proportion of respondents living with others (8.9%, *n*=27). However, respondents who were living with others reported that they played more card/board/tile games, with 31.7% (*n*=96) of older adults who are living with others

stating that they played card/board/tile games, compared to 22.1% of respondents (*n*=34) who were living alone.

In this study, the types of games that were not found to have a significant association with living arrangement were arcade, strategy, puzzle and sport games.

No significant association was found between the retirement status and six types of digital games (arcade, strategy, puzzle, word, sport, and card/board/tile games). There was also no significant association found between the working status reported by respondents and these six types of digital games.

4.2.5 Education with Types of Games

Table 13. Significant associations between types of games and education

	Education				Chi-square tests	
	High School or less	**College or 2-year degree**	**Post-graduate**	**Total**	**Chi-square**	**p-value**
Arcade	4 (3.1%)	11 (7.1%)	18 (10.5%)	33 (7.2%)	6.114	.047*
Word	7 (5.3%)	27 (17.4%)	24 (14.0%)	58 (12.7%)	9.775	.008**

*Significant at the .05 level; **significant at the .01 level; ***significant at the .001 level

Table 13 shows the education differences in the types of digital games that respondents reported that they played. Only arcade and word games were found to have a significant association with the respondents' education level. The proportion of older adults with high school or with lower levels of education who played arcade games (3.1%, *n*=4) is lower than the proportion of older adults with a college or a 2-year degree who played arcade games (7.1%, *n*=11). The proportion of older adults with postgraduate degrees that played arcade games was even higher (10.5%, *n*=18). The same situation can also be found among the respondents who reported that they played word games. The proportion of older adults with high school or lower levels of education who played word games (5.3%, *n*=7) is significantly lower than the proportion of older adults with a college or a 2-year degree who reported that they played word games (17.4%, *n*=27) and the proportion of older adults with postgraduate degrees who played word games (14%, *n*=24).

In this study, the types of games that were found to have no significant association with their level of education were strategy, puzzle, sport and card/board/tile games.

4.2.6 Summary of Findings

A total of 17 significant associations were found between the types of digital games that seniors reported playing and their demographic characteristics. Figure 1 shows a summary of significant associations related to research question 2, "Is there an association between types of digital games played by older adults and their background characteristics? (e.g., sex, age, living alone or with others)?" Further discussion of the results can be found in Section 5 Discussions.

Demographic characteristics that showed the most relationships with different types of digital games, which older adults reported that they played, were sex (4), age (3), language (3) and ethnic groups (3). Characteristics like living arrangement (2) and education (2) showed fewer associations with the types of digital games played and reported by older adults. Retirement status and working status also showed no association with the types of digital games that older adults played.

Types of digital games that older adults claimed they played that have the most significant associations with their demographic characteristics were word games (5), puzzle games (4) and card/board/tile games (4). Others such as arcade, strategy and sport have fewer associations with the older adults' demographic characteristics; in this case, two associations or fewer were found.

Figure 1. Summary of significant associations between types of digital games played by older adults and their demographic characteristics

	Types of digital games						
Demographic characteristics	**Arcade**	**Strategy**	**Puzzle**	**Word**	**Sport**	**Card/board/tile**	**Total**
Sex		X	X	X	X		4
Age	X		X			X	3
Language			X	X		X	3
Ethnic group			X	X		X	3
Living arrangement				X		X	2

Retirement status							0
Working status							0
Education	X			X			2
Total	2	1	4	5	1	4	17

4.3 Research Question 3: Is there an association between the types of digital games played and the amount of time spent in playing digital games?

4.3.1 Amount of Time Spent in Playing Digital Games

In the survey, two variables were used to collect the data for the amount of time that respondents spent playing digital games. The first variable is the average days per week that respondents spent playing digital games. The second variable is the average hours per day that respondents reported that they played digital games.

Table 14. Days per week and hours per day older adults reported playing digital games

Time Patterns	Category	Frequency (n)	Percent (%)
Days per week playing digital games	1-4 day(s)	249	61.5
	5-6 days	54	13.3
	7 days	102	25.2
	Total	405	100
Hours per day playing digital games	1 hr or less	254	58.1
	2 hrs or more	183	41.9
	Total	437	100

Table 14 shows the frequency statistics of the days per week and also the number of hours per day that the respondents reported in terms of their digital game playing. A quarter of the respondents, 102 (25.2%), claimed that they played digital games every day. There was a distinct decrease in the number of respondents

(13.3%, *n*=54) who reported that they played digital games 5 to 6 days per week, with 40 (9.9%) older adults reporting that they played digital games 5 days per week and only 14 (3.4%) reporting that they played 6 days per week. The group with the most respondents spread out their game playing from 1 to 4 days (61.5%, *n*=249), with 83 older adults (20.5%) reporting that they only played digital games one day per week, 72 (17.8%) reporting that they played two days per week, 52 (12.8%) reporting that they played three days per week and 42 (10.4%) reporting that they played four days per week.

Furthermore, the largest grouping reported by older adults in terms of the number of hours per day that they played digital games was for one hour or less, with more than half of the respondents (58.1%, *n*=254) claiming that they only played one hour or less per day. For the 41.9% of respondents (*n*=183) who reported playing two hours or more, 35.2% (*n*=154) played for two to three hours, 4.6% (*n*=20) played for four to five hours, 1.4% (*n*=6) played for six to eight hours, and 0.7% (*n*=3) played for more than 8 hours.

4.3.2 Days per Week Played with Types of Games

Table 15. Significant associations between types of games and days per week spent in playing digital games

	Days per week played				Chi-square tests	
	1-4 days	**5-6 days**	**7 days**	**Total**	**Chi-square**	**p-value**
Arcade	12 (4.8%)	7 (13.0%)	12 (11.8%)	31 (7.7%)	7.422	.024*
Puzzle	98 (39.4%)	32 (59.3%)	66 (64.7%)	196 (48.4%)	21.561	.000***
Word	13 (5.2%)	13 (24.1%)	25 (24.5%)	51 (12.6%)	31.922	.000***

*Significant at the .05 level; **significant at the .01 level; ***significant at the .001 level

Table 15 displays the cross-tabulations between the types of digital games and the days per week that respondents spent in playing digital games. The results showed that the proportion of older adults who played arcade games and reported that they played more than 5 days per week were higher than the proportion of older adults who played arcade games 1 to 4 days per week (4.8%, *n*=12). There were no significant differences between the proportion of older adults who played 5-6 days and the ones who played every day in terms of arcade games (13.0%, *n*=7; 11.8%, *n*=12, respectively). Among the older adults who reported that they played puzzle games, the proportion of older adults who played digital games every day (64.7%,

n=66) was slightly greater than those who played 5 to 6 days per week (59.3%, *n*=32), and significantly greater than those who played 1 to 4 days per week (39.4, *n*=98). The same results can be found among the respondents who played word games. Although there was no noticeable difference between the proportion of older adults who played digital games 7 days per week (24.5%, *n*=25) and the proportion of older adults who played 5 to 6 times per week (24.1%, *n*=13), both were greater than the proportion of older adults who played digital games 1 to 4 days per week (5.2%, *n*=13).

The types of digital games that were found to have no significant association with the days per week of play, as reported by the respondents, were strategy, sport and card/board/tile games.

4.3.3 Hours per Day Played with The Types of Games

Table 16. Significant associations between types of games and hours per day spent in playing digital games

	Hours per day played			Chi-square tests	
	1 hour or less	**2hours or more**	**Total**	**Chi-square**	**p-value**
Puzzle	134 (52.8%)	73 (39.9%)	207 (47.4%)	7.062	.008**

*Significant at the .05 level; **significant at the .01 level; ***significant at the .001 level

Table 16 displays the cross tabulations between the types of digital games that showed a strong relationship with the hour-per-day that respondents spent in playing digital games. The only type of game that has a significant association with the playing time each day is puzzle games. Among the respondents who reported that they played puzzle games, the proportion of older adults who played for 1 hour as well as the ones who played less than 1 hour per day (52.8%, *n*=134) were greater in comparison to the proportion of older adults who played for 2 hours or more than 2 hours per day (39.9%, *n*=72).

The types of digital games that were found to have no significant association with the hours per day of play, as reported by the respondents, were strategy, sport and card/board/tile games.

4.3.4 Summary of Findings

A total of four significant associations were found between types of digital games played by older adults and the amount of time that they spent in playing digital games. Figure 2 shows a summary of significant associations found in relation to research question 3, "Is there an association between the types of digital games played and the amount of time spent in playing digital games?" Further interpretation of this section's findings can be found in Section 5 Discussions.

Arcade, strategy and word games were found to have significant associations with the days per week that older adults reported having spent playing digital games. Only the game type puzzle was found to have a significant association with the hours per day that older adults spent in playing digital games.

Figure 2. ***Summary of significant associations between types of digital games played by older adults and amount time they spent in playing digital games***

	Types of digital games						
Amount of time spent	**Arcade**	**Strategy**	**Puzzle**	**Word**	**Sport**	**Card/board/tile**	**Total**
Days per week played	X		X	X			3
Hours per day played			X				1
Total	1	0	2	1	0	0	4

4.4 Research Question 4: Is there an association between the benefits reported by older adults and the types of digital games played and the amount of time spent in playing digital games?

4.4.1 Benefits of Social and Emotional, Cognitive, and Technological Skill

Table 17 – 19 cover the benefits reported by older adults in regards to social and emotional aspects (Table 17), cognitive aspects (Table 18) and technological skill aspects (Table 19).

Table 17. Social and emotional aspects

Social and Emotional	Increased	No Difference*	Total (*n*)
Developing new friendships	109 (25.6%)	317 (74.4%)	426 (100%)
Connecting with current friends	109 (26.6%)	301 (73.4%)	410 (100%)
Connecting with family	134 (32.8%)	275 (67.2%)	409 (100%)
Connecting with various age groups	111 (27.8%)	288 (72.2%)	399 (100%)
Developing self-confidence	175 (42.1%)	241 (57.9%)	416 (100%)
Dealing with loneliness	140 (34.3%)	268 (65.7%)	408 (100%)
Dealing with depression	93 (23.7%)	299 (76.3%)	392 (100%)

*Also includes a small number of respondents who reported a "decrease"

Table 17 shows whether respondents found that playing digital games helped them to increase their social and emotional aspects successful aging, such as developing new friendship, connecting with different people and dealing with certain psychological issues, such as loneliness and depression.

Around one-quarter of respondents reported that playing digital games helped them to improve in developing new friendship (25.6%, *n*=109), connecting with current friends (26.6%, *n*=109), connecting with various age groups (27.8%, *n*=111) and dealing with depression (23.7%, *n*=93). Around one-third of respondents reported that playing digital games helped them to improve in connecting with their family (32.8%, *n*=134) and in dealing with loneliness (34.3%, *n*=140). 42.1% of respondents (*n*=175) reported an increase in developing self-confidence through playing digital games. This was the highest reported increase for improvements in both social and emotional aspects.

Table 18. Cognitive aspects

Cognitive	Increased	No Difference*	Total (*n*)
Focusing Attention	309 (71.9%)	121 (28.1%)	430 (100%)
Memory	301 (69.4%)	133 (30.6%)	434 (100%)
Reasoning	240 (58.1%)	173 (41.9%)	413 (100%)
Problem Solving	273 (64.8%)	148 (35.2%)	421 (100%)
Speed in Reacting/ Responding	276 (65.7%)	144 (34.3%)	420 (100%)

*Also includes a small number of respondents who reported a "decrease"

Table 18 shows whether respondents found that playing digital games helped them to increase their cognitive functions or made no difference at all towards cognitive aspects, such as memory, problem solving ability, etc.

Different from respondents' opinions in regard to social and emotional benefits brought about by playing digital games, the respondents' opinions were more positive towards the cognitive aspects. In each cognitive area, more than half of the respondents reported an increase. Attention retention had the largest number of respondents reporting an increase (71.9%, *n*=309), followed closely by memory. 301 respondents (69.4%) reported benefits for memory. Problem solving (64.8%, *n*=273) and the speed in reacting/responding (65.7%, *n*=276) were both increased as reported by approximately two-thirds of the respondents. Although reasoning (58.1%, *n*=240) had the least number of respondents claiming an increase compared to other cognitive aspects, more than half of the older adults, in this study, reported an increase in terms of reasoning.

Table 19. Technological skill aspects

Technological Skill	Increased	No Difference*	Total (*n*)
Computer skills	265 (61.3%)	167 (38.7%)	432 (100%)
Internet skills	228 (54.4%)	191 (41.3%)	419 (100%)
Digital game-playing skills	291 (67.8%)	138 (32.2%)	429 (100%)

*Also includes a small number of respondents who reported a "decrease"

Table 19 shows whether respondents thought that there was an increase in their technological skills such as their usage of computer, Internet, and digital game-playing skills after they had played digital games. Around two-thirds of the respondents reported an increase in their digital game-playing skills (67.8%, *n*=291),

slightly higher than the number of respondents claiming an increase in their computer skills (61.3%, *n*=265). Internet skills (54.4%, *n*=228) had the least amount of respondents reporting an increase among these three technological skills. However, more than half of the respondents reported an increase.

4.4.2 Social and Emotional Benefits with Types of Games

Table 20. Significant associations between types of games & amount of time played and developing new friendships

		Developing New Friendships			Chi-square tests	
		No Difference +	**Increased**	**Total**	**Chi-square**	**p-value**
Puzzle	No	144 (64.0%)	81 (36.0%)	201 (100%)		
	Yes	173 (86.1%)	28 (13.9%)	225 (100%)		
	Total	317	109	426	27.158	.000***
Word	No	268 (72.4%)	102 (27.6%)	370 (100%)		
	Yes	49 (87.5%)	7 (12.5%)	56 (100%)		
	Total	317	109	426	5.800	.016*
Days per week played	1-4 days	155 (68%)	73 (32%)	228 (100%)		
	5-6 days	41 (82%)	9 (18%)	50 (100%)		
	7 days	80 (85.1%)	14 (14.9%)	94 (100%)		
	Total	276	96	372	12.032	.002**
Hours per day played	1 hr or less	197 (83.1%)	40 (16.9%)	237 (100%)		
	2 hrs or more	103 (61.3%)	65 (38.7%)	168 (100%)		
	Total	300	105	405	24.357	.000***

*Significant at the .05 level; **significant at the .01 level; ***significant at the .001 level
+ Also includes a small number who reported a "decrease"

Table 20 shows the relationship that was found between developing new friendships, types of digital games, and amount of time spent playing digital games as reported by older adults. Playing puzzle games and word games was found to be associated with developing new friendships. The days per week and hours per day played by older adults were also found to be associated with developing new friendships. The percentage of older adults who reported an increase in developing new friendships by playing puzzle games and word games (13.9%, *n*=28; 12.5%, *n*=7, respectively) was less than the percentage reported by older adults who did not play these types of games (36.0%, *n*=81; 27.6%, *n*=102 respectively). One possible

reason for this is that most of the games, such as puzzles and word games, which can be played on digital devices, were designed to be played alone or with friends that players already knew.

Out of the total respondents who played digital games, 1-4 days per week, on average, one-third (32%, *n*=73) of them reported an increase in developing new friendships. 18% (*n*=9) of the total respondents who played digital games, 5-6 days per week, on average, reported an increase. Only 14.9% (*n*=14) of respondents who played every day (7 days per week) reported an increase. Those who played digital games 2 hours or more per day, on average (38.7%, *n*=65), were more likely to report an increase in developing new friendships than respondents who played for an hour or less per day (16.9%, *n*=40) (Table 20). The results suggest that the more an older adult spent in playing digital games per day, the more likely they would report an increase in developing new friendships. However, the results also suggest that older adults who played digital games 1-4 days a week are more likely to report an increase in developing new friendships in comparison to those who played more than 5 days per week.

The types of digital games that were found to have no significant association with developing new friendships, as reported by the respondents, were strategy, sport and card/board/tile games.

Table 21. Significant associations between the types of games, the amount of time played, and connecting with current friends

		Connecting with Current Friends			Chi-square tests	
		No Difference +	**Increased**	**Total**	**Chi-square**	**p-value**
Strategy	No	265 (76.4%)	82 (23.6%)	347 (100%)		
	Yes	36 (57.1%)	27 (42.9%)	63 (100%)		
	Total	301	109	410	10.098	.001***
Puzzle	No	140 (66.7%)	70 (33.3%)	210 (100%)		
	Yes	161 (80.5%)	39 (19.5%)	200 (100%)		
	Total	301	109	410	10.044	.002**
Sport	No	292 (74.5%)	100 (25.5%)	392 (100%)		
	Yes	9 (50%)	9 (50%)	18 (100%)		
	Total	301	109	410	5.288	.021*
Hours	1 hr or less	192 (81.7%)	43 (18.3%)	235 (100%)		

per day played	2 hrs or more	92 (58.2%)	66 (41.8%)	158 (100%)		
	Total	284	109	393	25.975	.000***

*Significant at the .05 level; **significant at the .01 level; ***significant at the .001 level
+ Also includes a small number who reported a "decrease"

Table 21 shows the relationship between the types of digital games and amount of time spent connecting with current friends in playing digital games, as reported by older adults. Playing strategy, puzzle, and sport games were found to have significant associations with connecting with current friends. Compared to respondents who reported an increase in connecting with current friends but played no strategy games (23.6%, *n*=82), the percentage of respondents who reported an increase in connecting with current friends after playing a strategy game (42.9%, *n*=27) was much higher. One possible explanation for this result is that strategy games reported by respondents, such as Chess and Yahtzee, can be played with friends in person on portable digital devices. A similar trend was also found for the playing sports games. Based on the survey data, one-quarter of respondents who did not report playing sports games claimed an increase in connecting with current friends (25%, *n*=100). The percentage was doubled for respondents who claimed an increase in connecting with current friends after playing sport games (50%, *n*=9). Based on the survey data, a possible reason for this is that most sports games respondents reported that they played Wii sports. Wii sports support the use of multiple controllers, allowing for players to compete or cooperate with one another. The percentage of older adults who reported an increase in connecting with current friends by playing puzzle games (19.5%, *n*=39) was less than the percentage reported by those who did not play this type of game (33.3%, *n*=70). It may be because the typical games reported by respondents for this type of game, such as Sudoku and (Spider) Solitaire, are normally solo games on digital devices.

Older adults who played digital games for 2 hours or more per day, on average (41.8%, *n*=66), were more likely to report an increase in connecting with current friends than respondents who played for 1 hour or less per day (18.3%, *n*=43) (Table 20).

In this study, the types of games that were found to have no significant association with connecting with current friends were arcade, word and card/board/tile games. There was also no significant association found between the

days per week that older adults spent in playing digital games and connecting with current friends.

Table 22. Significant associations of the types of games & amount of time played with connecting with family

		Connecting with Family			Chi-square tests	
		No Difference +	Increased	Total	Chi-square	p-value
Strategy	No	238 (69.6%)	104 (30.4%)	342 (100%)		
	Yes	37 (55.2%)	30 (44.8%)	67 (100%)		
	Total	275	134	409	5.249	.022*
Puzzle	No	122 (58.7%)	86 (41.3%)	208 (100%)		
	Yes	153 (76.1%)	48 (23.9%)	201 (100%)		
	Total	275	134	409	14.155	.000***
Hours per day played	1 hr or less	168 (72.4%)	64 (27.6%)	232 (100%)		
	2 hrs or more	92 (58.6%)	65 (41.4%)	157 (100%)		
	Total	260	129	389	8.063	.005**

*Significant at the .05 level; **significant at the .01 level; ***significant at the .001 level
+ Also includes a small number who reported a "decrease"

Table 22 shows the relationship between the types of digital games and amount of time spent in connecting with family while playing digital games, as reported by older adults. Playing strategy and puzzle games were found to have significant associations with connecting with family. When it came to strategy games, 44.8% of the respondents (*n*=30) who played strategy games reported an increase in connecting with family when compared to 30.4% of respondents (*n*=104) who did not play yet also experienced an increase. It is possible that strategy games that were reported by respondents, such as Chess and Yahtzee, can be played with family members on digital devices face to face. Most of the chess games in mobile app stores support multiple players on a single device or support multiple devices connected via Bluetooth, allowing players to compete with one another. However, in terms of puzzle games, the results show that approximately only one-quarter of respondents who played puzzle games experienced an increase in connecting with family (23.9%, *n*=48) when compared with 41.3% of respondents who did not play puzzle games but claimed an increase in connecting with family. A possible reason, as mentioned above, is that the puzzle games that were reported by older adults,

such as Sudoku, and (Spider) Solitaire, are normally designed to be played alone on digital devices.

Respondents who played digital games for 2 hours or more per day, on average (41.4%, *n*=65), were more likely to report an increase in connecting with family than respondents who played 1 hour or less per day (27.6%, *n*=64).

In this study, the types of games that were found to have no significant association with connecting with family were arcade, word, sport and card/board/tile games. No significant association was found between the days per week that older adults spent in playing digital games and connecting with family.

Table 23. Significant associations of the types of games & amount of time played with connecting with various age groups

		Connecting with various age groups			Chi-square tests	
		No Difference +	**Increased**	**Total**	**Chi-square**	**p-value**
Puzzle	No	128 (64.0%)	72 (36.0%)	200 (100%)		
	Yes	160 (80.4%)	39 (19.6%)	199 (100%)		
	Total	288	111	399	13.364	.000***
Hours per day played	1 hr or less	180 (79.6%)	46 (20.4%)	226 (100%)		
	2 hrs or more	93 (60.0%)	62 (40.0%)	155 (100%)		
	Total	273	108	381	17.471	.000***

*Significant at the .05 level; **significant at the .01 level; ***significant at the .001 level
+ Also includes a small number who reported a "decrease"

Table 23 shows the relationship between the types of digital games played and the amount of time spent connecting with various age groups, as reported by older adults. The only type of game that was found to have significant association with connecting with various age groups was puzzle games. Most respondents (80.4%, *n*=160) who played puzzle games reported no increase in connecting with various age groups, whereas 64% of respondents (*n*=128) who did not play puzzle games reported no increase in connecting with various age groups. The typical puzzle games, reported by older adults, included Sudoku, and (Spider) Solitaire, etc., which are traditional games and are often not attractive to the younger generations. These games are normally designed and intended to be single player games on digital devices; thus, this is a possible contributing factor to these results.

Older adults who played digital games for 2 hours or more per day, on average (40%, *n*=62), were more likely to report an increase in connecting with various age groups than those who played for 1 hour or less per day (20.4%, *n*=46).

In this study, the types of games that were found to have no significant association with connecting with family were arcade, strategy, word, sport and card/board/tile games. No significant association was found between days per week that respondents spent in playing digital games and connecting with various age groups.

Table 24. The significant associations between the amount of time played and dealing with loneliness

		Dealing with loneliness			Chi-square tests	
		No Difference +	**Increased**	**Total**	**Chi-square**	**p-value**
Hours per day played	1 hr or less	161 (70.6%)	67 (29.4%)	228 (100%)		
	2 hrs or more	91 (56.5%)	70 (43.5%)	161 (100%)		
	Total	252	137	389	8.214	.004**

*Significant at the .05 level; **significant at the .01 level; ***significant at the .001 level
+ Also includes a small number who reported a "decrease"

Table 24 shows the relationship between dealing with loneliness and the amount of time that older adults spent in playing digital games. Only the hours per day played was found to have a significant association with dealing with loneliness. The results suggest that older adults who played digital games for 2 or more hours per day, on average (40%, *n*=62), were more likely to report an increase in dealing with loneliness than those who played for 1 hour or less per day (20.4%, *n*=46).

Table 25. The significant associations between the amount of time played and dealing with depression

		Dealing with depression			Chi-square tests	
		No Difference +	**Increased**	**Total**	**Chi-square**	**p-value**
Hours per day played	1 hr or less	177 (79.7%)	45 (20.3%)	222 (100%)		
	2 hrs or more	107 (69.9%)	48 (30.1%)	153 (100%)		
	Total	284	81	375	4.729	.030*

*Significant at the .05 level; **significant at the .01 level; ***significant at the .001 level
+ Also includes a small number who reported a "decrease"

Table 25 shows the relationship between dealing with depression and the amount of time that older adults spent in playing digital games. The only significant association was found between the hours per day played and dealing with depression. The results showed that older adults who played digital games for 2 hours or more per day, on average (30.1%, *n*=48), were more likely to report an increase in dealing with depression than those who played for 1 hour or less per day (20.3%, *n*=45).

There were no significant relationships found between the types of digital games as well as the days per week with developing self-confidence, dealing with loneliness and dealing with depression. However, with the hours played per day, the respondents reported that there was an increase in dealing with loneliness and depression but not with developing self-confidence.

4.4.3 Cognitive Benefits with Types of Games

Cross tabulations were respectively performed with the types of games and the amount of time spent in playing digital games in relation to cognitive aspects. Only problem solving and the speed in reacting/responding were found to have a significant association with the types of games played. The cognitive aspects that did not have a significant association with the types of digital games were focusing attention, memory, and reasoning.

Memory, reasoning, and problem solving were found to have no significant association with the amount of time that older adults spent in playing digital games. The only cognitive aspects that were found to be associated with the amount of time played were attention-focusing and the speed in reacting/responding.

Table 26. The significant association between the amount of time played and memory

		Memory			Chi-square tests	
		No Difference +	**Increased**	**Total**	**Chi-square**	**p-value**
Hours per day played	1 hr or less	86 (35.7)	155 (64.3%)	241 (100%)		
	2 hrs or more	36 (21.1%)	135 (78.9%)	171 (100%)		
	Total	122	290	412	10.275	.001***

*Significant at the .05 level; **significant at the .01 level; ***significant at the .001 level
+ Also includes a small number who reported a "decrease"

Table 26 shows the relationship between memory and the amount of time that older adults spent in playing digital games. The only significant association found with memory was with the hours per day of game playing. The results suggest that respondents who played digital games for 2 or more hours per day on average (78.9%, *n*=135) were more likely to report an increase in dealing with depression than those who played for 1 hour or less per day (64.3%, *n*=155).

Table 27. The significant associations between the amount of time played and reasoning

		Reasoning			Chi-square tests	
		No Difference +	**Increased**	**Total**	**Chi-square**	**p-value**
Hours per day played	1 hr or less	113 (48.1%)	122 (51.9%)	235 (100%)		
	2 hrs or more	52 (32.5%)	108 (67.5%)	160 (100%)		
	Total	165	230	395	9.506	.002**

*Significant at the .05 level; **significant at the .01 level; ***significant at the .001 level
+ Also includes a small number who reported a "decrease"

Table 27 shows the relationship between reasoning and the amount of time that older adults spent in playing digital games. The only significant association found as regards reasoning was the hours per day of game playing. The results indicate that respondents who played digital games for 2 or more hours per day, on average (67.5%, *n*=108), were more likely to report an increase in dealing with depression than those who played for 1 hour or less per day (51.9%, *n*=122).

Table 28. Significant associations between the types of games & amount of time played with problem solving

		Problem Solving			Chi-square tests	
		No Difference +	**Increased**	**Total**	**Chi-square**	**p-value**
Arcade	No	142 (36.6%)	246 (63.4%)	388 (100%)		
	Yes	6 (18.2%)	27 (81.8%)	33 (100%)		
	Total	148	273	421	4.5525	.033*
Hours per day played	1 hr or less	97 (40.9%)	140 (59.1%)	237 (100%)		
	2 hrs or more	43 (26.1%)	122 (73.9%)	165 (100%)		
	Total	140	262	402	9.474	.002**

*Significant at the .05 level; **significant at the .01 level; ***significant at the .001 level
+ Also includes a small number who reported a "decrease"

Table 28 shows the relationship between the types of digital games and the amount of time spent problem-solving while playing digital games, as reported by older adults. The only types of games that were found to have a significant association with problem solving were the arcade games category. The percentage of respondents who played arcade games and reported an increase in problem solving (81.8%, *n*=27) was greater than the percentage of respondents who did not play arcade games but reported an increase in problem solving skills (63.4%, *n*=246). Based on the typical games, reported by the respondents, in relation to these types of games (e.g., Angry Birds), a possible reason for the result is that most arcade games are designed in such a manner that they require the players to learn through trial and error. Most are often repetitive and require players to learn from failure, by exploring different methods or paths to achieve the targets required, in order to proceed through the game to higher levels. This kind of learning may apply beyond games to cognitive aspects such as problem-solving skills. Respondents who spent 2 or more hours in playing digital games per day, on average (73.9%, *n*=122), were more likely to report an increase in problem-solving capacities than those who played for 1 hour or less per day (59.1%, *n*=140).

In this study, the types of games that were found to have no significant association with problem-solving were strategy, puzzle, word, sport and card/board/tile games. No significant association was found between the days per week that the respondents spent in playing digital games and problem-solving.

Table 29. Significant associations between types of games and speed in reacting/responding

		Speed in Reacting/Responding			Chi-square tests	
		No Difference +	**Increased**	**Total**	**Chi-square**	**p-value**
Arcade	No	139 (35.8%)	249 (64.2%)	388 (100%)		
	Yes	5 (15.6%)	27 (84.4%)	32 (100%)		
	Total	144	276	420	5.354	.021*

*Significant at the .05 level; **significant at the .01 level; ***significant at the .001 level
+ Also includes a small number who reported a "decrease"

Table 29 shows the relationship between the speed in reacting/responding and the types of digital games, as reported by older adults. The only types of games that were revealed to have a significant association with speed in reacting/responding was arcade games. The percentage of respondents who played

arcade games and reported an increase of speed in reacting/responding (84.4%, *n*=27) was greater than the percentage of respondents who did not report playing arcade games yet reported an increase in their speed in reacting/responding to situations (64.2%, *n*=249). This may be attributed to the same reasons that were mentioned in relation to problem-solving in that arcade games require learners to repeatedly learning and trials to master the game. Doing this may include improving speed in reacting/responding so as to proceed through the game (e.g., Super Mario, which was reported by older adults).

In this study, the types of games that were found to have no significant association with speed in reacting/responding were strategy, puzzle, word, sport and card/board/tile games.

The days per week that respondents spent in playing digital games were found to have no relationship with any of the cognitive aspects. Moreover, no significant associations were found between the days per week that respondents spent in playing digital games and focusing attention or with speed in reacting/responding.

4.4.4 Technological Skills Benefits with Types of Games

Cross tabulations were performed using the types of games and the amount of time that respondents spent in playing digital games for technological skills, including computer skills, Internet skills and digital game-playing skills.

Table 30. Significant associations between types of games & amount of time played and computer skills

		Computer skills			Chi-square tests	
		No Difference +	**Increased**	**Total**	**Chi-square**	**p-value**
Strategy	No	147 (40.7%)	214 (59.3%)	361 (100%)		
	Yes	20 (28.2%)	51 (71.8%)	71 (100%)		
	Total	167	265	432	3.941	.047*
Puzzle	No	74 (33.0%)	150 (67.0%)	224 (100%)		
	Yes	93 (44.7%)	115 (55.3%)	208 (100%)		
	Total	167	265	432	6.200	.013*
Hours per day played	1 hr or less	109 (44.9%)	134 (55.1%)	243 (100%)		
	2 hrs or more	46 (27.4%)	122 (72.6%)	168 (100%)		

	Total	155	256	411	12.913	.000***

*Significant at the .05 level; **significant at the .01 level; ***significant at the .001 level
+ Also includes a small number who reported a "decrease"

Table 30 shows the relationship between the amount of time spent in playing digital games and the types of digital games that result in increases in computer skills, as reported by older adults. The results indicated that with strategy game-playing, the participants (71.8%, *n*=51) were more likely to claim that digital games led to an increase in their computer skills when compared to the respondents who did not report strategy game-playing (59.3%, *n*=147). When it comes to puzzle games, the same trend was not found in the data. The percentage of respondents who did not report playing puzzle games but still claimed an increase in their computer skills (67.0%, *n*=150) was greater than the percentage of respondents who reported playing at least one puzzle game and claimed an increase in their computer skills (55.3%, *n*=115). The results were difficult to interpret. There is no concrete evidence showing that compared to puzzle games, strategy games perform better in helping older adults improve their computer skills. Further research in this field will prove useful in investigating the effects of the types of games and older adults' computer training performance.

Respondents who spent 2 or more hours playing digital games per day, on average (72.6%, *n*=122), were more likely to report increased improvements in using the computer than those who played for 1 hour or less per day (55.1%, *n*=134).

In this study, the types of games that were found to have no significant association with computer skills were arcade, word, sport and card/board/tile games. No significant association was found between the days per week that the respondents spent in playing digital games and an increase in computer skills.

Table 31. Significant associations between the types of games & amount of time played and Internet skills

		Internet skills			Chi-square tests	
		No Difference +	**Increased**	**Total**	**Chi-square**	**p-value**
Puzzle	No	88 (40.9%)	127 (59.1%)	215 (100%)		
	Yes	103 (50.5%)	101 (49.5%)	204 (100%)		
	Total	191	228	419	3.857	.05*

Hours per day played	1 hr or less	123 (52.1%)	113 (47.9%)	236 (100%)		
	2 hrs or more	53 (32.3%)	111 (67.7%)	164 (100%)		
	Total	176	224	400	15.398	.000***

*Significant at the .05 level; **significant at the .01 level; ***significant at the .001 level
+ Also includes a small number who reported a "decrease"

Table 31 shows the significant relationships between the type of digital game, playtime and improvements in Internet skills. The only type of game that was found to have a significant association with Internet skills was puzzle games. The findings indicate that the percentage of respondents who did not report playing puzzles and claimed an increase in their Internet skills (59.1%, *n*=127) was greater than the percentage of respondents who reported playing at least one puzzle game and claimed an increase in their Internet skills (49.5%, *n*=101).

Respondents who spent 2 or more hours in playing digital games per day, on average (67.7%, *n*=111), were more likely to report increased improvements in using the Internet than those who played for 1 hour or less per day (47.9%, *n*=113).

In this study, the types of games that did not have any significant association with computer skills were arcade, strategy, word, sport and card/board/tile games. No significant association was found between the days per week that respondents spent in playing digital games and Internet skills.

Table 32. Significant associations between the types of games & amount of time played with digital game-playing skills

		Digital Game-Playing Skills			**Chi-square tests**	
		No Difference +	**Increased**	**Total**	**Chi-square**	**p-value**
Arcade	No	134 (33.8%)	262 (66.2%)	396 (100%)		
	Yes	4 (12.1%)	29 (87.9%)	33 (100%)		
	Total	138	291	429	6.584	.010**
Strategy	No	129 (35.9%)	230 (64.1%)	359 (100%)		
	Yes	9 (12.9%)	61 (87.1%)	70 (100%)		
	Total	138	291	429	14.295	.000***
Puzzle	No	60 (27.1%)	161 (72.9%)	221 (100%)		
	Yes	78 (37.5%)	130 (62.5%)	208 (100%)		
	Total	138	291	429	5.261	.022*
Word	No	127 (34.0%)	246 (66.0%)	373 (100%)		

	Yes	11 (19.6%)	45 (80.4%)	56 (100%)		
	Total	138	291	429	4.631	.032*
Hours per day played	1 hr or less	90 (37.2%)	152 (62.8%)	242 (100%)		
	2 hrs or more	38 (22.6%)	130 (77.4%)	168 (100%)		
	Total	128	282	410	9.805	.002**

*Significant at the .05 level; **significant at the .01 level; ***significant at the .001 level
+ Also includes a small number who reported a "decrease"

Table 32 shows the relationships that were found between types of games and amount of time spent in playing digital games, as reported by older adults, and an increase in digital game-playing skills. The respondents who reported playing at least an arcade game (87.9%, *n*=29), strategy game (87.1%, *n*=61), or word game (80.4%, *n*=45) were more likely to say that they found an increase in their digital game-playing skills. Interestingly, 62.5% of respondents (*n*=130) who reported playing at least one puzzle game reported an increase in their digital game-playing skills, This result is lower than the percentage of respondents who did not report playing puzzle games and claimed an increase in their digital game-playing skills (72.9%, *n*=161). Further investigation is needed to understand why only puzzle gamers were less likely to report an increase in their digital game-playing skills than other types of games.

Moreover, the results indicated that those respondents who spent 2 hours or more in playing digital games per day, on average (77.4%, *n*=130), were more likely to report an increase in digital game-playing skills than those who played for 1 hour or less per day (62.8%, *n*=152).

The types of games that had no significant association with computer skills in this study were sport and card/board/tile games. Also, no significant association was found between the days per week that respondents spent in playing digital games and their digital game-playing skills.

Another interesting finding is that approximately 50% or more of the respondents who played digital games for an hour or less per day reported an increase in memory, reasoning, and problem-solving (64.3%, *n*=155; 51.9%, *n*=122; 59.1%, *n*=140, respectively) as well as in computer, Internet and digital game-playing skills (55.1%, *n*=134; 62.8%, *n*=152, 47.9%, *n*=113, respectively). The percentages for older adults who played digital games for 2 or more hours were even greater. It shows a significant difference compared to the percentages for older adults who

played digital games for 1 hour or less per day and reported an increase in social and emotional aspects, which are either around 20% or around 30% (developing new friendships, 16.9%, *n*=40; connecting with current friends, 18.3%, *n*=43; connecting with family, 27.6%, *n*=64; connecting with various age groups, 20.4%, *n*=46; dealing with loneliness, 29.4%, *n*=67; dealing with depression, 20.3%, *n*=45, respectively). This finding may indicate that older adults who believe in playing digital games may benefit more in terms of cognitive aspects and technological skills than in terms of social and emotional aspects.

4.4.5 Summary of Findings

A total of 30 significant associations between the types of digital games and perceived benefits as well as between the amount of time that respondents spent in playing digital games and perceived benefits were found. Figure 3 shows a summary of significant associations, which are related to research question 4: “Is there an association between the benefits reported by older adults and the types of digital games played and the amount of time spent in playing digital games?” Further discussion on the results can be found in Section 5 Discussions.

The results indicated that among all of the perceived benefits, digital game-playing skills (5 associations) (technological skills), developing new friendships (4 associations), and connecting current friends (4 associations) (social and emotional) were found to have the most relationships with the types of digital games and the amount of time played, as reported by respondents. Other perceived benefits showed fewer associations with the types of games and amount of time played, with one to three associations, except for developing self-confidence (social and emotional) and focusing attention (cognitive), which were found to have no association to any of the types of digital games and to the amount of time played.

The type of digital games that had the most association with perceived benefits was puzzle games (7 associations). The next highest was strategy games (4 associations). Arcade, word, sport games showed fewer associations with perceived benefits, with only one to three associations. Card/board/tile games found no significant associations with any perceived benefits. The hours per day that respondents spent in playing digital games were found to have significant association with 12 perceived benefits, while the days per week were only associated with 1 perceived benefit.

Figure 3. ***Summary of significant associations between the types of digital games played by older adults, the amount of time playing and the perceived benefits***

	Types of digital games						**Amount of time played**		
	Arcade	Strgy.	Puzzle	Word	Sport	Card/b/t.	Days/w	Hrs/d	**Total**
Developing new friendships			X	X			X	X	**4**
Connecting with current friends		X	X		X			X	**4**
Connecting with family		X	X					X	**3**
Connecting with various age groups			X					X	**2**
Developing self-confidence									**0**
Dealing with loneliness								X	**1**
Dealing with depression								X	**1**
Social & Emotional Total	**0**	**2**	**4**	**1**	**1**	**0**	**1**	**6**	**15**
Focusing attention									**0**
Memory								X	**1**
Reasoning								X	**1**
Problem solving	X							X	**2**
Speed in reacting/responding	X								**1**
Cognitive Total	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**5**
Computer		X	X					X	**3**

Internet			X					X	**2**
Digital g-playing	X	X	X	X				X	**5**
Technological Skills Total	**1**	**2**	**3**	**1**	**0**	**0**	**0**	**3**	**10**
All Benefits Total	**3**	**4**	**7**	**2**	**1**	**0**	**1**	**12**	**30**

5. Discussion

5.1 Summary

The aging of the world population is unprecedented in human history – and the twenty-first century will witness an even more rapid aging process than the previous centuries did (United Nations, Department of Economic and Social Affairs, & Population Division, 2002). Since the improvement of technology has made the world a more interconnected and prosperous place, issues relating to an aging population are not limited to one society but become part of a global phenomenon, which affects every country, man, woman, and children. We must learn about the effects brought about by the aging population and, most importantly, we must examine how aging is affecting older adults and how older adults are adapting to the changing society around them so as to experience successful aging. In Canada, concerns relating to its aging population have begun to draw attention to this issue (Statistics Canada, 2011). Technology can be used as a good way to help older adults in their daily lives, as already observed by many communities and individuals (Chopik, 2016; Cresci et al., 2010; Fokkema & Knipscheer, 2007; Gatto & Tak, 2008; Sum et al., 2008).

High-tech products are used to support older adults in many fields. For instance, intelligent alarm systems can help detect older adults' health conditions and movements. In the case of an emergency, these systems can send alert messages to family members or doctors. Older adults' experiences with technology and digital tools tend to facilitate processes that slow the physical and mental damage caused by aging (Eisdorfer et al., 2003; McConatha et al., 1995; White et al., 2002). According to research, younger generations are not the only population group to feel the effects of technology. Researchers argue that a gradually increasing percentage of older adults are enjoying the physical, social, emotional, cognitive, and learning benefits brought about by technology (Broady et al., 2010). After retiring, many older adults actively search for ways to use their leisure time to provide them with opportunities to continue living meaningfully, independently, and happily as senior

citizens. Digital games, which older adults are likely to be open to playing, may facilitate many aspects of successful aging (Kaufman, 2013a).

Academic research, focusing on digital games and older adults, aim to investigate the potential benefits that playing digital games can afford to older adults. These benefits can be physical, mental, social and emotional. Many studies have found that playing digital games may help older adults to achieve their physical activity goals (Agmon et al., 2011; Nitz et al., 2010; Studenski et al., 2010) and the physical benefits brought about by playing exergames may be associated with improved cognitive performance (Maillot et al., 2012; Rosenberg et al., 2010). Some studies have also found that playing digital games has therapeutic value in enhancing older adults' cognitive abilities, including interference resolution, working memory (Anguera et al., 2013; Berry et al., 2010), and selective visual attention (Belchior et al., 2013; Green & Bavelier, 2003). Social and emotional benefits to older adults who have played digital games were also observed in previous research. Improvements in self-concept (Torres, 2011) and social interaction (Gerling et al., 2011), as well as in the reduction of depression (Allaire et al., 2013) have been found in studies investigating the relationships between cognitive benefits and the playing of digital games by older adults. Digital intergenerational gaming is an excellent way to improve computer-mediated interactions between older adults and younger generations (Ijsselsteijn et al., 2007), which is important because older adults display great enthusiasm for bettering their communication with their grandchildren (Mahmud et al., 2010).

The current study aimed to improve our understanding of the following:

- digital games that older adults, in Canada, are playing;
- profiles on the backgrounds of older adults who play digital games;
- amount of time that older adults spend in playing digital games; and
- benefits that older adults perceive as coming from playing digital games.

Further investigations were conducted to examine the relationships among the types of digital games that older adults play and their background characteristics, perceived benefits, and the amount of time that they spent playing digital games. The research also investigated the relationship between the duration of play and the perceived benefits of playing digital games. By obtaining a more detailed

understanding of older gamers' profiles, patterns of playing, perceived benefits as well as of the types of digital games that they play, the field's professionals and game designers can design games that take into better consideration the needs of older adults. Further research studies should also be conducted in this field.

Data for this study was collected from older adults, aged 55 and above, in the Greater Vancouver area. These individuals were mainly recruited from shopping malls, community centers, and older adults' independent and assisted living centers. They agreed to participate in a survey that covered questions about play patterns, games played, perceived benefits from playing (social and emotional; cognitive and technological skills), background characteristics, etc. Only data from the older adults who reported about playing digital games over the past year were used in this study. Cross tabulations were run between the types of digital games and the background characteristics of older adults (gender, age, and education level, etc.), amount of time they played, and perceived benefits in order to investigate any associations. Furthermore, cross tabulations were run, between the amount of time that older adults spent in playing games and the perceived benefits that they reported from doing so, in order to reveal potentialsignificant associations.

5.1.1 Key Findings

1. The types of digital games and background characteristics reported by older adults showed numerous associations. Gender, age, language, and ethnic groups are the background characteristic variables with the most associations, while puzzle, word, and card/board/tile games are the types of digital games with the most associations.
2. The days per week that older adults spent in playing digital games were associated with arcade, puzzle, and word games, while the hours per day of playing games were only associated with puzzle games.
3. Overall, the types of digital games and their associated perceived benefits as reported by older adults did not show many associations. Among all types of digital games, puzzle games have the most associations with perceived benefits, while card/board/tile games showed no relationship with any perceived benefits.
4. The hours per day that respondents spent in playing digital games and the perceived benefits have many associations, while the days per week that respondents spent in playing digital games was only associated with one perceived benefit. Respondents who played digital games for 2 hours or

more per day were more likely to report an increase in these perceived benefits.

5.2 Further Interpretation of the Findings

There has been a lack of intensive research on the types of digital games. Their relationships to older adults' characteristics, and perceived benefits that arise from playing digital games. However, with the rising population of older adults who play digital games, this special field of research is gaining popularity. The current study examined the associations between large numbers of variables that are important in the identification of digital game-playing among older adults. The numerous associations and variables that have been discovered through this study can be used as a reference by future research. It is recommended that future studies examine and generate more details on various aspects of digital games and how these relate to the benefits that older adults' perceive when game playing.

The results of this research were similar to previous studies in this field. A detailed interpretation can be found below. Current analyses were simply based on cross-sessional studies and further investigation focusing on different perspectives on the data may be needed.. The purpose of this study is not to convince and force older adults to play digital games. Rather, the aim of this research was to tell, from the data collected, which digital games are the ones that older adults, in Canada, prefer to play and to identify the relationships among these types of digital games and older adults' background characteristics, amount of time spent in playing games, and perceived benefits. We are witnessing more and more older adults engaging in playing digital games. Numerous research studies also conclude that playing digital games has potential in helping seniors achieve successful aging. The findings in this study may be inspiring to researchers and game developers, in this field, who would like to target this population by providing them with a more engaging and beneficial digital gameplay. Even though past research has found that digital games might bring benefits to older adults, some forms of these games are disliked by this population because of certain game features such as a fast game pace, violent scenes or overly loud background music. As McKay and Maki (2010) suggested, knowing which types of digital games are preferred by older adults can help them to choose appropriate digital games that are beneficial to their cognitive health.

5.2.1 Types of Digital Games Older Adults in Canada Played

All of the digital games that older adults reported, in the survey, that they had played were categorized by researchers into 12 types. The six types of digital games that were most frequently played, as reported by the respondents, were puzzle (46.7%), card/board/tile (28.7%), strategy (16%), word (12.5%), arcade (7.3%) and sport (3.9%). The results were similar to previous research in that most of the games that the elderly reported to have played were "casual" games such as card games and puzzle games. The study conducted by the BBC, in 2005 (Pratchett, 2005), showed similar results, with these being that older adults, between 51 and 65 years old, in the United Kingdom, preferred to play puzzle; quiz and board games. The reasons for why older adults are more likely to choose casual digital games may be as follows:

- Firstly, many digital games that were reported by older adults are digitized versions of traditional non-digital games. They chose these casual digital games because they were more familiar to them. Mahmud et al. (2010) interviewed an older adult who participated in their intergenerational study. The participant stated that he preferred digital games that have card elements because he had played the same card games for over 30 years.

- Secondly, the current commercial market lacks games that have been designed specifically for senior audiences. Ijsselsteijn et al. (2007) indicate that most studies, to date, reveal the potential benefits of the digital games played for older adults; the digital/computer games employed were especially designed for the elderly. Most commercially available games require fast reaction or complex responses, which makes them difficult for older adults to play. This age group may find that they experience problems playing these games because of issues with eye-hand coordination and cognitive processing (Ijsselsteijn et al., 2007).

However, personal interests, physical conditions, previous experiences and so on are parameters that dynamically affect an individual's preference for a particular type of digital game. No concrete data is available to develop a typology that profiles older digital games players. The results of this study as well as findings from other research studies provide insight on digital game types, and this study aimed to investigate older adults' digital game playing tendencies in order to provide a reference or guideline for designers who are targeting this specific age group in game development.

5.2.2 Background Characteristics and the Types of digital Games

A few previous studies have collected data on the background characteristics of elderly gamers. A deeper discussion regarding the background characteristics of the respondents and how these relate to the types of digital games, as reported by older adults, follows, below.

Gender Differences and the Types of Digital Games

Out of 456 respondents who had answered the question of gender, 283 (62.1%) were female and 172 (27.9%) were male (Table 7). Similar to results from previous studies (De Schutter, 2010; Pearce, 2008; Schultheiss, 2012), female players tend to slightly outnumber male players. Pearce (2008), in his study, also indicated that women players aged over 40 were the fastest growing gaming population. Many marketing studies showed that this demographic spent the highest number of hours per week playing games on the web, compared to other market segments. Statistics collected by the Entertainment Software Association of Canada (2016) also supported this result, showing that women players have increased over the past 10 years; their data showed that almost half (49%) of the gamers were female. In the *Digital Australia Report 2016,* provided by Interactive Games & Entertainment Association, statistics showed that 47% of video game players in Australia were female (Brand & Todhunter, 2015). Corresponding to this increase in women players across the world, recent statistics show that there are higher numbers of senior female players when compared to male players, as can be seen in this study. These findings suggest that women, in general, comprise a market segment that will be garnering increased market attention.

The current study found that gender has been associated with various types of digital games including strategy, puzzle, word and sports. Female respondents are more likely to play puzzle and word games than males, while male respondents are more likely to play strategy and sports games over females. Statistic from the Entertainment Software Association of Canada (2016) showed the same trend among older adult gamers, whose ages were 55 to 64. 73% of female gamers reported that they played puzzle games, compared to 36% of males. 30% of males showed their preference for sports games, while 44% of females reported playing card games and 16% of females reported playing casino games. 28% of males reported a preference for shooting games. Since only a relatively small number of participants were found to have a preference for shooting games and because of the

ambiguity of casino games, which led to these games being placed in the “others” category, these two game types were not included in the data analyses procedures for this study. However, gender tendencies were useful to know since older female, adult gamers prefer to play more casual games such as puzzle and word games, while older male, adult gamers are more likely to play shooting and sports games.

Age Difference and the Types of Digital Games

Data showed that in this study, older adults who played digital games were those aged 55 to 90 plus. Though the majority of respondents fell into the age range of 55 to 64 (43.8%) and 65 to 74 (37.8%), there were participants in every age group, indicating that digital game-playing may be a lifelong activity, which may be enjoyed by every age group. In addition, because digital games can be conveniently accessed by a modern household that has at its disposal smart phones, tablets, and handheld game devices, more older adults spend their leisure time on playing digital games. The average age of all digital game players in Australia has increased by nine years, from 24 to 33, in 2015. The game-playing participation of the older population was found to contribute to this increase (Brand & Todhunter, 2015). Changes in the nature of game playing will be witnessed, in a couple of years, so as to adapt to the larger audience segment of older adults (Brand & Todhunter, 2015).

Age was found to be associated with several types of digital games, including arcade, puzzle, and card/board/tile games. This study has found that respondents in the age group of 55-64 and in the age group of 65-74, compared to respondents aged over 75, tend to play less arcade games and play more puzzle games. The reason for this trend may be related to the nature of these two types of digital games. The most common arcade games, reported by respondents, included Angry Birds, Super Mario, Catch a Cat, and so on, which required some cognitive and game-playing skills, such as a relatively fast reaction speed, good hand-eye coordination, and appropriate game control. Adults over the age of 75 may find these kinds of games more challenging. In terms of the puzzles games that were reported by respondents in this study, typical games were Sudoku, Solitaire and Hidden Objects, etc., which require more thinking and observation. In a study examining the neurocognitive validity of commercially available, smartphone-based puzzle games, playing these kinds of games was found to have a correlation with several cognitive measures, including working memory (Thompson, Barrett, Patterson, & Craig, 2012). Almost half of the older adults who participated in a survey by Whitbourne et al. (2013) reported that playing puzzle games helped them feel sharper. It may explain

why, in this study, older adults over the age of 75 were more likely to play puzzle games than the other two age groups, since they may believe that puzzle games can help sharpen their minds.

It is hard to interpret the finding that in comparison to age groups 55 to 64 and 75 and above, older adults between 65 and 74 tended to play more card/board/tile games. Further qualitative studies can be considered to investigate the reasons behind this phenomenon.

Language and Ethic Group Differences

This study found that respondents whose primary language was English and respondents who were Caucasian were more likely to play puzzle games and word games than other native language speakers and respondents from other ethnic groups. Non-English speakers and respondents from other ethnic groups were more likely to play card/board/tile games compared to English native speakers and Caucasian respondents. The possible reasons may be:

1. Most digital word games in the Canadian app stores are in English, which may be a challenge to play for certain players who are not native English speakers. The majority of non-English speakers in Canada are from different ethnic groups (Statistics Canada, 2011).
2. Asian comprised the largest ethnic group in the "other ethnic groups" category. In a survey study by Wohn and Lee (2013), Asians were more likely than Caucasians to report that they expected social outcomes from playing digital games and were more likely to engage in avatar customization activities. Card/board/tile games, which support multiple players with virtual characters, may gain more popularity among other ethnic groups than Caucasians.

These findings may also be beneficial to game developers in Canada. Canada is a country with many immigrants from other ethnic groups whose native language is not English. However, most computer games and mobile games in the Canadian market are English by default. Ensuring that more games have the option to select other languages may be one way to encourage older adults whose native language is not English to accept more types of digital games.

Living Arrangement Differences and Education differences

This study found that the types of digital games that have significant associations with older adults' living arrangement were word games and card/board/tile games. Older adults who were living alone were likely to play more word games and less card/board/tile games, compared to respondents who were living with others. A possible reason for this finding may be because most of the card/board/tile games support multiple players so older adults can play them with their families or roommates. Word games, which are normally designed to be played alone on digital devices, were reported to be played by a higher proportion of older adults who lived alone. This finding indicates that the environmental context in which older adults live, such as their living arrangements, may impact their digital game preferences and the level of social engagement that they experience during game playing. Brown (2012) found that older adults who were living in an assisted living center preferred to play digital games with others in a group setting, which may be related to the social dynamics of their living environment.

In this study, arcade and word games were found to be significantly associated with the respondents' education level. Older adults with higher education levels (college or higher) were likely to play more arcade games and word games than older adults with an educational level equivalent to high school or below. Certain arcade games such as Angry Birds may require related knowledge in physics and space cognition to pass them with higher scores. Word games such as Scrabble require a good English vocabulary. These may be reasons for why older adults with higher levels of educational were found to be more likely to enjoy arcade and word games.

5.2.3 Amount of Time Played and Types of digital Games

The majority of older adults played digital games 1 to 4 days per week (61.5%). However, it is surprising to see that one-quarter of older adults, more or less, played digital games everyday. This does not mean that these older adults were addicted to digital games. Rather, this may be viewed as a trend, revealing how digital games are gradually becoming a part of people's daily lives. Research has found that, on average, an Australian adult player has been playing digital games for more than 12 years This length of time is expected to increase because of the aging of those people who had have played digital games for a long period of time. This study also found that almost 60% of respondents reported that they spent one hour or less, on average, per day in playing digital games. The other 40% of older adults played digital games for two or more hours per day, on average. These findings

indicate that older adults, in general, have a favorable attitude towards digital games and that they make these games a part of their daily entertainment routine.

In this study, the category of days per week that older adults spent playing digital games was found to be associated with arcade, puzzle and word games. The results indicate that the majority of respondents who reported that they played arcade, puzzle or word games played these games 5 days or more per week, even every day. The only type of digital game that was found to be significantly associated with the hours per day that older adults spent in playing digital games was puzzle games. Older adults who reported playing puzzle games were more likely to play this type of game for one hour or less per day.

The above results concur with the frequency and duration of digital game playing in Australia. In a survey study, people who played digital games were asked to think about how long and how often they spent playing two kinds of games: casual games, which were played for a period of 1 to 20 minutes, and in-depth games, which were played for a period of half an hour or more. The results showed that casual games were often played 2 or 3 times per day and for a period of 10 minutes each time, while in-depth games were normally played daily for half an hour to two hours (Brand & Todhunter, 2015). Arcade, puzzle, and word games are all games that can be played casually on digital devices by older adults. So it is not a surprise to see that more and more individuals in this age segment reported playing these games every day. Puzzle games such as Sudoku are representative of the kind of casual game that is played for approximately 10 minutes each time that it is played. Casual games can be a good way for older adults to relax or pass time during short periods such as waiting for a bus.

5.2.4 Perceived Benefits and the Types of Digital Games

The frequency analysis conducted on the perceived benefits, as reported by this study's respondents, showed that, in general, more older adults experienced no difference in social and emotional benefits than those who felt they had experienced an increase. On the other hand, the majority of respondents thought that playing digital games was beneficial to them cognitively in terms of focusing attention, memory, reasoning, problem solving, and speed in reacting/responding. Playing digital games was also able to increase their technological skills such as using the computer, Internet as well as their own game play. The results suggest that older adults were more likely to recognize the cognitive and technological skill acquisition

benefits of playing digital games. The motivation for many older adults in choosing to play digital games could relate to their belief that this activity is good for their minds and for their mental health. An 84-year-old player indicated, in an interview, that the reason why she chose to play digital games was that she just liked playing, that she felt that playing digital games stimulated her, and that it kept her mind active (Brand & Todhunter, 2015). 76% of respondents, in Brand and Todhunter's survey (2015), thought that playing digital games could help to increase mental stimulation, followed by 61% of respondents who believed that digital games could be used to fight dementia. It is noteworthy that 55% of respondents supported the idea that playing digital games could help maintain social connections for successful aging. However, in this study, playing digital games seems to have had less of an effect on social and emotional benefits when compared to cognitive and technological benefits. This finding suggests that older adults might hold relatively high expectations in terms of digital games being helpful in maintaining social connections with others. Yet, the effects of the digital games that they currently play do not correspond with these expectations since the majority of games reported by respondents are designed to be played alone.

The reason that older adults reported less increases in social and emotional aspects may be due to the nature of the digital games that were reported by older adults. Most of the digital games that were reported by respondents of the survey were designed to be played alone, so they are not likely to be used as an efficient tool for increasing connections with family, friends or new people. Encouraging older adults to play more social networking games may improve the way in which they socialize with others (Whitbourne et al., 2013).

Social and Emotional Benefits

Strategy games were found to be associated with connecting with current friends and family. Puzzle games were found to be associated with developing new friendships, connecting with current friends, connecting with family and connecting with various age groups. Word games were associated with developing new friendships. Sport games were associated with connecting with current friends. Playing puzzle games seems to have no effect in helping older adults to develop new friendships, to connect with current friends, to connect with family, or to connect with various age groups. Word games, similarly, were limited in facilitating the development of new friendships for older adults who play this type of game. On the other hand, strategy games and sport games were more likely to benefit older adults

who play them in connecting with current friends. Playing strategy games was also more likely to benefit older adults who play them in connecting with family.

Respondents are less likely to report an increase in social connections when playing puzzle games (e.g., Sudoku) and word games (e.g., Scrabble) in comparison to strategy (e.g., chess) and sports games (e.g., Wii Sports). This is most likely due to the nature of the games. Since games like puzzle and word games were mostly designed to be played alone as single player games, this eliminates the interaction element in gaming when compared to strategy and sports games. Certain strategy games and sports games can even be played on digital devices with others online or in person. When asked about which kind of games they played with their family, participants in a study reported playing chess, cards and board games (Khoo et al., 2009). Previous studies have found that playing Wii sports games can improve older adults' social interactions with others. Wollersheim et al. (2010) found that by playing Wii sports games at home, older female players reported greater connectedness with their family members, especially intergenerational connectedness. The results of a study that was conducted by Theng, Chua and Pham (2012) also showed that playing Wii sports in senior centers created a social space for the elderly and teenagers who came to visit, thereby facilitating positive interactions between the generations.

Cognitive Benefits

Only arcade games were found to have a significant association with problem solving and speed in reacting/responding. It is interesting to find that respondents who played arcade games were more likely to report an increase in problem solving and speed in reacting/responding than those who did not play. Early studies on arcade games showed that older adults who played arcade games experienced improvements in reaction time tests and processing speed tests (Dustman et al., 1992; Goldstein et al., 1997; Whitcomb, 1990). Enhancement of memory and self-confidence was also a beneficial outcome observed after older adults played digital games (Whitcomb, 1990). Older adults who played Bejewelled Blitz, an arcade game, reported perceived benefits on cognitive functions (Whitbourne et al., 2013).

Since the results showed a positive association between playing arcade games and improvements in certain cognitive abilities, older adults are encouraged to play arcade games for their enjoyment and cognitive health.

Technological Skills Improvement and Learning

Arcade games were found to be associated with digital game-playing skills. Strategy games were found to be associated with computer and digital game-playing skills. Puzzle games were found to be associated with all three, digital game-playing; computer; and Internet skills. Meanwhile, word games were found to be associated only with digital game-playing skills.

Older adults who played arcade, strategy, or word games were more likely to report an increase in digital game-playing skills than older adults who did not play. Older adults who played strategy games were also more likely to report an increase in computer skills than those who did not play these games. While those who played puzzle games reported the opposite. The results showed that non-puzzle game players were more likely to report an increase in computer, Internet, and digital game-playing skills than those who played puzzle games.

The results suggest that playing arcade, strategy, and word games is more likely to bring technological benefits to older adults, compared to playing puzzle games. It was difficult to interpret this result since limited research has been conducted to support why arcade, strategy, and word games are beneficial for players in terms of computer or digital game-playing skills. Further research into this area is encouraged. In-depth analyses into this field should be conducted to investigate the reasons for these findings. One possible reason may be that strategy and arcade games require more complicated operations on computers or other devices while playing. While most commercial digital games require rapid or complex responses, as discussed earlier, it may be possible that, by playing different kinds of digital games, older adults are becoming more familiar with computers and other digital devices including tablets and smart phones. It is also very important to investigate and take into consideration the game preference of older adults, which may lead to a better understanding of the learning expectations of older players (Romero, Ouellet, & Sawchuk, 2017).

The findings of this study indicate the great potential of digital games to facilitate older adults' informal education. Beyond their primary recreational purpose and therapeutic functions, digital games also have educational effects on older adults in terms of increasing their computer literacy and improving their self-efficacy when using modern technologies (Ijsselsteijin, et al., 2007). The foremost motivating factor for why older adults choose to learn in later life is their desire to keep up with the rest of society as it rapidly changes (Harris Interactive Inc., 2000; Tam, 2016) and, in doing so, to improve their technological skills on a consistent basis. In a survey

conducted by Wang et al. (2011), 95% of participants who had previously played computer games believed that playing computer games, to a certain degree, helped them enhance their computer skills. Many studies also found that an openness exists within seniors' communities with respect to the potential use of digital games for learning (Fuyuno, 2007; Nap et al., 2009; Pearce, 2008; Wang et al., 2011). This also supports the finding that many older learners prefer to learn in an informal setting (Tam, 2016), such as playing digital games.

Wang and Burton (2010) state that modern computer games such as MMORPGs could be used by older adults to learn computer skills for three reasons:

1. Computer games have strong motivating and engaging properties that allow seniors to learn computer skills in an enjoyable way.

2. Most computer games only require fundamental computer skills at first, and older adult players can gradually acquire computer and gaming skills while playing under various competency levels, designed by developers.

3. The virtual interaction environment, embedded into computer games, allow older adult players to communicate and collaborate with their peers and younger friends.

Ferreira, Sayago, and Blat (2017) found that cross-generational communication is quite essential to enhance older adults' engagement in learning via digital educational activities including playing digital games. The results indicated that older adults learned more about digital technologies after they communicated with their friends from different age groups. Overall, they suggested that digital informal learning activities, such as playing digital games, has great potential to improve learning in later life (Czaja & Sharit, 2013; Ferreira et al., 2017; Hollander & Plummer, 1986)

5.2.5 Amount of Time and Perceived Benefits

Previous studies used inconsistent measurements of time spent in playing digital games. Some studies used the number of hours per week as a measure (De Schutter, 2010; Pearce, 2008), while some used a measurement of days per week or the months that older adults spent in playing digital games (Allaire et al., 2013). Brand and Todhunter (2015) used casual and in-depth games to separately measure

frequency and duration. The inconsistencies of measurements in the frequency of digital gameplay caused difficulties in evaluating the impact of perceive benefits gained through gameplay. In this study, two measurements were used to quantify the amount of time spent in playing – days per week spent and hours per day spent playing.

Developing new friendships was the only perceived benefit related to the measurement of days per week in playing digital games. On the other hand, twelve associated perceived benefits were found, including developing new friendships; connecting with current friends, family, and various age groups; dealing with loneliness and depression; memory; reasoning; problem solving; computer skills; Internet skills and digital game-playing skills, using the measurement of hours per week. The results showed that older adults who played digital games one to four days per week, on average, were more likely to report an increase in developing new friendships than those who played digital games five or more days per week. Older adults, who spent two hours or more per day playing digital games, on average, were more likely to report an increase in the above twelve perceived benefits than individuals who played for only one hour or less per day.

The results indicate that older adults who spent more time (around two hours or more per day) playing digital games may have greater potential to receive benefits brought about by game playing. Hence, there might be a minimum threshold for the amount of time that older adults should play in order to receive the beneficial outcomes of playing digital games.

5.3 Limitations

There were several limitations to this study. The first limitation is that the data was mainly collected in shopping malls and seniors' communities. In other words, the recruitment was based upon using convenience sampling that was limited to in-person settings, which may not be representative of the population being studied. Different recruiting approaches should be used to obtain a more diverse representation of older adults who play digital games. Approaching online communities, game forums, and Facebook groups should be considered or used. Since older adults are now increasingly using the computer and Internet in their daily lives, these types of questionnaires should also be made available on the web. Not only would collecting data from different sources be more representative of older

gamers, but the data collected would also add to our existing data set, which could potentially lead to unexpected findings.

Although the sample size of almost five hundred respondents is relatively large, certain types of digital game categories did not have enough respondents to be adequately included for data analyses. Game categories such as shooter, adventure, and fighting games were not included. Among the 14 types of digital games, only six of them were used in further analyses. This study provides a preliminary investigation into these six types of games but requires more comprehensive insights using a larger sample size and greater resources to cover more types of digital games.

The use of the Chi-square test throughout the thesis caused several of the analyses to be compromised. Due to the small sample size in some of the response categories, it was necessary to recode these to a smaller set of categories, thereby losing some of the variation in the data. This may have caused a type 2 error, i.e., not finding a statistically significant result when there actually was one.

While data from this study suggest certain relationships among older adults' background characteristics, amount of time spent playing, perceived benefits and types of digital games, the precise nature of these relationships is still unclear and needs further in-depth inquiry with more sophisticated analyses. It is important to highlight that all of the benefits used as outcome variables in our analyses were self-reported. Therefore, the findings of this study should be interpreted with caution. Further experimental research is needed to confirm these findings.

Though the questionnaire used in this study was well designed, there were still some questions that could be slightly modified to meet further analyses' needs. The days per week and hours per day were used as two measures of the time that older adults spent playing digital games in this study. The findings of the relationships between the types of digital games and the amount of time played indicate that there might be a threshold and a ceiling for the duration, between which older adults would find the playing to be beneficial. Hence, the measurement of how many hours older adults spent in playing digital games, within a certain time frame (e.g., a week), is recommended to be integrated into the questionnaire.

5.4 Conclusion

This study involved an initial exploration of the types of digital games that older adults play, the players' characteristics, and the possible benefits of playing digital games. A large number of associations were found between older adults' background characteristics, the amount of time that they played, the perceived benefits and the types of digital games they chose to play. The interpretation of these associations adds to the existing data set and provides valuable insights into future research and improvements to the design of the questionnaire. With a deeper understanding of the older adults' game preferences; more complex relationships can potentially be identified with the perceived benefits in terms of social, emotional, cognitive, and technological skills.

These findings can help the field's professionals and game developers to better understand older adults' needs regarding the playing of digital games, and they can raise public awareness of the potential use of digital games to aid older gamers in aging successfully.

Which genre of digital games older adults choose to play can be influenced by their background characteristics such as gender, age, primary language, and living arrangement. These findings are promising in that they provide digital game developers with factors to consider in terms of understanding what influences older adults' acceptance of a certain game, thereby facilitating the development of innovations that can be made more appealing to a wider audience. For instance, with these data, game developers can now develop a gaming suite, including the most popular game types, which appeal to a wide audience of older adults who vary with respect to age, gender, and preferences. This not only benefits the developers in increasing market coverage, but it also helps promotes gaming and the intrinsic benefits that accompanies it. Further improvements like including support for multiple languages, difficulty settings, and multiplayer as well as single player modes will aid older adults in feeling more comfortable with embracing new games.

As the findings in this study showed, playing digital games has the potential to be used as an intervention tool to improve the quality of life of older adults. However, the findings also suggest that different types of games have different influences on older adults in terms of improving cognitively, socially as well as in terms of improving in their technological skills. Not all types of digital games have similar effects. When using digital games to improve older adults' cognitive abilities,

to increase their social connections, or to decrease their feelings of depression and loneliness, the type of digital games to be used should be carefully selected. The duration and frequency of play are also important and should be taken into consideration by future research.

Another interesting study would be to compare the demographics and other characteristics of those who responded only to the first section of the questionnaire (the non-digital game players) with those who completed the second section (the digital game players).

To conclude, the rapid change in new technologies is forcing older adults to adapt to the environment. It can be an enjoyable and inspiring learning process for them, unless they are not provided with enough support from their family, friends and the industry. Gaining a better understanding of how and what types of digital games older adults are playing will facilitate their adaptation to the changes surrounding them and, eventually, contribute to their independence, health, happiness, and enjoyment of their lives as they age.

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Appendices

Appendix A.

Questionnaire – English Version

SFU SIMON FRASER UNIVERSITY
ENGAGING THE WORLD

FACULTY OF EDUCATION AND GERONTOLOGY RESEARCH CENTRE
SURVEY OF OLDER ADULTS AND GAME PLAYING

This survey is designed for adults aged 55 years and over.

1. What are your three main leisure activities?
   (for example, TV, movies, walking, sports, bingo, photography, internet, etc.)

   a) _____

   b) _____

   c) _____

Non-Digital Games refer to all types of games that don't require the use of digital devices to play. Some examples include social games such as Trivial Pursuit, Monopoly, Concentration, Clue, card games such as Patience, Bridge, Hearts, Crazy Eights, Checkers, and Chess. Casino games such as slot machines are considered as non-digital games since skill is not required.

2. Have you played non-digital games in the past year?
   - ☐ Yes (**GO TO A**)
   - ☐ No (**GO TO B**) WHY NOT? _____

A. NON-DIGITAL GAMES

3. When you have played games, how many hours on average did you play in a day?
   ☐ 1 hr or less ☐ 2-3 hrs ☐ 4-5 hrs ☐ 6-8 hrs ☐ More than 8 hrs

4. Which games have you played? (For example, card games, board games, other)?

   _____

5. With whom have you played non-digital games? (select all that apply)
   - ☐ On my own
   - ☐ Family members (e.g., partner, children, relatives)
   - ☐ Friends
   - ☐ With members of a club or association
   - ☐ Other_____

6. Why do you play non-digital games? _____

7. What do you think are the benefits of playing non-digital games? (*select all that apply*)
   - ☐ Mental exercise
   - ☐ Social interaction
   - ☐ Enjoyment (fun)
   - ☐ Escape from daily life
   - ☐ Other _____

B. DIGITAL GAMES

Digital Games refer to all types of video games and computer games, whether played on computers, handheld devices, video game consoles or other means. Casino games that require skill such as poker or blackjack are considered as digital games.

8. Have you played digital games in the past year?
   - ☐ Yes (**GO TO Q. 9**)
   - ☐ No (**GO TO C**) Why not?_____

9. How many years have you been playing digital games?
   ☐ Less than 1 year ☐ 1-4 years ☐ 5-9 years ☐ 10 + years

10. Have you played digital games in the past month?
    - ☐ Yes
    - ☐ No Why not?_____

11. During the past **month**, how many **days per week on average** have you played digital games?
    ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7

12. During the **past month**, when you played digital games, how many **hours per day on average** did you play?
    ☐ 1 hr or less ☑ 2-3 hrs ☐ 4-5 hrs ☐ 6-8 hrs ☐ More than 8 hrs

13. What is your skill level in playing digital games?
    ☐ Beginner (Low level) ☐ Intermediate (Middle level) ☐ Expert (High level)

14. What is your skill level in using computer technology/Internet?

☐ Beginner (Low level) ☐ Intermediate (Middle level) ☐ Expert (High level)

15. Which digital games have you played, either alone or with others?

1) _____

2) _____

3) _____

16. Which of the following devices did you use to play digital games? (*select all that apply*)

☐ A video game console (example: Xbox, Playstation, Wii)

☐ Portable device (example: Nintendo DS, Gameboy, Playstation PSP)

☐ Desktop or laptop computer

☐ Handheld device (example: iPhone, iPad, Android, Blackberry, other tablets)

☐ Digital game machine in a casino

17. Have you played role-playing games online with other players? (e.g., World of Warcraft, Everquest)

☐ Yes ☐ No ☐ Don't know what this is

18. Have you played social games online with other players? (e.g., bridge, chess, scrabble, Facebook games)

☐ Yes ☐ No ☐ Don't know what this is

19. Have you met new people while playing these online games?

☐ Yes ☐ No

20. Have you played digital games? (*select all that apply*)

☐ Alone

☐ With others who are in the same room with you

☐ With others online through the internet

21. With whom have you played digital games? (*select all that apply*)

- ☐ On my own
- ☐ Family members (e.g., partner, children, relatives)
- ☐ Friends
- ☐ Members of a club or association
- ☐ Others _____

22. What do you think are the greatest benefits of playing digital games? (*select all that apply*)

- ☐ Mental exercise
- ☐ Social interaction
- ☐ Enjoyment (fun)
- ☐ Escape from daily life
- ☐ Other _____

23. What are your main difficulties in playing digital games? (*select all that apply*)

- ☐ Difficult to see or hear
- ☐ Too complicated
- ☐ Privacy
- ☐ Difficult to use controller
- ☐ Limited or no access to technology
- ☐ Other _____
- ☐ None

24. In your opinion, has playing digital games increased or decreased the following:

Social & Emotional	Increased	No difference	Decreased
Developing new friendships	☐	☐	☐
Connecting with current friends	☐	☐	☐
Connecting with family	☐	☐	☐
Connecting with various age groups	☐	☐	☐
Developing self-confidence	☐	☐	☐
Dealing with loneliness	☐	☐	☐
Dealing with depression	☐	☐	☐

25. In your opinion, has playing digital games increased or decreased the following:

Cognitive	Increased	No difference	Decreased
Focussing attention	☐	☐	☐
Memory	☐	☐	☐
Reasoning	☐	☐	☐
Problem solving	☐	☐	☐
Speed in reacting/responding	☐	☐	☐

26. In your opinion has playing digital games increased or decreased the following:

Technological Skills	Increased	No change	Decreased
Computer skills	☐	☐	☐
Internet skills	☐	☐	☐
Digital game-playing skills	☐	☐	☐

C. BACKGROUND / DEMOGRAPHICS

27. Sex:

☐ Male ☐ Female

28. Age:

☐ 55-59 ☐ 60-64 ☐ 65-69 ☐ 70-74 ☐ 80-89 ☐ 90 +

29. Primary language

☐ English ☐ French ☐ Other_____

30. Country:

☐ In which country were you born?_____

☐ In which city do you live now?_____

31. What is your ethnic group?

☐ Caucasian ☐ Asian ☐ African-American ☐ Aboriginal ☐ Other_____

32. Living arrangement:

☐ Alone ☐ In a couple ☐ With family ☐ With others

33. Where do you live?

☐ Home ☐ Assisted-living facility ☐ Nursing home ☐ Other _____

34. Level of education completed:

☐ Less than High school
☐ High school or equivalent (such as GED)
☐ Some College/CEGEP
☐ 2-Year degree (associate, diploma)
☐ 4-Year degree (BA, BS)
☐ Professional designation (e.g., CA,CGA,CMA)
☐ Master's Degree
☐ Doctoral Degree (e.g., PhD, EdD, MD, JD)

35. Are you retired?

☐ Yes ☐ No ☐ Never worked

36. Describe your working situation at the present time:

☐ Not working
☐ Working part-time (paid or voluntary)
☐ Working full-time (paid or voluntary)

Thank you for completing this survey.

DRAW FOR $100. If you wish to become eligible for the lucky draw of three $100 cash prizes, please provide your contact information on the separate card provided.