# Cognitive Benefits of Digital Games for Older Adults

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**Abstract:** Maintaining older adults' vitality, independence and quality of life well into old age helps both older adults themselves and their societies. There is evidence to suggest that technology can provide people with meaningful and engaging activities that are stimulating, enjoyable and fun. In particular, technology-based games promise many benefits to older adults, but research evidence is sparse about whether and how these can be realized. This paper describes some key results regarding gameplay patterns and cognitive benefits reported from an early survey of 463 Canadian older adults who play digital games. The results demonstrate that numerous older adults are actively playing digital games on a regular basis. The majority of players reported cognitive skill increases, with a greater percentage of intermediate compared to beginner players reporting increases. These results are encouraging and promising for using digital games to enhance older adults' aging processes.

## Introduction

The aging of populations worldwide is no secret. The percentage of the older population has increased in recent decades. By 2050, one in five people in the world will be 60 and older (Akitunde, 2012). In fact, the proportion of people aged 60 and over is growing faster than any other age group and is predicted to grow to two billion by 2050 (Aalbers et al., 2011; WHO, 2002). Aging older adults face declining physical and cognitive capacities, shifts from career or family focus to different interests and activities, loss of long-term companions and social supports, changed living arrangements, and increasing likelihood of chronic and debilitating illness. Successful aging – maintaining an independent, positive, independent, healthy, and meaningful quality of life – is a continual challenge for older adults, yet it is paramount for individual older adults and societies, which benefit both from older adults' continuing contributions and from reduced social and care costs. Effective mechanisms to enhance older adults' life functions will be invaluable as we work to cope with what has been called a demographic revolution (WHO, 2002).

While physical and cognitive decline is generally thought to be a natural result of aging, emerging evidence from social and cognitive neuroscience suggest that appropriate training or therapeutic techniques can not only slow, but also actually reverse this trend (Green & Bavelier, 2004). Maintaining older adults' vitality, independence and quality of life well into old age helps both older adults themselves and their societies. The potential for technology

to support older adults to live well and experience the things that make life worth living has received much less attention than the physical, mental and social challenges they face. However, evidence suggests that technology can provide people with meaningful and engaging activities that are stimulating, enjoyable and fun (Sixsmith, Gibson, Orpwood, & Torrington, 2007). In particular, technology-based games promise many benefits to older adults, but research evidence is sparse about whether and how these can be realized. Using a positive psychology approach, Astell (2013) argues that games can contribute to older adults' happiness and life satisfaction through cognitive exercise, social interaction and physical activity. The evidence and guidelines for practice resulting from research in this area will benefit not only individual older adults, but also their families, communities and societies-at-large.

## Purpose

The purpose of this study was to survey the opinions and experiences of older adults (aged 55 years and older) who play non-digital and digital games. It explored issues such as which games they play, with whom they are playing, how frequently they play, the reasons they play, and their perceived benefits and drawbacks. There also were questions about their ratings of social, emotional and cognitive changes through game play. Older adults' backgrounds and patterns of use were examined and compared with their opinions and experiences to search for relationships.

## Cognitive Skills and Successful Aging

One of the important factors associated with successful aging in older adults is cognitive health. It is generally accepted that aging is associated with a decline in many cognitive processes, but the extent to which this occurs, and whether it can be slowed, or even reversed, has become of interest to researchers and scientists. Among other mechanisms, cognitive decline can be marked by a slowing of chemical reactions and neural connections (Yankner, Lu, & Loerch, 2008). With an increase in our understanding of cognition and aging, science now sees cognition as not a fixed event, but dynamic and plastic in nature (Bishop, Lu, & Yankner, 2010). Brain plasticity is the brain's ability to change and reorganize neural networks. It is the foundation of our ability to learn and adapt, and in turn to survive. This is how individuals are able to learn and change ideas and understanding. As individuals age, neural plasticity declines; however, it does not disappear completely. A recent study suggests there may be more plasticity than previously thought (Kramer, Bherer, Colcombe, Dong, & Greenough, 2004). The ability for the brain to adapt and reshape thoughts is crucial for coping with the changes that occur in life and aging (Gamberini et al., 2006). Thus, it is important for successful aging.

Cognitive processing involves two distinct functions: crystallized abilities (such as knowledge based) and fluid based abilities (such as processing) (Kramer et al., 2004). The crystallized abilities tend to have little decline over the lifespan, and even improve; however, it is the fluid abilities that seem to suffer the most from aging (Kramer et al., 2004). It is suggested that age causes the greatest impairment to those abilities associated with executive control processes or cognitive control, as these have to be constantly monitored and maintained, due to the many changes that occur within the brain in adapting to everyday life (Basak, Boot, Voss, & Kramer, 2008). There are areas in the fluid abilities that show distinct declines, such as in spatial memory (Burke & Barnes, 2006). However, not all processes and related cognitive abilities that decline with age do so at the same rate or the same time (Kramer et al., 2004). Furthermore, changes within the brain that occur with aging can cause a number of dysfunctions within attention, perception, and memory (Mahncke et al., 2006).

As mentioned, cognitive decline is not set at a certain rate or speed, and various research has been exploring the possibility of certain life factors that may prevent cognitive decline and possible interventions that may stop or improve cognition (Hedden & Gabrieli, 2004; Mahnke et al., 2006; Wang et al., 2006). There has been some evidence to suggest that physical exercise and simply keeping the brain active may slow down this process (Kramer & Erickson, 2007; Matsou, Nagasawa, Yoshino, Hiramatsu, & Kurashiki, 2003). With this in mind, some studies have also found that certain leisure activities can reduce the risk for cognitive decline (Kramer et al., 2004; Wang et al., 2006). A study by Wang et al. (2006) found that playing board games (most respondents played Mahjong) could reduce risk factors for cognitive impairment in older adults, while television increased the risk. Thus, this study showed two important points; firstly, that leisure activities can have an impact on cognitive decline; and secondly, that games may be a leisure activity that may help reduce cognitive impairment.

More recently there has been a focus on using digital games to improve different aspects of cognition in older adults. Even large computer game companies such as Nintendo have brought out games, such as Brain Age, which are meant to enhance cognition. Many games have fallen within this category and have been incorporated into recent designs. Specific game-based projects, e.g., ELDERGAMES, HERMES, have been designed to enhance cognitive function and to attempt to overcome some of the difficulties that arise with aging. These projects have been on the increase as many researchers attempt to assess the impact of games on cognition (e.g., Buiza et al., 2009; Gamberini et al., 2006). Digital games alone would not be as interesting, nor sustain our attention for as long, if we did not have the capacity to improve each time and overcome our challenges (Lynch, Aughwane, & Hammond, 2010). Challenge is one of the main motives that older adults had for playing digital games; thus, digital games and cognition are deeply intertwined and connected (Gamberini et al., 2008). There seems to be little doubt that many computer games provide mental stimulation; however, further investigation is needed regarding transferability, sustained benefits, and to better understand which cognitive processes are being activated during game play.

Some studies have compared regular gamers to non-gamers and suggest that certain cognitive processes appears to be more enhanced (Basak et al., 2008; Boot et al., 2006). Various studies have found digital games to be useful in stimulating cognition (Basak et al., 2008; Boot et al., 2006; Chuang & Chen, 2009). Digital games require a certain amount of perceptual learning. Although perceptual learning involves varying cognitive skills, many of theses have been thought to only be specific to the current task (such as attentional weighting). However, recent studies in digital games and cognition have found that the general cognitive skills can sometimes be enhanced by game play (Lynch et al., 2010). For example, a recent review of research that looked into surgical ability and playing digital games has found a correlation in some skills across the two activities (Lynch et al., 2010). Spence and Feng (2010) suggest the most prominent cognitive skills used in many digital games are related to spatial cognition, which includes a variety of underlying cognitive aspects that contribute to the overall ability. Many studies have looked at specific cognitive abilities in relation to game play, although it should be noted that there are likely to be multiple processes occurring at the same time. Different games may also increase the use of different cognitive skills. Spence and Feng (2010) have suggested some different cognitive skills that may be used with different game types.

For older adults, the new cognitive skills learned can be maintained for years if they regularly rehearse their skills (Peretz et al., 2011). Moreover, another study shows that older adults who were given innovative and new challenges outperformed their colleagues who played traditional games such as card games (Friedland et al., 2001).

These studies are promising with regard to cognitive improvements in older adults who use computer games. However, the extent to which individuals feel that the games improve their cognition still lacks exploration within the research. As mentioned earlier, many older adults find that the challenge of games is appealing, while others mentioned they feel it keeps their brain active.

Digital games have the ability to stimulate many cognitive processes at once (Basak et al., 2008). However, for the sake of discussion and the current research, five varying cognitive areas will be considered that have often been considered by researchers on digital games and older adults: reaction time, attention, memory, problem solving and reasoning. Although this is not an exhaustive list, and they entail a number of cognitive tasks within, for the purposes of this study these categories are useful.

A recent meta-analysis arrived at four conclusions with respect to the cognitive benefits of digital games for older adults (Zhang, 2013). First, video game playing is positively associated with physical and cognitive benefits in older people. This confirms theories and findings in current brain research and in cognitive neuroscience that age-related physical and cognitive declines can be slowed or reversed by involving older people in appropriate training. Second, both medical condition and living setting are significant moderators. Studies associated with health older people yielded bigger effect sizes than did those with unhealthy older people in all outcome measures for which there were sufficient studies. Also, video game playing shows bigger cognitive improvements for community-dwelling older people than on nursing home residents. These findings confirm that the effectiveness of video games in older people differs from medical conditions and living settings. Third, results on outcome variables from various studies revealed that age of older people and time of game playing are related to degree of cognitive benefits. Finally, older adults do not need to be technologically savvy to benefit from training.

**Research Questions in this Paper**

This study explored the following questions:

1. What are the patterns of digital gameplay exhibited by older adults?
2. What are the cognitive benefits of digital gameplay reported by older adults??

## Research Methods

**Participants**
The targeted population comprised older adults, aged 55 or more, who play digital games. We included both those who have and those who haven't retired, since many people work part- time, or do voluntary jobs after retirement. Also, a non-retired older adult group added an interesting comparative group. The full survey involved 891 participants recruited from assisted living and community centres, shopping malls, and other public venues as needed. A total of 463 (52%) of these responded to the digital gameplay section of the survey. The others responded only to the non-digital section of the survey.

**Instrument**
The study used a print-based, mainly closed-ended, questionnaire that consisted of questions asking older adult gamers about their background characteristics, demographics, patterns of use, opinions, and experiences. A small number of open-ended questions were asked to gain a deeper understanding of some issues. The survey asked about background information, digital game playing patterns and experiences, and opinions regarding social, psychological, cognitive and educational aspects. Respondents required 15-20 minutes to complete the survey.

**Recruitment and Data Collection**
Recruitment used four methods. First, a number of older adults' independent/assisted living centres were targeted. Second, centre directors were contacted to assist in recruitment in local community centres and older adult centres. Third, directors of local shopping malls were approached for permission to publicly solicit participants. Finally, directors of independent and assisted living facilities were contacted. Each potential participating organization was sent a recruitment letter and asked to reply in writing by email or letter if they agreed to participate. As compensation for the time involved, participants were offered a gift certificate of $5 for their participation, and offered entry into a draw for three chances to win $100 upon completion. If they agreed, respondents were given a separate postcard to provide their contact information in order to maintain their anonymity.

**Data Analysis**
The data were analyzed using SPSS software (version 19). Both descriptive and inferential statistics were used to do the analyses. The descriptive statistics reported are frequencies and percentages. The inferential statistical tests used were Chi-squared analysis on cross-tabulation tables to examine respondents' cognitive benefits on selected items based on their skill levels in playing digital games. Other analyses will be conducted in later papers and the open-ended items will be coded into categories and themes will be generated.

## Results

**Participants' Backgrounds (n=463)**

1. Sex:
   (38%) Male (62%) Female
2. Age:
   (37%) 55-64 (50%) 65-74 (13%) 80-90 +
3. Living arrangement:
   (36%) Alone (36%) In a couple
   (24%) With family (4%) With others
4. Residence:
   (83%) Home (8%) Assisted-living (9%) Other
5. Retired:
   (80%) Yes (20%) No

6. Working situation:
   (62%) Not working
   (28%) Working part-time (paid or voluntary)
   (10%) Working full-time (paid or voluntary)

Almost two-thirds (62%) of respondents were females. We hypothesize that this is because females are generally more willing to help and also more prominent in the research sites in which the data were gathered. Respondents ranged in age from 55 to 90 plus years, were fairly well balanced across the various age categories, and represented more the 65 years and older adults (63%). Slightly over one-third (36%) lived alone and the great majority (83%) lived at home and were retired (80%). Almost two-thirds (62%) were not working at all while more than one-third (38%) were working part- or full-time.

**Participants' Gameplay Patterns (n=463)**

1. How many years have you been playing digital games?
   Less than 1 year (20%)
   1-4 years (30%)
   5-10+ years (50%)
2. Have you played digital games in the past month?
   Yes (84%) No (16%)
3. During the past month, how many days per week on average have you played digital games?
   0 (12%) 1-4 (54%) 5-7 (34%)
4. During the past month, when you played digital games, how many hours per day on average did you play?
   1 hr or less (0%)
   2-5 hrs (92%)
   6-8+ hrs (8%)

About half (50%) have played for five years or more. It is interesting to note that although half of the respondents had played digital games for five years or more, the other half were relatively new to the world of digital games. Most (88%) reported that they had played at least one day or more per week on average and most had played in the past month (84%). Nearly all (92%) played between 2-5 hours per day when they did play, which suggests that they are experiencing the 'flow' experience that can occur in playing digital games (Duplaa & Taiwo, 2013).

**Benefits Reported by Participants**

Table 1 lists the benefits of playing digital games reported by participants.

| Benefits | % Reporting |
|---|---|
| Mental exercise | 83 |
| Social interaction | 26 |
| Enjoyment (fun) | 71 |
| Escape from daily life | 26 |
| Other | 7 |

Table 1. Reported Benefits of Playing Digital Games (n=463)

Most (83%) of respondents reported that 'mental exercise' was the greatest benefit of playing digital games. The next greatest benefit was 'enjoyment/fun' (71%). Social interaction was reported as a benefit by more than a quarter (26%) of respondents.

Table 2 below shows older adults' self-reported cognitive benefits of playing digital games. It lists the percentage of respondents reporting an increase in each cognitive skill in the table.

| Cognitive Skill | Increase **(%)*** |
|---|---|
| Focusing attention | 72 |
| Memory | 69 |
| Reasoning | 58 |
| Problem-solving | 64 |
| Reaction speed | 66 |
| *Almost no one reported a decrease. Others stayed the same. | |

Table 2. Reported Increase in Cognitive Skills (n=463)

The most frequently reported cognitive skill increase (72%) was in focusing attention followed by memory (69%), reaction speed (66%), problem-solving (64%), and reasoning (58%).

Table 3 compares 'beginner' versus 'intermediate' digital game players on their ratings of cognitive skill increases. (No participants rated themselves as 'expert.') It can be seen that a greater percentage of intermediate skill players, compared to beginners, reported statistically significant increases in five of the six cognitive skills listed in Table 3. The only skill showing no difference between both groups was 'memory'; however, it was the cognitive skill rated as increasing by the greatest number of 'beginner' respondents.

| | Skill Level | | | |
|---|---|---|---|---|
| Cognitive Skill Increase | Beginner | Intermediate | Chi-squared | p-value |
| Focusing attention | 64.7 | 76.7 | 8.61 | .013 |
| Memory | 66.2 | 72.1 | 2.06 | .357 |
| Reasoning | 44.6 | 66.7 | 23.15 | .000 |
| Problem-solving | 48.4 | 74.6 | 30.51 | .000 |
| Reaction speed | 59.9 | 69.3 | 7.11 | .029 |
| *Almost no one reported a decrease. Others stayed the same. | | | | |

Table 3. Relationships Between Skill in Playing Digital Games and Cognitive Benefits Reported

**Conclusions**

These results demonstrate that many older adults are actively playing digital games on a regular basis and report a number of benefits with cognitive benefits, i.e., mental exercise, being the most frequently reported benefit by more than 80% of older adult respondents. More than two thirds of respondents responded that they had improved the specific cognitive skills of focusing attention, memory, and reaction speed while more than half indicated improvements in problem solving and reasoning. Older adults who rated their videogame playing skills as 'intermediate' (no one rated these as 'expert') rated their improvements significantly higher in five of the six above cognitive skills (except memory) than 'beginner' players. These results suggest that digital games may be useful for improving older adults cognitive skills and that these improvements are greater if players have gone beyond the 'beginner' category to develop 'intermediate' level gameplay skills. It has been shown that the longer the time spent playing video games, which are ergonomically viable, the higher the degree of use of sophisticated techniques (Harley, Fitzpatrick, Axelrod, White and McAllister 2010). This means that older adults can experience increased cognitive competence as they spend more time playing digital games and developing higher skill levels. Other analyses also will be conducted to determine whether other demographic variables, gameplay patterns, or digital games genres are related to cognitive improvement.

The results reported in this paper are preliminary and a series of interventions will be conducted to measure the cognitive benefits of digital games for older adults. The interventions will be accompanied by a series of experimental studies involving pre- and post-testing and control groups. However, the results of this study are

encouraging and promising for using digital games to provide an innovative and engaging activity to enhance older adults' aging processes.

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