Older Adults Effect on the Development of Video Games

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

The start of a global pandemic occurred in 2020 due to the spread and numerous deaths from the coronavirus disease (COVID-19) (Ciotti et al., 2020). Everybody had to become socially isolated to prevent the transmission of the COVID-19 virus. According to the Center for Disease Control and Prevention (CDC), older adults aged 50 or older were at a higher risk of developing serious complications from the virus so socially isolating themselves from others was essential (CDC, 2021). Social isolation increased feelings of loneliness and took away the daily activities of everybody, especially older adults (Caruso et al., 2022).

As shown in figure 1, with an increase in age comes a decrease in cognitive factors of speed, reason, and memory (Salthouse, 2004). Before the pandemic, some of the older populations were already suffering from loneliness and social isolation because they functionally depend on family or services. Older adults are more likely to feel lonely and adopt sedentary behaviors if they do not have social or family support (Soares et al., 2021). It is important to note that an individual can be socialy isolated and not feel lonely and vice versa. The pandemic forced older adults to socially distance themselves from all or most social and family support. According to the National Institute of Aging (NIA), research has shown that social isolation and loneliness is linked to a higher risk of Alzheimer's disease and cognitive decline (NIA, 2019).

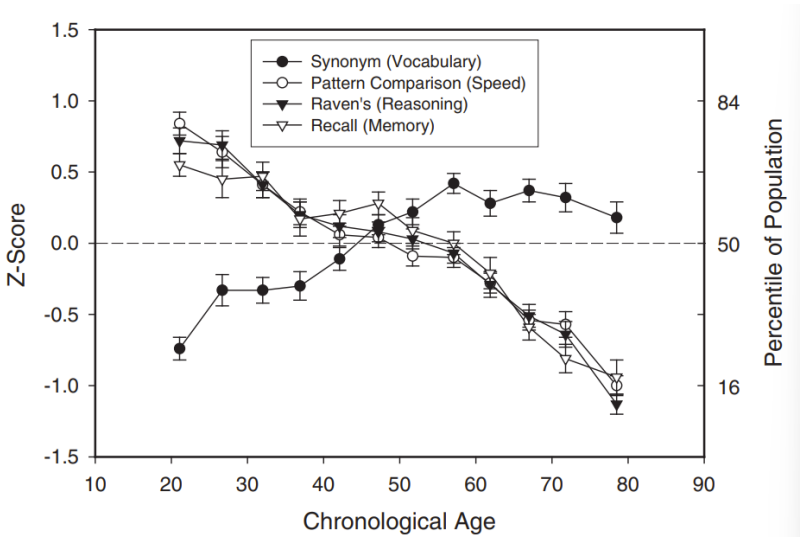

Figure 1. Graph of Chronological Age versus the Z-Score of Cognitive Factors (Salthouse, 2014).

To start the discussion of the technological aspect of this research paper, the stigma that surrounds video games will be introduced. A stigma around video games started after the increase of research on the effect of video games after the rise of the popularity of video games. This stigma was mostly due to research showing the negative effects of video game addictions. Research on the effect of video games actually showed that they had positive and negative effects on players. In a study that analyzed the behavior of violent and non-violent video game users found that an exposure to violence in video games was strongly associated with increased aggression (Bartholow, Bushman, & Sestir, 2005). It has been shown that being addicted to video games results in poor impulse control, poor cognitive function and worse emotional health (Stockdale & Coyne, 2018). On the other hand, video games that include a social activity aspect influences prosocial behavior and aspects of social well-being in players (Halbrook et. al, 2019) and video games have also been utilized in a wide variety of medical contexts (Griffiths, 2004). Despite video games having a stigma around them, video games can have positive effects on the mental health of players as long as the player is not addicted to video games.

This research paper will combine both topics previously discussed and explore the effect of video games on the cognitive health of older adults. To start, the effect on the rate of cognitive decline from social isolation and/or feelings of loneliness and the effect on the cognitive health of older adults from playing video games will be discussed. Then the concept of social shaping of technology is introduced and used to analyze the design and development of video games.

Case Context

I have explored the effect of social isolation and/or feelings of loneliness on the cognitive health of older adults and the effect of video games on older adults' cognitive function by researching different studies in each topic. In a study that measured social isolation and cognitive function of individuals 50 and older in 2011 and repeated those measurements in 2015, found that social isolation was associated with decreases in episodic memory and mental status (Yu et. al, 2021). After considering confounding variables, like depressive symptoms, this association between social isolation and cognitive health remained significant. The Health and Retirement Study (HRS) collects information on the health, social, work, and economic characteristics of older adults in the United States biennially since 1992. A study analyzing the relations of loneliness and cognitive function in older adults used data from the HRS pertaining to participants that were 65 and older in 2000, from 1998 to 2010 (Donovan, 2017). The results of the study showed that greater loneliness at the baseline (1998) was associated with accelerated cognitive decline over the 12 years independent of established socio-demographic risk factors and other significant factors. The rate of cognitive decline was about 20 percent faster in the participants that were lonely at baseline compared to participants who were not lonely. Another study examined the association of loneliness and social isolation on cognition over a 3 year follow up period in individuals aged 50 years or older (Lara, 2019). This study analyzed data from a nationally representative household survey of the noninstitutionalized adult population in

Spain. Social isolation was found to be associated with lower scores in the composite cognitive score, verbal fluency, and forward digit span and loneliness was found to be associated with lower scores in the composite cognitive score, immediate and delayed recall, verbal fluency, and backward digit span. The effect of loneliness and social isolation found in this study did not change after excluding the participants with depression. As mentioned before, an increase in age comes with a decrease in cognitive factors. In addition, social isolation has taken a toll on mental health and has accelerated the rate of cognitive decline in older adults.

It is shown that the presence of social isolation and/or feelings of loneliness contribute to a declince in cognitive health so it is important to try and combat this decline. Digital games involve social interaction whether you are playing online with other players or playing with virtual game opponents (Kaufman, 2020). The effect of video games on the cognitive health of older adults has been analyzed by researching studies that focused on this topic. A study analyzed the differences in psychological functioning between older adults who play digital games and older adults that do not play digital games (Allaire, 2013). The adults in the study lived alone and were aged 63 to 92. The participants were separated into three groups which were regular gamers, occasional gamers, and non-gamers. The older adults completed an array of perceptual, cognitive, and affective tests. The results of the tests showed that the regular and occasional gamers reported significantly better instrumental and everyday functioning and had significantly better well-being and social functioning than the non-gamers. In another study, the impact of video game training on the cognitive functioning of community-dwelling adults aged 65 or older was investigated (Sosa & Lagana, 2022). The participants were randomly assigned to either a video game training group or a control group. The older adults completed an assessment before and after a five-week period. The results of the study were that the participants in the

video game training group performed significantly better than the participants in the control group in the arithmetic and syllable-counting tasks. Overall, over 80 percent of the cognitive effects favored the video game training group. Also, another study that examined the effects of video game training on cognitive function in healthy older adults aged 60 years or older found that video games increased memory, processing speed, and attention in the participants (Hou, 2022). It has been proven that video games have a positive impact on the cognitive health of older adults which was used in the analysis on the design and development of games using the Social Construction of Technology (SCOT) framework.

Older Adults Effect on the Development of Video Games

SCOT is a theory developed by Trevor Pinch and Wiebe Bijker that argues that human action shapes technology (Pinch and Bijker, 2008). The development process of a technological artifact in SCOT is described as an alternation of variation and selection which leads to a multidirectional model and not a linear model of innovation. Social groups or stakeholders define technology and attach a meaning to it. A social group is defined as an institution or a group of individuals that share the same meaning or perspective of an artifact. The perspective of the artifacts is dynamic and it affects the design of the technology. The different interpretations of the artifact can produce conflicts between criteria of the artifact which could be difficult to resolve technologically. Different groups have different problems which leads to different designs. According to Pinch and Bijker, there are two mechanisms to the closure of conflicts which is rhetorical closure and redefinition of the problem. Rhetorical closure is when the social groups view the problem as being solved so there is no need for alternative designs. Redefinition of the problem is when the conflict arises due to a design that can be stabilized by using it to solve a new and different problem which ends up being solved by this original design.

In this specific case, the social groups that have attached different meanings to video games are younger adults and older adults. According to the United Nation's World Population Ageing Report (UN, 2017), the global population aged 60 years or older has reached a total of 926 million in 2017 and this number is expected to double by 2050. This increase in the number of older adults has increased the necessity to research and develop technologies to support older adults (Martinho et al., 2020). In addition, this necessity has increased because of increased social isolation due to the COVID-19 pandemic which led to an increased rate of cognitive decline and it has been proven that video games have a positive impact on the cognitive health of older adults. The increased rate of cognitive decline, the increase in the number of older adults, and the research that shows the positive implications of video games has made older adults a relevant social group. The term 'Serious Games' refers to a game that is designed for a primary purpose other than entertainment (Dorner et al., 2016). Projects have been created to examine the potential of serious games to encourage physical and mental activities. Eldergames is a project to develop games using advanced visualization and interaction interfaces to improve the cognitive function, and social skills of older adults (Gamberini et al., 2006). This project performed extensive research into the abilities of the elderly and brought forth design guidelines for technology. These guidelines that they established will help create video games that are easy to use for older adults and their varying abilities, and enjoyable to play. Older adults are a social group that have influenced an alternative design to video games. To children, video games are for fun and entertainment but to older adults these games could mean improving their cognitive health while keeping the game enjoyable.

Research Questions and Methods

I have completed a literature review and through a case study approach and the use of the Social Construction of Technology (SCOT) framework, I have answered the question: how has

the cognitive and social decline of older adults affected the development of video games? This question required extensive research into the design process for video games that were intended for the entertainment of kids and younger adults and the design process for video games that were created for older adults and their varying abilities. This is an important topic because there is a decline in cognitive health with an increase in age and this rate of decline was increased due to the necessary social isolation during the COVID-19 pandemic. Another reason why this is an important topic to cover is because there has been a significant increase in the percentage of individuals aged 50 or older of the population. This increase in the number of older adults is due to the rapid medical innovations so this topic pertains mostly to developed countries. I analyzed studies that focused on the effect of social isolation and feelings of loneliness on the rate of cognitive decline as well as the effect of video games on the cognitive health of older adults. To examine if there was a change in the development of video games, I performed a case study analysis on the design process of video games for a younger audience versus an older audience. To analyze the design process for a younger audience I looked at the game design specifications for games that used a younger age group for the usability tests of the game. To analyze the design process for an older audience I looked at the game design specifications for games that took into account the varying abilities of the players. The results of the research were then analyzed using the SCOT framework to answer the research question.

Results

Video games are designed and promoted for "typical" gamers which consists of individuals younger than 40 (Schultheiss, 2012). According to the Entertainment Software Association (ESA), 60% of gamers are 34 years or younger, 25% of gamers are 35 to 54 years old, and 9% are 55 to 64 years old in 2022. The average age of gamers was 33 in 2022 while the average age of gamers was 29 in 2004 according to the ESA. The average age of gamers has increased

slightly while the percentage of older gamers is still low but there has been development for designing video games for the elderly. Since the creation of video games, video games have been designed and produced for individuals aged 40 and below. Due to the increase in the percentage of older adults and the increase of the rate of cognitive decline with age due to the COVID-19 pandemic, there has been a great amount of research dedicated to the design of video games for older adults. The design of video games for a younger audience included issues such as great gameplay, a good story to interest the player, and the presentation of the game. It did not include issues such as the volume or the accessibility to the different settings and game modes. Navigating through the game was expected to either be easy or manageable by the game designers due to the audience of the games being young. The designing of games for older adults differs from the designing of games for a younger audience. Both design processes include making the game enjoyable to the target audience but the design process for older adults includes aspects like ease of accessibility, clear rules and instructions, reward systems, large font sizes, and an appropriate sound output. The purpose of video games designed for a younger audience is to provide entertainment and the purpose of video games designed for an older audience is to improve the cognitive health and wellbeing of the players. In the view of the SCOT theory, this new perspective from older adults on video games influenced how video games are being designed. The results of my case study approach is that the increasing presence and needs of older adults has lead to an increase of a new design process of video games. Despite the great amount of research on the design of video games for older adults, there has been no production of such games. According to SCOT, even though there has been progress made to solve the problem there has been no closure in this technological case because the problem has not been seen as solved.

Design Process for a Younger Audience

A study that looked at the video game development process and the practices that studios currently use presented four case studies from gave developers (McAllister & White, 2015). One case study was on Black Rock Studio which specializes in developing racing games for Xbox, PlayStation and personal computers (PC). For the usability tests on the game called *Pure* that Black Rock Studio was developing, the only requirements were that the participants were 14 to 24 years old, male, and owned at least one of the current generations of the console. The testers had never played the game before and divided the test into different categories. The categories of the testing were free flow, narrow specific, and broad specific. Free flow is an unguided test where the player is encouraged to play the game however they want. The purpose of this test is to give an imporession of how enjoyable the game is. In the narrow specific mode, the player would only play a single level and they might play it multiple times in order to measure their improvement with familiarity. In the broad specific test, the participants played the game over many levels. Another case study was done on Relentless Software which is an independently owned developer, working exclusively for Sony Computer Entertainment. Sony's marketing team chose 3 demographic groups for the focus group test which included social players that are in their mid-20s, family players which consisted of a mother, two children, and a family friend, and gamers which consisted of students and late teens. 64 questions were devised for the focus test which was grouped into the following 8 categories:

1. Instructions in the intro sequence
2. Using the game's menus
3. News page
4. First impressions
5. The overall experience

6. Enjoyment
7. User created quizzes
8. Future purchases

Andrew Rolings and Ernest Adams discuss the anatomy of game design and how it cannot be reduced to a set of discrete instructions and processes (Rolings and Adams, 2003). To design a successful game, you have to consider the ways that humans interact with each other and subconscious stimuli that influence them. Good game design is a matter of craftmanship and it is a creative process that requires the ability to dream and imagine amazing worlds populated by strange and wonderful denizens. Great gameplay is important and most publishers want something similar to a recent hit game but with a few more twists. Key elements of games, according to Rolings and Adams, are storytelling and interactivity. All games tell a story and part of the story is told by the author and designer to the player. Without a story, the game will not interest the player. Interactivity is the way that the player sees, hears, and acts within the game's world. In other works it is how aspects like graphics, sounds, and user interface come together to present the gaming experience. The user interface is the buttons you push to play the game and defines the "flavor" of the game. The capabilities of new machines require that more effort be spent on presentation and the more effort spent on presentation, the more the player expects to see in the next game which results in a vicious positive-feedback cycle of player expectations.

Design Process for Older Adults

In the first study, it provides an overview of age-related changes followed by a summary of game design considerations for senior audiences (Gerling et. al, 2012). The changes and challenges of the elderly are:

1. Cognitive impairments: problem solving skills, information processing, and reduced attention span when working on complex tasks

2. Decline of motor skills: fine motor skills, changes in posture and balance, and negatively affected motor learning
3. Chronic illnesses: range from arthritis to severe heart conditions which have an impact on physical abilities and mobility of senior citizens

The design considerations for senior audiences can be separated into three categories: players and resources, the user interface, and the core mechanics. Research has shown that elderly individuals enjoy engaging in active play, following games as spectators, and commenting on other players. The considerations in the players and resources category are having an online multiplayer functionality, having nonrestrictive availability of in-game resources, and that the in-game resources should be adjustable. In regards to the user interface, holding a controller while pressing small buttons could be difficult and should be avoided. The complexity of input sequences should be significantly reduced for an elderly audience and the difficulties with parallel player input (performing complex point-and-click operations) should be considered. Other specifications that should be considered for the user interface include the visual game element size, font size, auditory output, and haptic output. The core mechanics of a game is the internal processes and requirements of digital games which consists the procedures, rules, objectives and conflicts. In-game actions should be easy to understand and ideally incorporate metaphors of daily life to facilitate the learning process. Parallel input and quick sequential reactions should be avoided to lower the players cognitive load and to account for changes in sensorimotor abilities. Rules should be easy to understand and elderly players may need additional and more detailed information to understand the requirements of the game due to their lack of gaming experience. Suitable game genres and features should be considered for the elderly audience.

In the second study that was analyzed, McLaughlin et. al described how the expectations of the game and the initial experience strongly affects game adoption and describes how designers could approach designing games for older players (McLaughlin et. al, 2012). The costs experienced by older gamers include difficulty with reading text, identifying objects, being able to separate the interface elements and display from the scene behind them, and activating icons and display elements. Another cost that older players experience is the stereotype threat which is that they are more likely to believe that they are not supposed to like video games or be able to play video games. The presence of stereotype threat is partly due to their age group being underrepresented in game characters. Studies have found that this makes older gamers feel excluded. Stereotype threat can reduce memory abilities especially while encountering a hard task. Aspects of games that prevent stereotype threat include giving feedback to the gamers, presenting designs that signal appropriateness for older audience, starting players at less challenging stage than that for a younger audience, and providing early rewards for small accomplishments. Other costs experienced by older gamers are perceived lack of benefit and the high perceived costs of playing games. Design thoughts for video games for older players includes instructions to convey some of the potential benefits to encourage play, allowing the players to share the process of learning with others to reduce perceived barriers, and requiring more realistic motion to possibly prevent some less able older players from not being able to participate. McLaughlin et. al had participants aged 65 and older play a game called *Boom Blox* that was designed for all ages and required motor control, reasoning, and some amount of reaction time. The participants were examined and McLaughlin et. al found that the following characteristics of the game increased benefits for the older players:

1. Simple interaction: having a single movement that operated the game mechanics throughout the game
2. Low physical demand: for players with differing movement abilities
3. Novel sensory experience: fireworks display, explosiongs, positive works and phrases, and cartoon characters
4. Social component
5. Reward system
6. Performance scaffolding through initial experiences with the game
7. Feelings of flow and engagement: “A positive experiential state that occurs when the performer is totally connected to the performance, in a situation where personal skills equal required challengs.”

The third study introduced the Eldergames project which is a project to develop games using advanced visualization and interaction interfaces to improve the cognitive, functional and social skills of older users (Gamberini et. al, 2006). In this project the design specifications include:

1. Vision: adapting the font size, minimize glare, and use great color contrast
2. Hearing: increase stimulus intensity and controlling background noise
3. Reduction of operations offered at once to avoid excessive interface complexity
4. Giving immediate feedback about any selection on the screen to simplify the understanding
5. Relying of familiar aspects of the activity to reduce the amount of learning efforts
6. Minimize the number of interface elements
7. Maximize the interface consistency
8. Signal strength of messages should be increased

9. Decrease the number of steps and controls needed to complete a task
10. Information required to perform a task should be immediately visible in the interface
11. Focus on documentation, available helps, error messages, and manuals to help users recognize and correct possible issues

Discussion

Video games have not, typically, been designed with the mental and physical abilities of older adults in mind. This is similar to the development of smartphones. Smartphones provide many opportunities to meet the needs of older adults and they also provide applications that can assist older adults in different aspects of their lives (Pang et. al, 2011). Generally for a younger audience, smartphones are mostly used for social media and entertainment pruposes and generally for an older audience, smartphones are mostly used for emergency services and to connect with family and friends. Many usability studies that have been conducted suggest that older adults have difficulties using smartphones. In light of the SCOT framework, a relevant social group is older adults and they have attached a different perspective on this technological artifact and a problem has arisen. In response to this problem, guidelines have been developed to design better interfaces for older adults. Apple has implemented some of these guidelines in their new smartphones to benefit the older population. In 2021, 61% of individuals aged 65 and older and 83% of individuals aged between 50 and 64 own a smartphone. This technological case has been closed because the problem has been seen as solved due to the majority of the public interpretation being changed.

There has been progress in the development of video games for older adults but there is a lack of motivation for older adults to play video games. Especially due to some older adults feeling like they are too old to play video games. Video games have been proven to improve the cognitive health of older adults but older adults may not have access to computers or consoles

which are required to be able to play the game. In addition, the designing of video games for older adults has tried to take into account the varying abilities of older adults but it is possible that the game could still not be playable by every individual. There are video games that exist that were not designed for older adults but are relatively easy for some to play but there are limited options. Despite the amount of research for the design of video games for older adults, no publications have been found that show any type of video games designed for older adults coming out.

In the future, I would complete a survey by asking individuals older than 50 a series of questions. First, I would ask how often they play any type of video game. If they said yes, I would ask what type of video games that they play and how frequently they play. If their answer was no, I would ask why they do not play video games. Then I would ask a series of questions about how they feel towards video games and what kind of video games would they like to play. The purpose of this survey would be to gauge what older adults think and how they feel about video games and what type of video games would be enjoyable by the majority of older adults.

My research has shown that when designing technology, the impacts of that technology is often not looked at. The creation of video games was built for a younger audience and it excluded other social groups. In the future, I will ensure that when designing engineering systems I will look at the impact of it in different aspects and not simply its original purpose. I will not overlook the societal impacts of my technology and I will take accountability for the social impacts that my technology brings.

Conclusion

The percentage of older adults of the population has increased significantly and with an increase in age comes a decline in cognitive health. This rate of cognitive decline with age was increased after the global pandemic that occurred due to the necessary social isolation. It has

been proven that video games have a positive impact on the cognitive health of older adults and could combat the cognitive decline of older adults. Using the theory of SCOT, the development of video games was analyzed by performing a case study on the change in the design process for a younger audience versus an older audience. The different social groups define technology in different ways and each have had an impact on the development of technology. The increase in the percentage of older adults and the need to reduce the rate of cognitive decline has influenced a new design process of video games. There has been a lot of research on the design of video games for older adults but there still has been no production of such games. According to SCOT, this technological case will be closed when video games designed for older adults hit the market and the public sees this problem in video games as resolved. After the production of these video games, next steps for the designing of video games for older adults includes implementing cognitive and physical assessments in the game. The purpose of these assessments is for the families and doctors of the older individual to be able to see how well they are performing and how they are progressing.

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