PHYSICAL BATTLESHIP GAME: HUMAN VERSUS ROBOT

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). 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.

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 shown in figure 1, with an increase in age comes a decrease in cognitive factors of speed, reason, and memory (Salthouse, 2004). In addition, social isolation has taken a toll on mental health and has accelerated the rate of cognitive decline in older adults.

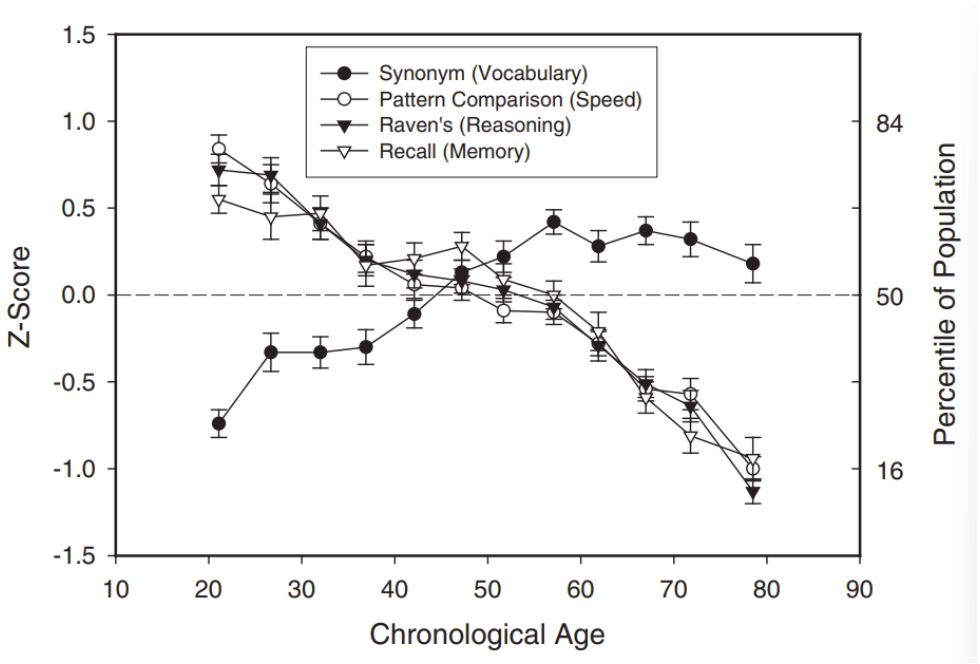

Figure 1. Graph of Chronological Age versus the Z-Score of Cognitive Factors

The technical aspect of this paper discusses the redesign of the original two player battleship game into a digital, one player battleship game. The digital battleship game is a physical game that an individual can play despite them not having someone else to play with. This section of the paper also shows evidence that video games have a positive effect on older adults.

This paper will also cover the concept of social shaping of technology and how the direction of video game productions has changed. It will examine the change in perspective of video games and its effect on the production of video games.

Physical Battleship Game: Human versus Robot

The goal of my technical project is to create a working physical battleship game that a human player will play against an automated opponent. This is a group capstone project in the course Electrical Computer Engineering (ECE) 4991. My team members names are Madisen Patrick, Kyle Kuennen, and Deianira Griffith. The physical game will be 3D printed and shaped like a computer. The "screen area" will consist of an eight-by-eight array of red, green, and blue (RGB) light emitting diodes (LEDs). The color of each LED will communicate to the player where they have guessed and the result of their guesses. The "keyboard area" will consist of an eight-by-eight array of RBG LEDs and magnetic sensors. The color of each LED will communicate to the player where their ships are, where the automated player has guessed, and the result of their guesses. There will be 3D printed ships that have magnets on the bottom. When the game begins, the player will place their ships on the array that contains the magnetic sensors, and the LEDs on the "keyboard area" will light up green where they have placed their ships. The ships will then be put to the side and the player will use a magnet to select where they would like to make their guess. Then the automated player will make a guess which will be

shown on the “keyboard area” of the game. The game will end when either the human player or automated player sinks all the other’s ships, and a winner will be declared using a liquid crystal display (LCD). The LCD will be used for game management like showing whose turn it is. There will be an extra magnet sensor that will also be used for game management like starting the game and stopping the game.

Digital games involve social interaction whether you are playing online with other players or playing with virtual game opponents (Kaufman, 2020). 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).

Older Adults Effect on the Development of Video Games

The Social Construction of Technology (SCOT) is a theory 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. 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. According to SCOT, social groups or stakeholders define technology and attach a meaning to it. Varying social groups produce different meanings of an artifact which leads to separate artifacts. It has been proven that video games have a positive impact on the cognitive health of older adults. Video games can be used in antisocial ways (Shaffer et al., 2005) but the potential benefits of playing games includes cognitive skills development, combatting loneliness, and improving well-being. In the previous studies examining the effect of video games on the cognitive health of older adults, the video games used were created and designed for entertainment purposes. The term 'Serious Games' refers to a game that is designed for a primary purpose other than entertainment (Dorner et al., 2016). The use of game mechanics can not only engage, motivate, and influence behavioral change but also can be used as an indicator or determinant of physical and mental well-being (Wortley, An, Heshmati, 2017). Projects have been created to examine the potential of serious games to encourage physical and mental activities and to monitor and assess physical and mental capabilities. Psychologists and engineers

are joining together to create these projects due to the increase in the percentage of older adults of the global population and due to the increasing amount of evidence that video games combat cognitive decline. Gerontechnology is the expanding field of technology applications to improve the elderly life conditions whose abilities and needs at the cognitive, social, and health levels need to be considered in the design process (Burdick and Kwon, 2004). 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. The different interpretations of the artifact can produce conflicts between criteria of the artifact which could be difficult to resolve technologically. Closure of conflicts happens when social groups view the problem as solved or when a design is stabilized by using it to solve a different problem which leads to the original problem being solved. Older adults are a social group that has changed the development of video games. To children, video games are for fun and entertainment but to the doctors and families of older adults these games could mean improving and assessing their cognitive health while keeping the game enjoyable.

Research Questions and Methods

Through a case study approach and using the Social Construction of Technology framework, I will answer the question: how has the cognitive and social decline of older adults affected the development of video games? This question will require extensive research into the decline of cognitive health that comes with aging, the social isolation that comes with aging and

life after the COVID-19 pandemic, and the development of video games that are designed for older adults.

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. Gerontechnology is the scientific study of aging and using the potentials offered by the progress of technology to help elderly people slow down the effects of increasing age (Micera, Bonato, & Tamura, 2008). Specifically, the development of video games that are intended for older adults will be analyzed. To analyze this development, I will investigate the projects that have been done to research the design specifications of video games for older adults and their varying abilities. Psychologists and engineers work together to produce video games that are proven effective to prevent cognitive decline, assess cognitive health, and be easy and enjoyable for older adults.

Conclusion

The technical aspect of this paper covered the redesign of a two-player game into a one-player game which an individual can play when socially isolated. Studies showing how video games can have a positive impact on the cognitive health and function of older adults was also included in this section. The concept of social shaping of technology was applied to the development of video games. Video games were first created for entertainment and now there are games being designed to help the mental well-being of older adults. The digital game that my group and I are designing will help decrease the feeling of being socially isolated for older adults

and the development of video games for older adults will help combat the cognitive decline that people face with an increase in age.

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