

The World of Warcraft and Cognition

A Study on the Cognitive Effects of Playing the World of Warcraft

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Introduction:

With video games regularly criticized for being “addictive” or even responsible for “[taking] away normal social development” (Rauh, 2006), the cognitive enhancements and positive effects of video games are much less addressed by common media outlets. Despite its inferior consideration in the media, numerous studies in the past have suggested that certain cognitive enhancements such as reduced reaction times do occur as a result of playing action video games (i.e. *Call of Duty* and *Unreal Tournament*). One such study published in the *Current Directions in Psychological Science* journal provided evidence that action video games improved processing speeds over time without affecting accuracy of decisions (Dye, Green, and Bavelier, 2009). Other studies show that such video games have great potential to enhance short-term memory (Boot et al., 2008) or even augment visual discrimination (Green, Bavelier, 2007). The implications of such findings may suggest that video games could be used as “efficient training regimens” (Dye, Green, and Bavelier, 2009) to increase processing speeds and other cognitive functions in specific tasks or activities. In addition, these findings would imply that there are indeed some positive aspects to playing video games and might bring about a more positive perspective of them. Could they be applied in the future to enrich learning or even to increase the speed at which individuals process information?

While many studies have examined the relationship between certain cognitive skills and playing action video games, this study will focus specifically on the ability of the MMORPG (Massively Multiplayer Online Role-Playing Game) World of Warcraft (WoW) to enhance reaction time, visual discrimination, and memory using both quantitative assessments and textual research. Based on the findings provided by numerous studies in the past (as mentioned above),

I believe that the MMORPG World of Warcraft similarly has the ability to improve reaction time, visual discrimination, and memory.

Methods:

In order to examine the effects of video games on specific cognitive skills, I implemented four major steps. The first consisted of analyzing the World of Warcraft as a textual source and evaluating whether or not it had the potential to develop improved reaction times, visual discrimination, and memory by looking at specific game features. More specifically, I chose to analyze the interface, gameplay while in PvE (Player vs. Enemy or non-playable character) combat, and the tasks required by quests. These specific features were chosen while playing the game for four weeks at around twenty or more hours each week; specifically looking for features or gameplay mechanics that might encourage the development of the intellectual processes previously mentioned. For each of these features I applied a disciplinary lens. That is, I viewed the text through a psychological filter; concerned with how each textual feature affected or enhanced one or more of the three cognitive skills being investigated.

The second step involved the application of three brief tests which would each essentially assess one of the three cognitive skills being investigated. I chose each of these tests by considering the amount of time they took (the shorter the test the more willing people would be to participate) and their ability to provide a basic evaluation of the desired characteristic. The first test, titled "Online Reaction Test" (Allen, 200), involved a very quick online assessment which measured reaction time over five trials. Each participant was given the same instructions and was given the same mouse prior to beginning the test. In each trial, the participant clicked a button when ready and clicked again as soon as a green light flashed on the screen. The amount

of time that elapsed between the green light and the mouse click was recorded in seconds over five trials. Finally, the average response time over each of the five trials was calculated and recorded. The second test also consisted of a very brief online assessment titled “Memory Test” (Memory test, 2011). This test instead measured the participant’s memory by the amount of levels they completed correctly. Again, each participant was given the same instructions on how to take the test. In each level, the participants were asked to reproduce a pattern of rectangles previously shown on the screen. If they correctly reproduced the pattern, they were allowed to move on to the next level. On the other hand, if they failed to correctly reproduce the pattern, the test would end at the current level. The level of correct patterns that each participant attained was recorded. The third and last test was used to assess visual discrimination. This test made use of a “Where’s Waldo” search book (a book with pictures that challenges readers to find specific objects) and a stopwatch. Each participant was shown a picture of the object they would be finding (Waldo) for reference and was told to find it in two different pictures. The same pictures were used for each participant. The amount of time it took each participant to find the object in both pictures was recorded in seconds.

The third step in this study consisted of having the participants fill out a concise survey to gather relative information. Questions from this survey gathered the participant’s age and gender as well as how many hours each week on average they played WoW. This data would be useful for later determining what relationships if any exist between those who play World of Warcraft and processing speeds, memory, and visual discrimination.

Results:**Overview:**

Overall, the results from the quantitative assessments supported my hypothesis that playing World of Warcraft enhances certain cognitive skills. Generally, reaction times were quicker (WoW M = .26s, SD = .03; non-WoW M = .36s, SD = .09), visual discrimination was faster (WoW M = 16.89s, SD = 5.65; non-WoW M = 23.62s, SD = 15.99), and recall ability was better (WoW M = 6.67, SD = .52; non-WoW M = 5.44, SD = .88). Table 1 presents the raw data from each of the three assessments. Out of all participants (N=15), less than half (n=6) played World of Warcraft regularly (more than 0 hours each week). The rest of the participants (n=9) had never played World of Warcraft before, but may have regularly participated in other video games.

Table 1

Hours spent playing WoW each week on average	Reaction Time (Seconds)	Amount of time in seconds to find object in search book (Visual Discrimination)	Memory Test Level
0	0.5742	27.92	5
0	0.3244	63.44	6
0	0.3214	30.80	6
0	0.3012	190.30	4
0	0.3838	142.24	7
0	0.3904	50.22	5
0	0.3458	8.39	5
0	0.3128	10.12	5
0	0.2900	14.28	6
6	0.3102	18.92	6
9	0.2374	15.91	7
15	0.2560	12.31	6
18	0.2372	17.83	7
20	0.2747	10.13	7
22	0.2746	26.23	7

Reaction Time:

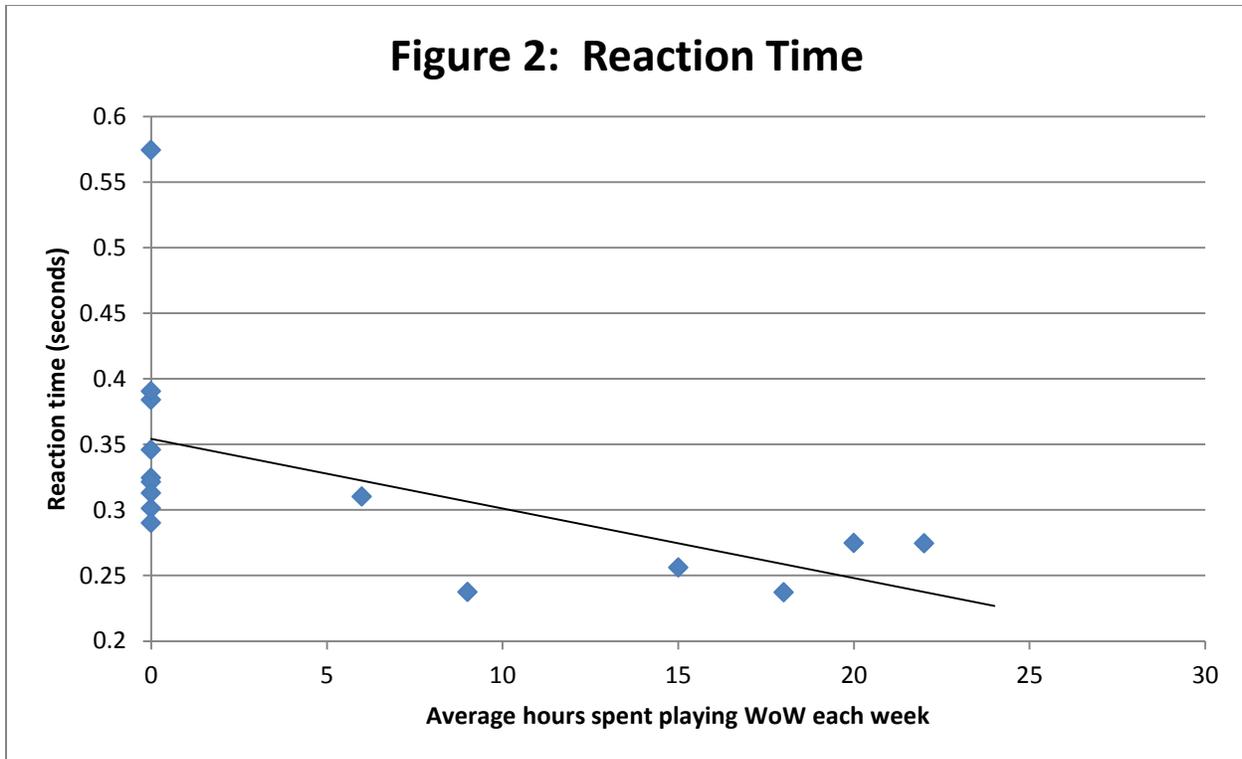
Reaction time is the amount of time that passes between an initial stimuli and a given response to that stimuli. Although reaction time may be based on a number of factors, many sports-related studies such as a study on the effects of intensive baseball practice show that reaction time can indeed be improved through practice responding quickly to certain stimuli (Kida, Oda, & Matsumura 2005). This being said, it makes sense that the repetition of quick responses to constant environmental changes in video games such as the World of Warcraft may also induce faster reaction times. Looking specifically at the PvE combat gameplay in the World of Warcraft, it is apparent that quick reactions to certain events are encouraged and sometimes even necessary in order to overcome one's foes. An excellent example of gameplay that requires a series of quick and correct responses in order to survive is the encounter with Ragnaros (a tough boss in the game). Ragnaros has a variety of powerful and sometimes lethal attacks at its disposal. One such attack, Sulfuras Smash, will one-shot (completely kill) any player whom it hits. Not only do players need to be constantly aware of this attack, but they also must react quickly in order to avoid being completely eliminated from the battle. Additionally, certain players may be launched in the air unexpectedly by powerful explosions. Players must react quickly by casting other spells/abilities in order to avoid death by falling. All the while, players must be constantly aware of magma traps and lava waves as they battle this challenging boss. Although this is one of the more extreme examples of World of Warcraft players using quick reaction times to survive and succeed in the game, a large majority of encounters with bosses and other non-playable characters similarly implement tactics that necessitate quick responses; thus further developing and enhancing a player's processing speed and reaction time.

Figure 1
Ragnaros



Source: World of Warcraft® provided courtesy of Blizzard Entertainment, Inc.

The quantitative results from the reaction time assessment supported my hypothesis that playing the World of Warcraft increases processing speed and reduces reaction time. Figure 2 illustrates that there was indeed a strong inverse relationship ($r = -.5401$) between the amount of time it took to react and the amount of hours played on average each week. This means that participants who played World of Warcraft were much more likely to have quicker reaction times.



A scatter plot plotting reaction time and average hours spent playing WoW each week. The line represents a linear trend for this data set. As illustrated by the trend-line, a strong inverse relationship ($r = -.5401$) existed between the amount of time taken to react and the amount of time spent playing WoW on average each week.

Visual Discrimination:

Visual discrimination is the ability to discriminate between the differences and similarities in shape, pattern, form, position, color, and size. Similar to reaction time, visual discrimination has been shown to improve with repeated “training” or practice discriminating between different objects, orientations, and colors (Stickgold, James, & Hobson, 2000). In the World of Warcraft, discriminating between different spells in the interface or identifying different objects to complete quests is a frequent occurrence. The interface in the World of Warcraft consists of up to 48 buttons that a player can select to perform specific spells, attacks, or abilities in combat. Each button has a small icon (see Figure 3) which allows the player to differentiate between these actions while in combat. This requires characters that do not use hotkeys (keys on the keyboard that are assigned to actions) to quickly discriminate between the

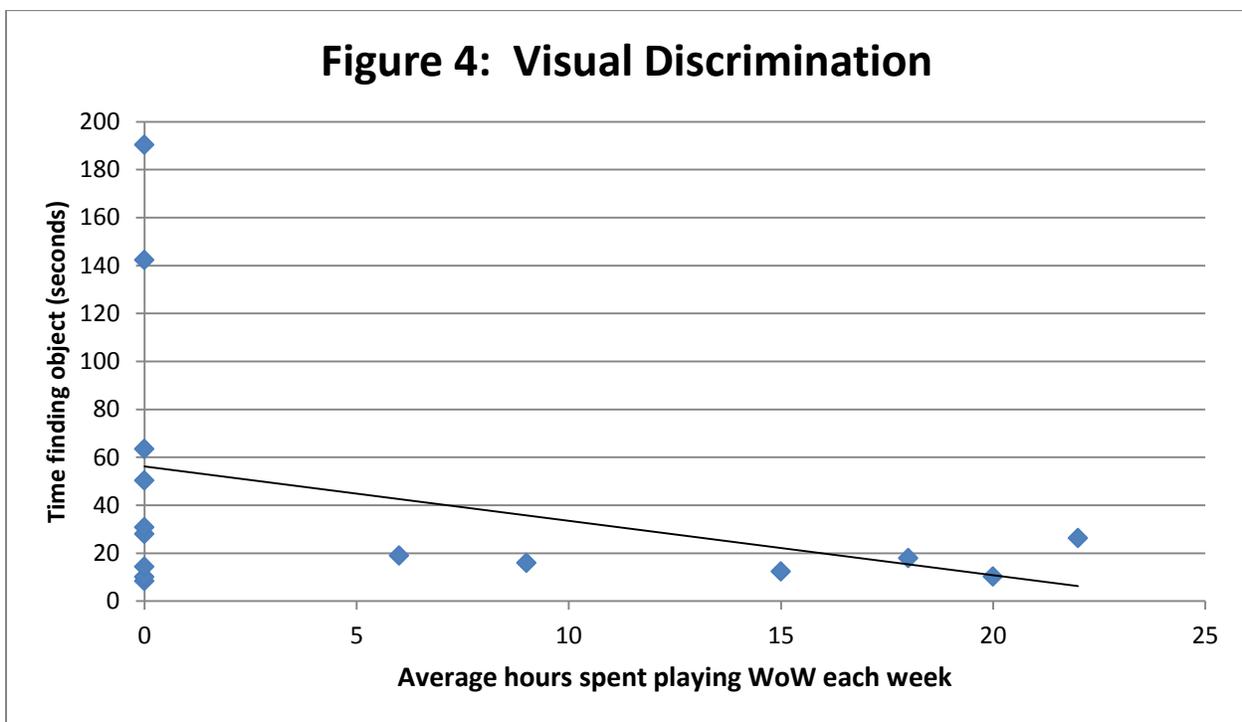
tiny icons while in combat to implement the correct action at the correct time; further developing their ability to differentiate and categorize visual images. Another aspect of the game that may improve visual discrimination is searching for specific items or for loot required by quests. Many quests specifically ask a player to collect “X” amount of an object or to kill “X” non-playable characters. One quest in the dungeon of Stratholme requires players to search for particularly shaped crates in order to obtain a specific item. As Figure 3 illustrates, players must develop a strong ability to differentiate between different objects in order to obtain the item necessary to complete the quest. These types of goals again force players to pick certain objects out of their environment based on their size, shape, color, and orientation and thus develop and enhance a player’s visual discrimination.

Figure 3
Collecting Crate Objects in Stratholme



Source: World of Warcraft® provided courtesy of Blizzard Entertainment, Inc.

The quantitative results from the visual discrimination assessment supported my hypothesis that playing the World of Warcraft enhances visual discrimination. Figure 4 illustrates that an inverse relationship ($r = -.3618$) existed between the amount of time it took to find the object (Waldo) and the amount of hours played on average each week. This means participants who played the World of Warcraft overall found Waldo much quicker than other participants; suggesting that the World of Warcraft more likely improves visual discrimination.



A scatter plot plotting the amount of time taken to distinguish Waldo from his surroundings and average hours spent playing WoW each week. The line represents a linear trend for this data set. As illustrated by the trend-line, an inverse relationship ($r = -.3618$) existed between the amount of time taken to find Waldo and the amount of time spent playing WoW on average each week.

Memory:

According to the journal *Science*, a “wealth of research has established that practice tests improve memory” (Pyc & Rawson, 2010). In addition, a recent study in the journal by Mary A. Pyc and Katherine A. Rawson has produced evidence that “more-effective mediators (that is,

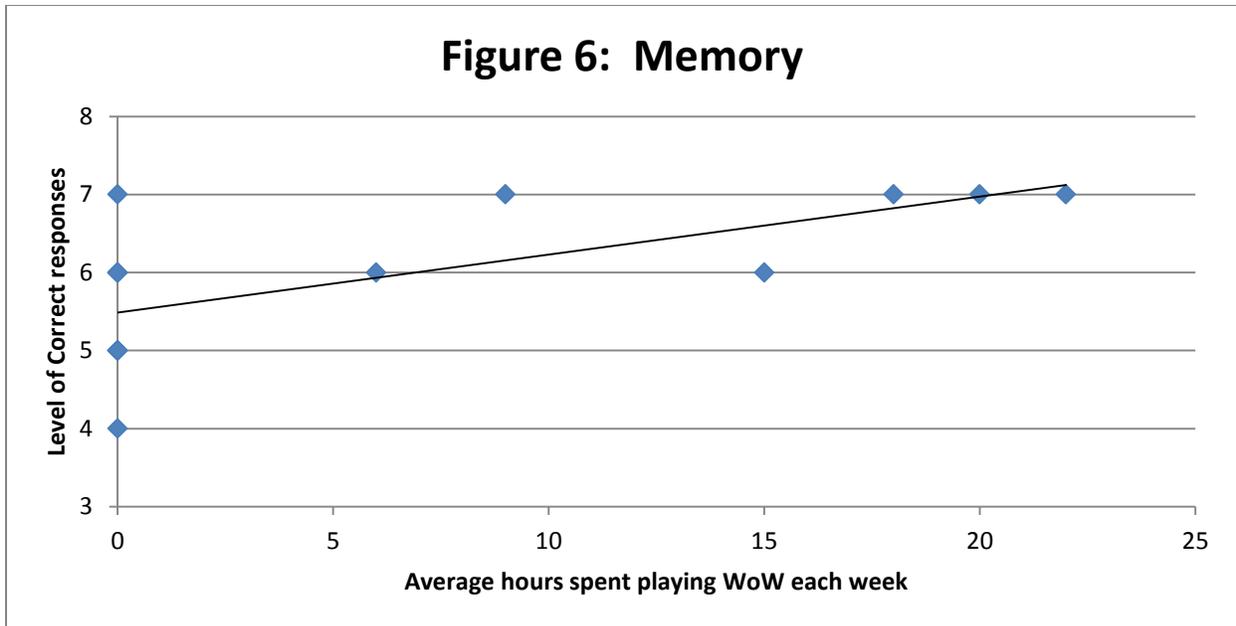
information linking cues to targets) are generated during practice” (Pyc & Rawson, 2010). In the World of Warcraft, the spatial locations of quests and the use of hotkeys encourage constant recall and may similarly induce more effective mediators and an improved memory. One particular area in the game, Storm Peaks, requires players to repeatedly travel across the map in order to complete quests. More importantly, players must continually recall the locations where they received each of their quests in order to complete them. Although a player can use a map for navigation, it can be much more time efficient and thus rewarding to recall the general direction one came from. Even so, upon arrival in the general area where a player received the quest, they must still recall where the person who gave them the quest was standing or what they looked like. Constantly remembering the spatial location of creatures that give quests in the World of Warcraft may effectively enhance mediators and improve a player’s ability to recall information. The use of hotkeys may also improve a player’s ability to recall information. Hotkeys are keys on the keyboard which a player has assigned a given attack or ability to. Just about every key on the keyboard can be used as a hotkey. In addition, the shift and control keys can be used with the number keys to produce ten additional hotkeys. While in combat, players who utilize hotkeys are rewarded in that they may be able to perform actions more quickly than players who must locate and click on the icons in their interface. On the other hand, players who use hotkeys must remember which keys result in which actions in order to efficiently perform in combat situations. Constantly recalling this information and remembering where the keys are located on the keyboard may also enhance a player’s mediators and improve their ability to recall information in other areas.

Figure 5
Flight Paths in Storm Peaks



Source: World of Warcraft® provided courtesy of Blizzard Entertainment, Inc.

The quantitative results from the memory assessment also supported my hypothesis that playing the World of Warcraft enhances one's memory. Figure 6 illustrates that a somewhat strong correlation ($r = .6562$) existed between the level of correctly repeated patterns and the amount of hours played on average each week. This means participants who played the World of Warcraft on a regular basis were overall more likely to reproduce patterns previously presented by the memory test; suggesting that the World of Warcraft does in fact improve memory.



A scatter plot plotting the level of correct responses and average hours spent playing WoW each week. The line represents a linear trend for this data set. As illustrated by the trend-line, a strong correlation ($r = .6562$) existed between the level of correct responses and the amount of time spent playing WoW on average each week.

Discussion:

While previous studies have addressed the ability of action video games to enhance cognitive skills, there has been little research done examining the ability of the World of Warcraft specifically to enhance these skills. The results of this study aim to provide further insight on this gap; examining the World of Warcraft's effects on a player's reaction time, visual discrimination, and memory. Knowing which types of video games can enhance certain cognitive skills is important for developing other video games or simulations explicitly designed for training and augmenting desired intellectual processes. Such findings might suggest that games or simulations with characteristics similar to MMORPGs may be used in the future for training members of various professions. In this discussion, I will summarize what I have learned from this study, talk about limitations of this study, and discuss what my findings mean for future research.

The results from the reaction time, visual discrimination, and memory assessments showed a surprisingly strong correlation between the amount of hours one spent playing WoW on average each week and ability in each of these skills. Overall, participants who played WoW had a much shorter reaction time than those who did not. Looking at the PvE gameplay in the World of Warcraft, it was easy to see how non-playable characters trigger quick responses from players and thus develop their ability to react. Participants who played WoW also showed an enhanced ability to visually discriminate objects. The interface as well as specific quest objectives in the game demonstrated that players needed to practice singling out certain objects based on their size, color, and orientation; thus improving visual discrimination. Finally, participants who played WoW exhibited a superior short-term memory. Constantly recalling the spatial location of different quest-givers and remembering which hotkeys were assigned to which abilities in WoW may have contributed to this effect. In each cognitive skill inspected, the study showed that participants who played the World of Warcraft were more likely to perform better.

This study has provided evidence that people who play the World of Warcraft are more likely to have somewhat better reaction times, better visual discrimination, and a greater ability to recall information than those who do not play. It additionally examined aspects of the game that may be responsible for development in these areas. However, there are many related questions that this study did not address. Future research should look into whether or not the improved reaction times from WoW players had any impact on the accuracy of their decisions. Their reaction times may be quicker, but has this improvement made them less accurate or even impulsive? My study could additionally be taken a step further to determine whether or not certain cognitive skills are developed more effectively with different classes or different activities in the World of Warcraft. It may be possible that a player using a healer class may

develop better reaction times while responding to high damage output than a player using a hunter class who is more focused on doing damage. In the same way, a player who spends more time in PvE may develop greater reaction times than a player who spends a lot of time in the game fishing or mining (other activities in the game). Another major concern for future research could be determining the capability of WoW to cause improvement in each of the cognitive skills, as opposed to simply measuring correlations between the two and examining the game for characteristics that might explain them. It would be quite beneficial to observe the effects of the World of Warcraft on a player over time in order to determine concretely whether or not the game or similar representations could be used to effectively train individuals and augment their cognitive skills.

Admittedly, the results from each assessment produced much stronger correlations with the average amount of time playing WoW each week than originally expected. This has led to much examination of the methodology implemented in this study. One of the more prominent flaws observed was the amount of participants examined. This study assessed reaction time, visual discrimination, and memory across fifteen distinct participants. This begs the question: would the correlations discovered in this study be nearly as strong had a larger pool of participants been examined? In addition, the participants all were randomly selected from the University of Denver campus. It is possible that the range of participants in this study did not accurately represent the general population. Did the fact that a large majority of participants were college students affect the levels of cognitive skills or even the disparity between people who played WoW a lot and people who did not? Another problem with this study is that it did not account for the amount of time a participant spent playing other video games. Previous studies have shown that other action video games do in fact improve reaction time, visual

discrimination, and memory. So did a participant's involvement in another game or other games influence their capability to perform well in these tests? This study indeed provides evidence of strong correlations between playing the World of Warcraft and enhanced cognitive skills, but its methods are far from perfect and it requires future study for further validation.

The idea of an activity generally intended for entertainment actually augmenting mental processes across different tasks is exciting to say the least. This research is important for determining which kinds of video games and which aspects of these games are effective in developing mental processes. Many of the results from this study can be applied to creating training games or simulations explicitly designed for preparing individuals for various professions. Although this study only superficially scathes the surface of a problem that requires much more work, further studies that address the ability of video games to enhance cognitive skills may largely affect how video games are portrayed and implemented in society.

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