2014

Cognitive Effects And Academic Consequences Of Video Game Playing

Sean Hollis
University of Mississippi

COGNITIVE EFFECTS AND ACADEMIC CONSEQUENCES OF VIDEO GAME PLAYING

A Thesis
presented in partial fulfillment of requirements
for the degree of Master of Science
in the Department of Clinical Psychology
The University of Mississippi

by

SEAN D. HOLLIS

June 2014

ABSTRACT

Introduction: Prior video game playing (VGP) research has generated mixed empirical findings. Recent studies suggested positive effects VGP may have on cognitive skills, particularly improvements in visuospatial skills, processing speed, working memory, multitasking, and problem solving skills. By contrast, other studies have suggested that VGP leads to lower academic performance – indicating further research on VGP effects is needed. This study investigated the effects of VGP on cognitive skills and academic performance. *Methods:* 208 participants were recruited from the University of Mississippi psychology department in exchange for research participation credit. The sample was 68.9% female and 31.1% male. Ages ranged from 18-40, though 92.9% of participants were between the ages of 18-21. Ethnic breakdown was – 77.5% Caucasian, 12.9% African American, 6.2% Asian, 1.0% Hispanic, and 2.4% other. Participants were administered a battery of demographic and VGP habit questionnaires, and measures of problem solving, executive control, time management, memory, attention, and spatial skills. Participants were divided into three groups - heavy gamers (5+ hours VGP/week), sometime gamers (1-4 hours/week), and non-gamers (0 hours/week). *Results:* Sometime video game players were found to perform better on measures of time management ($F(2, 205) = 4.15$, $p = .017$), and memory ($F(7, 200) = 2.21$, $p = .035$); and marginally better on measures of problem solving ($F(2, 205) = 2.70$, $p = .07$), and executive control ($F(7, 200) = 2.05$, $p = .051$) than were heavy gamers and non-gamers. Heavy gamers also reported the greatest number of problems related to their game playing, (F (2, 131) =

6.30, p = .02). Additionally, time management was found to be related to academic performance, (F (42, 164) = 1.46, p = .05). Finally, heavy gamers performed best on measures of spatial skills, followed by sometime gamers and non-gamers (F (2, 205) = 3.29, p = 0.39). *Conclusion:* These findings suggest the consequences of VGP are complex. Video game playing appears to positively affect skills such as time management, problem solving, executive control, memory, and spatial abilities when performed in moderation. However, as frequency of playing increases, the time management detriments associated may counterbalance gains.

LIST OF ABBREVIATIONS AND SYMBOLS

ACT	ACT Test, formerly American College Test
ADHD	Attention Deficit/Hyperactivity Disorder
ESA	Entertainment Software Association
GAMS	Gaming Motivation Scale
GEQ	Gaming Engagement Questionnaire
GHQ	Gaming Habits Questionnaire
GPA	Grade point average
RBANS	Repeatable Battery for the Assessment of Neuropsychological Status
SAT	Scholastic Aptitude Test
SPSS	Statistical Package for the Social Sciences
TMQ	Time Management Questionnaire
ToL	Tower of London task
VGP	Video game playing

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I. INTRODUCTION

Video games have become a widespread form of entertainment across age and gender. In 2010, 67% of American households played video games (Blumberg, 2011). As many as 97% of adolescents age 12-17 play video games (Lenhart, et al., 2008). According to the Entertainment Software Association (ESA), consumers spent nearly $25 billion dollars on video games in 2011. Despite a prevailing view that video game players consist primarily of adolescents and young adults, the average video gamer is thirty years old, and 68% of gamers are over age 18. While young adults play most frequently, games are played across all age ranges. 37% of gamers are 36 or older, 31% are between 18 and 35, and 32% are under age 18. Contrary to popular opinion, gaming is also no longer a male-centric domain. Women now make up 47% of all video game players (ESA, 2012). However, males are still more likely to play more frequently and to engage in problematic playing habits (Ogletree & Drake, 2007; Roe & Muijs, 1998).

Additionally, video game playing (VGP) is not a solitary activity for most, as for 62% of gamers, playing video games is a social activity shared with others. For most video game players, the time spent playing games reportedly replaces time that would otherwise be spent playing board games, watching movies, and watching television. The majority of gamers (78%) play at least one hour per week. As for specific genres of games played, 42% of gamers play puzzle games, while 25% play strategy and action games, with other genres, such as sports and racing, fighting, and simulation games lagging significantly behind (ESA, 2012).

a. VGP and Aggression

The majority of previous studies on VGP focus on the relationship between violent video games and aggression in children and young adults (e.g. Anderson & Dill, 2000; Anderson, Gentile, & Buckley, 2007; Bowman & Rotter, 1983; Griffiths, 1999). The study of violent video games goes back at least as far as the early 1980s with a study of Pac Man (Ferguson, 2007). While for a time it was widely accepted that violent video games played a role in increasing aggression, these findings have increasingly undergone criticism for overstating their findings. This criticism has risen to the level of a ruling by the United States Supreme Court in 2011 that psychological research into violent video games had serious methodological flaws and that conclusions reached went beyond the available evidence (Ferguson, 2013). Subsequent research has questioned the proposed relationship between violent video games and aggression (e.g. Ferguson, Garza, Jerabeck, Ramos, & Galindo, 2013). Beyond challenging the relationship between video games and aggression, some researchers have explored the potential for positive effects resulting from this popular method of entertainment.

b. Social Skills

More recently, studies have begun to focus on potential positive aspects of VGP. One of these more positive findings is that VGP also has a potential beneficial affect on socialization. Massive online multiplayer games (e.g. World of Warcraft) improve cooperation and social skills in some studies (Voulgari & Komis, 2010). Additionally, VGP has been shown to have a positive relationship on activity involvement, school engagement, and friendship networks in high school students (Durkin & Barber, 2002; Lee & Peng, 2006; Scantlin, 2000; Willoughby, 2008). Durkin & Barber (2002) also found that the majority of VGP time is spent with friends or family members, noting an obvious social aspect to video gaming. However, social costs have also been noted in some cases in that these games may limit face to face interactions and strain interpersonal relationships with significant others (Buckley & Anderson, 2006). Additionally, on measures of social adjustment, low frequency gamers performed better than high frequency gamers and non-gamers (Ventura, Shute, & Zhao, 2013). This includes higher self-esteem, less depression, more positive self-concept, lower substance use, and lower disobedience. In contrast, the high frequency gaming group performed better than the non-gaming group on all measures. Hamlen (2012) also found that gamers who were more willing to cheat at video games were also more likely to cheat in academic and business settings.

c. "Brain Training"

As more possible beneficial aspects of VGP have been identified, "brain training" has become a hot topic in the field. Studies on specific educational or "brain training" games, e.g. "Brain Age", which target improving cognitive abilities as their primary purpose, have found that VGP improved executive functioning and processing speed in elderly. Generalizability research would determine if a brain training game can affect performance on everyday tasks rather than simply laboratory cognitive tests (Goldstein, Cajko, Oosterbroek, Michielsen, et al., 1997; Nouchi, Taki, Takeuchi, Hashizume, et al., 2012). Similarly, brain training games may be effective for improving working memory, reasoning, and fluid intelligence (Baniqued, Lee, Voss, Basak, et al., 2013). Yang, Roskos-Ewoldsen, Dinu, & Arpan (2006) found that gaming improved implicit memory but had no effect on explicit memory. Other studies have also found that cognitive training with VGP may be effective even in improving self-efficacy and social connectivity (Jak, Seelye, & Jurick, 2013).

Voss, Prakash, Erickson, Boot, et al. (2012) described the use of “Space Fortress,” a videogame developed by cognitive psychologists to study skill acquisition. Studies utilizing this game found that variable priority training enhanced learning and that plasticity related to game training seemed to be domain specific rather than generalized. This raises questions about the generalizability of game training. On the other hand, another group of researchers (Sassi, 2012) found that action video games do show more generalizable results than other forms of brain training in the area of attention.

Indeed, many modern classrooms are beginning to incorporate educational video games into their curriculums as a form of "brain training" (Baniqued, Lee, Voss, Basak, et al., 2013; Druckman, 1995; Hubbard, 1991; Lieberman, Chaffee, & Roberts, 1988; Ricci, Salas, & Cannon-Bowers, 1996). However, it is still somewhat unclear exactly what cognitive effects these games may be having, or how pronounced the effects may be. There is some question as to whether common, popular video games offer the same effects as games designed specifically as brain training games (Tannahill, Tissington, & Senior, 2012). Another factor that must be considered is that students actually find it unappealing when games are simply placed into the classroom setting without a subsequent alteration in other classroom methodologies. It is the merging of education and entertainment which seems to be appealing to students (Baniqued, Lee, Voss, Basak, et al., 2013). Regardless, gaming has been promoted as a possible beneficial new tool in the teaching repertoire. Several studies have suggested that gaming is beneficial to learning because it offers real-time feedback on performance as opposed to the delayed feedback often given in educational settings. Gaming also has a low cost of failure, thus encouraging players to adjust their perception of failure to that of a temporary setback to be learned from rather than a permanent or punishing feature. It is also suggested that gaming encourages systems thinking and an understanding of relationships between how different variables may affect one another as a whole. Additionally, video games promote individualized skill development - the difficulty is gradually raised as a player's skill improves, such that they remain challenged without being placed into a setting which will be too difficult to master (Tannahill, Tissington, & Senior, 2012). Indeed, Wiebe & Martin (1994) found that a teaching style that integrated VGP improved student learning in a geography class. Similarly, another study found that educational games improved spelling and decoding abilities, but not mathematical ability (Din & Calao, 2001).

Other studies, (e.g. James, Phillips, & Best, 2011), have shown positive effects of brain training games on performance on Raven's matrices, a measure of fluid intelligence. The possibility that video games may improve fluid intelligence is an important finding and could indicate the possibility of a relationship between gaming and academic performance. Overall, cognitive training by video games has tended to show an improvement in the cognitive skill directly being trained but limited generalization to other cognitive skills (Lee, Boot, Basak, Voss, et al., 2012). This suggests that specific skills are actually being trained, rather than the training simply resulting in an overall improvement in cognitive functioning.

<u>d. Spatial Skills</u>

Some of the first experiments to investigate positive effects of video games on cognitive abilities included a series of experiments that lent strong support for a positive relationship between video game training and spatial memory improvements. VGP enhanced visuospatial ability through increased memorization of object locations, object tracking, and mental rotations. Initially, gamers were found to perform better than non-gamers on these cognitive tasks. To better determine conclusions based on causation rather than correlation, non-gamers were then trained to play video games over several weeks. The newly trained gamers were shown to improve their performance longitudinally on cognitive tasks such as task switching and object placement memorization (Green & Bavelier, 2006). These findings suggest possible causality and help rule out the explanation that individuals with these skills simply choose to play video games, opening the door for further study of alterations in cognitive skills following playing video games.

Aside from the initial studies by Green & Bavelier (2006), several other studies also found strong relationships between VGP and improved visuospatial skills such as visual attention, object tracking, visual memory, and task switching (e.g. Boot, Kramer, Simons, Fabiani, & Gratton, 2008; Castel, Pratt, & Drummond, 2005; Feng, Spence, & Pratt, 2007; Ferguson, Cruz, & Rueda, 2008; Green & Bavelier, 2003; Green & Bavelier, 2007; Greenfield, Brannon, & Lohr, 1994; Nelson & Strachan, 2009).

e. Problem Solving

In addition to improved visuospatial skill effects, several studies have begun to investigate the relationship between playing video games and more complex cognitive skills, such as problem solving. According to Hamlen (2012), proficient game players have been shown to exhibit higher levels of information seeking, categorizing, risk-taking, strategizing, critical thinking, and confidence in knowledge. The author also listed a set of possible skills and strategies utilized in game playing that included these types of problem solving behaviors. These findings suggest that the efficiency in learning to play games may be transferrable to other contexts. The study also pointed out several gender differences, including that female gamers tend to use more creative learning styles than male gamers. Additionally, Spires, Rowe, Mott, & Lester (2011) found that gamers were more likely to successfully utilize hypothesis testing as a problem-solving strategy than non-gamers.

f. Executive Control

As researchers began to further investigate the effects of video games on cognitive skills, follow-up studies continued to find strong relationships between video game playing and executive control skills such as multitasking, attention splitting, task switching, processing speed, working memory, and improved reaction time without loss of accuracy (e.g. Andrews & Murphy, 2006; Baniqued, Lee, Voss, Basak, et al., 2013; Barlett, Vowels, Shanteau, Crow, & Miller, 2009; Drew & Waters, 1986; Dustman, Emmerson, Steinhaus, & Shearer, 1992; Kearney, 2005; Krishnan, Kang, Sperling, & Srinivasan, 2012). Executive and cognitive control skills control and manage other cognitive processes. These skills are important in completing multiple tasks simultaneously. For example, split attention or multitasking is an important skill to have when trying to study with the television on or when a roommate is talking. Additionally, in gaming scenarios, responses are time limited and fast reaction times are rewarded. This should have beneficial effects for answering quickly and accurately (fluently), which seems as if it should have a positive effect on timed test performances (Strobach, Frensch, & Schubert, 2012).

Krishnan, et al. (2012) found that fast-paced shooter-style games were particularly effective in developing implicit cognitive strategies for splitting attention. Players of these types of games were shown to use an active suppression mechanism to avoid irrelevant information and to utilize signal enhancement of desired attentional targets. This resulted in better performance compared to individuals who play slower paced role-playing games. Still, both groups of gamers performed better than non-gamers on these tasks.

Executive control and processing speed also improved in elderly individuals playing a video "exergame" (exercise games utilizing physical input devices, e.g. Wii and Xbox Kinect). Executive control measures included Trails, Stroop, Matrix Reasoning, and Digit Symbol Coding. Processing speed tasks included Finger Tapping and Cancellation. Greater visuospatial effects were seen with action games compared to other forms of games, and compared to non-game players (Maillot, Perrot, & Hartley, 2012).

Researchers have shown that playing games can cause physical changes to brain chemistry such as increasing dopamine release, adding evidence to the idea that playing video games over time can increase plasticity in the brain – the brain's flexibility in altering neuronal purpose and functioning (e.g. Van Eck, 2011; Koepp, Gunn, Lawrence, Cunningham, et al., 1998). Thus, neurological changes may mediate skill acquisition and performance differences seen in video game players. In fact, Terlecki & Newcombes (2005) have proposed that VGP may be a contributing cause as to why males exhibit better spatial skills than females.

However, not all studies have shown positive results. Donohue, James, Eslick, & Mitroff (2012), found that gamers also show task decline while trying to multitask and thus are not immune to multi-task demands. 2.5% of people do seem to be "super-taskers" who do not show a decline in performance when multitasking. However, this does not appear to be related to gaming experience. Additionally, gamers were found to be no better at distracted driving than non-gamers. Yet another disparate study found that gamers showed no better performance on attentional tasks than non-gamers (Irons, Remington, & McLean, 2011). Gentile et al. (2012) found that attention problems such as ADHD were correlated with higher levels of video game playing. This relationship could be due to the excitement of games making other activities less appealing by comparison; to drawing individuals with attention problems to VGP; or by VGP taking up time that could be otherwise used in other pursuits.

g. Academic Performance

While it has been shown that VGP may have a beneficial effect on a number of cognitive skills, increased knowledge and clarification of the specific effects VGP has on the academic performance of college-age individuals would open new avenues of research into video game effects, and expand the field beyond the proliferation of aggression and spatial studies. It may also be useful practically in defining healthy patterns of game use. Finally, it is important that consumers of video game products understand the effects that such activities may have on their other daily activities, such as their academic functioning.

In one of the few studies that directly addressed academic skills, Ashkenazi & Henik (2012), showed a link between dyscalculia and deficits in attention. An action video game (Call of Duty) used for "attentional training" improved performance on arithmetic both for those with dyscalculia as well as a normal control group. A possible explanation for this finding was that mathematical abilities are directly related to verbal and visuospatial working memory: video games improve executive functioning and visuospatial working memory, increasing individuals' subitizing range (an immediate recognition of the quantity of stimuli within the visual field). However, other studies have shown no difference in attention, but rather simply faster speed of responding in gamers compared to non-gamers (Nelson & Strachan, 2009).

The effects of video game playing have also been studied in the realm of language acquisition. Playing videogames helped Japanese individuals learn English in a more efficient, brief manner (Lim & Holt, 2011). While this is likely related to language exposure, it may also show that video games may have an effect on verbal skills as well.

Some previous research has shown GPA and SAT scores decrease proportionally to the amount of time spent playing video games. According to the authors of one study, this is not related to time spent studying (Anand, 2007). Harris & Williams (1985) found that gaming was negatively correlated with grades independent of time spent gaming as well. Wood, Griffiths, & Parke (2007) found that some gamers may experience time loss in which they are unaware of how much time they are spending playing video games, and this may negatively impact their academic performance. Burgess, Stermer, & Burgess (2012), found that students were more likely to play video games than non-students. However, students who were gamers had lower GPAs than students who were non-gamers. This was explained by time management and motivational deficits: participants reported playing games to avoid doing homework. Additionally, Gentile, Swing, Lim, & Khoo (2012) and Blumberg (1998) found that VGP may be related to a higher prevalence of attention problems such as ADHD. However, these findings are contrary to the earlier studies noted that showed VGP may increase fluid intelligence as well as academic performance (James, Phillips, & Best, 2011). Several studies seem to indicate a potentially positive effect on academic performance with moderate levels of gaming when time spent playing is not excessive and does not take away time from engaging in academics.

In a study by Ventura, Shute, & Kim (2012), medium selective gamers (game players who are more specific about which types of games they enjoy playing and who play at a moderate frequency) had higher GPAs than low selective gamers. High habitual gamers were lower on conscientiousness than low habitual gamers. Previously, educational games have been shown to improve math skills; however, some studies have found negative correlations between gaming and GPA, others show no relationship, and some show positive correlations. The Ventura et al. (2012) study attempted to explain these differential results by exploring how gaming habits may have an effect on outcomes. Participants were divided into three groups - habitual, selective, and diverse gamers. Habitual gamers play consistently for lengthy periods of time. Selective gamers play heavily in a given gaming session, but do not play on a frequently consistent basis. And diverse gamers play many different games for varying and inconsistent amounts of time. Diverse VGP was positively correlated to openness. Openness (the disposition to engage in intellectual experiences) is in turn correlated with academic self-efficacy and a willingness to learn. Solving problems in unique ways in games may also be related to Openness. Problem solving is pervasive in video games, thus possibly one method of building up these skills. By creating challenging problem solving behaviors in games; the zone of proximal development is utilized and allows players to best maximize their skill learning. Gaming can also build organizational skills and a motivation to repeatedly try hard, both of which are aspects of conscientiousness. Certain types of games have stronger positive and stronger negative relations to GPA than others. Strategy and puzzle games have been found to be more highly positively correlated with GPA, while violent games are more negatively correlated with GPA overall.

Adachi & Willoughby (2013), found an indirect association between playing strategy games and academic performance. More strategy game playing led to higher self-reported problem-solving skills, and higher self-reported problem-solving skills in turn were related to higher grades in school. The authors suggest that this genre of games in particular encourages the development of problem solving skills through thoroughly exploring different possibilities in a game, and considering new strategies and goals prior to continuing on rather than simply working forward as quickly as possible. It is suggested that this improvement may not be seen in other game genres in which there is not time or motivation to stop and work through various solutions to a problem over the longer term. The authors also suggest that this effect may be particularly strong in adolescents. Since inhibitory control tends to develop during adolescence, its suggested that strategy gaming may help this process by confronting gamers with problems that are best solved by stopping to carefully consider different options and strategies. These findings have been supported by several other studies which also found that video game playing is associated with better problem solving ability (e.g. Adachi & Willoughby, 2013; Doolittle, 1995; Spires, Rowe, Mott, & Lester, 2011).

Another behavioral area in which video games seem to result in improved functioning is that of persistence. Ventura, Shute, and Kim (2012) found that gamers show a higher level of persistence in solving complex and challenging problems, such as anagrams and riddles, than non-gamers. Repeated exposure to failure in games promoted persistence and willingness to work hard and try tasks repeatedly due to a lower cost of failure. This is yet another factor that could contribute to improved academic performance.

h. Summary of General Research Aims

Previous studies have shown that VGP may increase students' attentional resources; improve processing speed and working memory; and improve problem solving strategies. If any or all of these improvements can generalize to skills outside of VGP, they would have obvious beneficial effects on academic performance. However, most previous studies in this realm have been exploratory and limited to self-report measures of cognitive abilities. While still correlational, the current study employed objective problem solving and cognitive control tests to replicate and expand upon prior findings that video games improve these cognitive skills, which may be related to academic performance (as measured by grade point average and standardized test scores).

It was expected that moderate VGP in the long-term would be related to increased performance on cognitive control and problem solving tasks due to the cognitive training aspect of VGP.

Current college students likely played video games as children, much more so than in previous generations. Therefore, it is possible that this generation may have VGP related performance effects. Also, more time spent playing games may mean less time spent doing homework, as has been self-reported by students in several studies (Bioulac, Arfi, & Bouvard, 2008; Harris & Williams, 1985). Thus, the current study investigated whether any academic performance effects are related to time management or to other underlying factors.

Previous studies have not fully investigated whether a small proportion of cases account for a significant amount of the variance in these previous findings, perhaps whether individuals on either extreme of VGP habits skew results. Based on previous research, it seems likely that moderate doses of VGP that do not create time management deficits have beneficial effects. However, if played enough to affect time management, VGP could certainly have a negative effect on academic performance. For the current study, results were predicted to show an inverted U-shaped curve effect of VGP on academic performance, with academic performance for moderate VGP exceeding that for extremes in either direction . The study also explored whether there is threshold beyond which VGP may be harmful.

i. Specific Hypotheses

1) Heavy VGP will be associated with stronger cognitive skills such as problem solving and cognitive control. Increased problem solving and cognitive control skills will, in turn, be associated with increased academic performance.
2) The relation of academic performance to VGP will follow an inverted U-shaped curve: performance will decrease as hours spent gaming increases beyond a critical point, with negative effects on time management and assignment completion below the baseline level seen with no playing. Moderate amounts of playing will show a beneficial effect overall.
3) Drug use and ADHD diagnosis will be negatively related to academic performance and cognitive skills.

CHAPTER II. METHODOLOGY

a. Measures

A questionnaire battery, followed by a series of cognitive control and problem solving skills tasks was administered. Tasks included the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) list learning, digit span, and line orientation subtests (Randolph, 1998); the Stroop color word task (Golden, 1978); the Tower of London problem solving task (Shallice, 1982); and a functional fixedness task adapted from Duncker's classic box task (1945). The questionnaire battery included the following measures: a demographic questionnaire, the Gaming Habits Questionnaire (Hellstrom, Nilsson, Leppert, & Aslund, 2012); the Gaming Motivation Scale (GAMS) (Lafreniere, Filion, & Vallerand, 2012); the Game Engagement Questionnaire (GEQ) (Brockmeyer, Fox, Curtiss, McBroom, et al., 2009); and the Time Management Questionnaire (Britton & Tesser, 1991).

b. Surveys

The demographic questionnaire contained questions about age, race, gender, class standing, GPA, ACT/SAT scores (confirmed by Registrar report), video gaming experience, gaming time per week, length of lifetime game playing, type of games played, ADHD or other mental health diagnosis, current medication use, history of head injury, drug use, and exposure to prior testing.

i. Gaming Motivation Scale (GAMS)

Lafreniere, Filion, & Vallerand (2012), developed the Gaming Motivation Scale (GAMS), a 24-item measure rated on a 7 point Likert scale. It measures gaming motivation based on self determination theory and explores intrinsic versus extrinsic motivations for game playing. The GAMS has a reliability of 0.83 (Lafreniere, Filion, & Vallerand, 2012).

ii. Gaming Habits Questionnaire (GHQ)

The Gaming Habits Questionnaire (GHQ) was developed by Hellstrom, Nilsson, Leppert, & Aslund (2012). It is a measure of the time individuals spend playing video games in various settings. The GHQ consists of six multiple part items which are rated on a five-point Likert scale. Sections include gaming problems, gaming reasons, and perceived effects of gaming on academic performance. Reliability has been found to be 0.81 (Hellstrom, et al., 2012).

iii. Game Engagement Questionnaire (GEQ)

Brockmeyer, Fox, Curtiss, McBroom, et al. (2009) developed the Game Engagement Questionnaire (GEQ) as a measure of how invested into gaming individuals may become and what effects this investment may have on other areas of their life. The GEQ is a 19 item measure rated on a 3 point Likert scale. It has been found to have a reliability of 0.85 (Brockmeyer, et al., 2009). Adapted for this study into a 5-point Likert rating scale, it was used to measure participants' depth of gaming experiences and any effects their gaming may have on other areas of functioning.

iv. Time Management Questionnaire (TMQ)

Britton & Tesser (1991) utilized the Time Management Questionnaire (TMQ) in a study of college student academic success. The TMQ consists of 35 items, 18 of which will be utilized in this study. Responses are given on a 5 point Likert rating scale. It has been found to have item reliabilities ranging from 0.42 to 0.79 (Britton & Tesser, 1991). The TMQ was used in this study to determine the time management skills of participants.

c. Tasks

i. Stroop

Participants also completed several brief objective measures of cognitive skills including problem solving, verbal memory, and cognitive control. The Stroop color word task was utilized as a measure of cognitive control. This task includes 300 possible items, but is time-limited. The Stroop task has a reliability of 0.82 (Golden, 1978). In this task, participants are asked to either read text written in opposing colors or to name ink color which is opposed to the text.

ii. Repeatable Battery of Neuropsychological Status (RBANS)

Several subtests from the RBANS were utilized in this study. The RBANS list learning and story memory subtests were utilized as a measure of immediate verbal memory. These tasks include both an immediate and delayed free recall portion, as well as a recognition memory aspect. It consists of four trials of ten items for the word list and two trials of a twelve item story. The ten-item RBANS digit span task and the RBANS coding task measured working memory. The RBANS Picture Naming and Semantic Fluency tasks measured language skills. Finally, the ten-item RBANS line orientation task measured spatial skill ability. The RBANS has been found to have 0.85 reliability (Randolph, 1998).

iii. Tower of London

Problem solving was measured with two classic problem solving tasks – the Tower of London and the Duncker's box functional fixedness problem. The Tower of London has participants rearrange rings among three columns while following certain rules for how the rings may be moved. Time taken to complete the task, in addition to the number of ring movements made, indexes participant skill. A four ring task was utilized in order to minimize the possibility of participants being exposed to the task previously, which is often used as an example in introductory psychology courses but with only three rings (Shallice, 1982).

iv. Duncker's Box

The Duncker's box problem measures functional fixedness by challenging participants to solve a problem that requires non-customary uses for common objects. Participants receive a candle, matches, and a box of tacks; and are told to affix the candle to the wall with these items. Time taken to complete the task measures functional fixedness (Duncker, 1945).

Boot & Simons (2012) put forth several suggestions for appropriate methodology in the study of video gaming. Those relevant to this study include: participants should not know why they are being recruited, such that gamers aren't motivated to perform better in a gaming study or perceive experimental demand characteristics; and minimizing transfer tasks in order to avoid fatigue. However, there is some controversy over this, as Schubert & Strobach (2012), claim that motivation to look good as a gamer cannot account for differences seen in cognitive performance. Regardless, the current study followed the noted guidelines set forth by Boot & Simons (2012) as a general rule to attempt to avoid confounding factors.

d. Participants

208 participants were recruited from undergraduate classes utilizing the Sona software system and fliers placed around campus in public areas. In exchange for their participation, participants were offered their choice of research credit for introductory psychology classes or entry into a raffle to win a gift card to a local store. The study contained both male and female college students at least eighteen years of age. The sample was 68.9% female and 31.1% male. Ages ranged from 18-40, though 92.9% of

participants were between the ages of 18-21. Ethnic breakdown was as follows – 77.5% Caucasian, 12.9% African American, 6.2% Asian, 1.0% Hispanic, and 2.4% other. Consent was obtained from students to receive their standardized test scores and GPA from the university registrar.

Several demographic factors were taken into account in recruiting participants for this study. Males generally tend to play video games more frequently than do females (Williams, Consalvo, Caplan, & Yee, 2009). Thus, gender was determined through a demographic questionnaire and analyzed as a possible covariate. Additionally, older adults tend to spend less time playing video games than younger adults. Thus, age was also controlled for in the case of the non-traditional students in the sample.

e. Procedures

Participants completed measures in the laboratory in a single session. Following consent, participants completed the measures of cognitive performance. The RBANS (Randolph, 1998) list learning and story memory tasks were conducted first to allow time for the delayed memory component later in the study. Following the story memory task, the remaining tasks were administered in counterbalanced fashion to control for fatigue effects. The others were the RBANS line orientation, picture naming, semantic fluency, coding, and digit span, the Stroop color word task, the Tower of London, and the Duncker's box functional fixedness task. At the conclusion of these measures, the questionnaires were administered.

f. Level of VGP Categorizations

Participants were assigned to three groups based on responses to GHQ items related to frequency of VGP - heavy gamers, sometimes gamers, and non-gamers. As with prior studies, heavy gamers were defined as individuals who play video games for at least five hours per week for the last six months. Non-gamers have generally been defined in one of two ways: either as completely game-naive during their lifetime, or as playing less than a set number of hours per week. Thus, these gamers can either be classified as individuals below a threshold (1 hour per week for last 6 months) or as true novices who have never played a video game. For this study, we considered individuals who played 1-4 hours per week on average as sometimes gamers, and individuals who played on average less than one hour per week for the past six months as non-gamers. Group sizes were as follows: 107 non-gamers, 57 heavy gamers, and 44 sometimes gamers.

g. Statistical Analysis

SPSS for Windows was utilized for the statistical analysis. Analyses compared gaming habits and perceptions of those habits with academic performance, test scores, time management, and procrastination. Additionally, performance on the attention and problem solving tasks were compared based on group membership and demographic variables. Substance use was also explored as a cofactor.

CHAPTER III. RESULTS

208 participants completed the study, none who started the procedure discontinued. Observation of participants during the questionnaire process insured no missing data. Some individuals who were non gamers did fill out gaming related questionnaires with neutral responses, these data were thrown out. Demographic variables were analyzed with Chi-squared analyses as possible confounding factors across groups. See table 1 for demographic breakdown by group. Ethnicity and class standing were not found to be significantly related to VGP status, though gender was significantly related at the $p < .01$ level. Table 2 lists the results of Chi-squared analyses of demographic variable effects on gaming group status. Females were more likely to be in the non gaming and sometime gaming groups while males were more likely to be in the heavy gaming and sometime gaming groups. Gender was also significantly related to performance on the following questionnaire measures - gaming engagement, gaming problems, and gaming motivation. See table 3 for comprehensive listing of gender analyses.

<u>a. GEQ</u>

Gaming engagement was significantly positively correlated with gaming problems, gaming motivation, gaming reasons, and alcoholic drinks consumed per week. It was significantly negatively correlated with gender, school performance perceptions, time management, tobacco use, drug use, and ACT score. Also, not surprisingly, heavy gamers (36.7 ± 13.4) were found to have the highest levels of gaming engagement (F [2, 207] = 12.368, $p < .0l$; $\eta^2 = .109$) compared to sometimes gamers (33.6 ± 13.41). Non-gamers were not asked to complete the measure of gaming engagement. Gaming engagement was also significantly related to gender (F [1, 207] = 12.867, $p < .0l$; $\eta^2 = .060$), as males (35.47 ± 1.6) reported higher levels of gaming engagement than females (28.50 ± 1.2).

b. GAMS

Gaming motivation was significantly positively correlated with gaming reasons, gaming problems, gaming engagement, alcohol use, and Line Orientation. It was significantly negatively correlated with gender, Story Memory improvement, and time management. Heavy gamers (40.5 ± 11.31) were also found to have the highest levels of gaming motivation (F [2, 205] = 3.81, $p = .02$; $\eta^2 = .009$) compared to sometimes gamers (37.7 ± 13.06). Non-gamers did not complete this measure.

c. GHQ

GHQ results were used to divide participants into groups and to measure gaming problems and reasons for playing video games. The gaming problems section of the GHQ was significantly positively correlated with VGP status, gaming engagement, gaming motivation, alcohol use, Line Orientation, and gaming reasons; while it was significantly negatively correlated with gender, time management, ToL time, and ToL moves. The gaming reasons section was significantly positively correlated with VGP status, gaming motivation, gaming engagement, gaming problems, Story Memory retention, List Recognition, Duncker's box time, and Story Recall; while it was significantly negatively correlated with time management, gender, and Story Memory improvement. The gaming school performance perception section was significantly positively correlated with Picture Naming, while it was significantly negatively correlated with gaming engagement. Gaming problems and gaming reasons were significantly related to VGP status. Heavy gamers (9.0 ± 3.27) reported the greatest number of problems related to their game playing compared to sometime gamers (8.2 ± 2.7) and non gamers (7.2 ± 0.68), (F [2, 131] = 6.30, p = .02; ; $\eta^2 = .042$). Similarly, heavy gamers (40.47 ± 1.23) reported the higher scores on reasons for gaming compared to sometime gamers (36.62 ± 1.48), (F [1, 140] = 3.975, p = .02; ; $\eta^2 = .056$).

d. TMQ

Time management was significantly positively correlated with GPA, List Recall, gender, VGP status, and List Learning improvement. It was significantly negatively correlated with ADHD status, gaming problems, gaming engagement, gaming reasons, and gaming motivation. Sometime video game players (63.0 ± 8.05) were found to perform better on a measure of time management (F [2, 205] = 4.15, p = .017; $\eta^2 = .023$) than were heavy gamers (58.3 ± 9.27) and non-gamers (61.8 ± 9.05).

e. Cognitive Skills

The relationship between gaming group status and performance on cognitive measures and gaming questionnaires were analyzed utilizing one-way ANOVAs. An ANOVA was performed for each measure given, based on group status and gender. Significant findings are described below, and full results may be found in tables 4 and 5.

f. Stroop

Accuracy was significantly related to VGP status (F [2,207] = 3.17, p = .044; η^2 = .03). Sometime gamers (0.954 ± 0.017) were more accurate on the Stroop than were heavy (0.91 ± 0.011) and non-gamers (0.949 ± 0.014). Tukey post-hoc tests showed that heavy gamers were significantly worse than sometime gamers (p = .034) and marginally worse than non gamers (p = .073). Stroop time or fluency was marginally related to VGP status (F [2,207] = 2.701, p = .070; η^2 = .026). Sometime gamers responded fastest (1087.89 ± 212.29) compared to non gamers (1170.38 ± 253.35) and heavy gamers (1190.67 ± 319.34).

g. RBANS

i. Memory

Sometime gamers (5.6 ± 1.62) performed better than heavy (5.5 ± 1.56) and non-gamers (5.3 ± 1.46) on a measure of memory (List Learning Retention) (F [7, 200] = 2.21, p = .035). Story Memory improvement (F [2,205] = 3.520, p = .031; η^2 = .034) was also significantly related to VGP status. Non-gamers (3.72 ± 1.86) improved performance on Story Memory across trials the most, followed by heavy gamers (3.25 ± 1.92) and sometime gamers (3.15 ± 1.77). List Learning retention, List Recall, and Immediate Memory - Language Index discrepancies were related to gender. Females (82.90 ± 1.75; 5.7 ± 0.16) performed better on List Learning retention (F [1,207] = 5.780, p = .017; η^2 = .028) and List Recall (F [1,207] = 6.341, p = .013; η^2 = .030) compared to males (75.88 ± 2.33; 5.0 ± 0.22). Females (15.80 ± 1.84) also exhibited a larger discrepancy between Immediate Memory and Language Index scores than males (9.14 ± 2.45) (F [1,204] = 4.748, p = .031; η^2 = .023). Interaction effects between VGP and gender were found for

Story Memory Improvement (F [2,205] = 4.682, p = .01; η^2 = .045). Male non gamers performed best while heavy gamers showed the best performance for females. However, group differences were non-significant when analyzed with a Tukey test. See Figure 1 for means and an illustration of the interaction effect. Group differences on the remaining measures of memory were not found to be significant.

ii. Language

Performance in this area was not found to be related to VGP status. The overall Language Index (F [1,204] = 4.393, p = .037; η^2 = .022) and Picture Naming subtest (F [1,204] = 3.930, p = .049; η^2 = .019) were related to gender. Males (96.57 ± 2.01; 5.23 ± 0.25) performed better on both the Language Index and Picture Naming task compared to females (91.30 ± 1.52; 4.61 ± 0.19). Group differences on the remaining measures of language were not found to be significant.

iii. Spatial Skills

Heavy gamers (5.5 ± 1.35) performed best on a measure of spatial skills (Line Orientation), followed by sometime gamers (5.0 ± 1.69) and non-gamers (4.8 ± 1.70), (F [2, 205] = 3.29, p = 0.39). Line Orientation was related to gender (F [1,207] = 4.952, p = .027; η^2 = .024). Males (5.60 ± 0.22) performed better on this task than females (4.98 ± 0.17).

iv. Attention

Digit Span longest string (F [2,207] = 4.374, p = .014; η^2 = .042), Digit Span (F [2,207] = 4.840, p = .009; η^2 = .046), Attention Index (F [2,205] = 3.439, p = .034; η^2 = .033), and Attention - Language Index discrepancies (F [2,204] = 3.425, p = .034; η^2 = .033) were related to VGP status. Sometime gamers (7.29 ± 0.19; 10.93 ± 0.45; 108.90 ± 2.15) performed best on Digit Span longest string; Digit Span; and Attention Index, followed by non-gamers (6.83 ± 0.18; 9.87 ± 0.42; 102.15 ± 1.99) and heavy gamers (6.55 ± 0.16; 9.09 ± 0.38; 102.36 ± 1.82). Sometime gamers (16.37 ± 3.01) also showed the largest discrepancy between Attention and Language Index scores, followed by heavy gamers (9.29 ± 2.56) and non-gamers (5.76 ± 2.80). Digit Span longest string ($F [1,207] = 7.923$, $p < .01$; $\eta^2 = .038$) and Digit Span ($F [1,207] = 12.071$, $p < .01$; $\eta^2 = .056$) were related to gender. Males (10.81 ± 0.39; 7.18 ± 0.16) performed better than females (9.12 ± 0.29; 6.60 ± 0.12) on Digit Span and Digit Span longest string. Interaction effects between VGP and gender were found for Attention Index ($F [2,205] = 4.099$, $p = .02$; $\eta^2 = .039$). Sometime male gamers performed significantly better than did any other group. However, once again Tukey post-hoc analysis showed no significance. See figure 2 for means and an illustration of the interaction effect. Group differences on the remaining measures of attention were not found to be significant.

<u>f. Problem Solving</u>

i. Tower of London

No in either speed or accuracy of performance on this task.

ii. Duncker's Box

On this task, no significance was found for VGP status, gender, or VGP status – gender interaction was found in either speed or accuracy of performance across groups.

<u>g. Academic Performance</u>

Interaction effects between VGP and gender were found for registrar reported cumulative GPA ($F [2,206] = 3.189$, $p = .043$; $\eta^2 = .031$). Male sometime gamers had a higher GPA than heavy gamers and non-gamers. Female heavy gamers had a higher GPA than sometime and non-gamers. See figure 3 for means and an illustration of the interaction effect. No other academic performance measures were found to be significantly related to variables of interest.

h. Substance Use

Alcohol use was significantly positively correlated with gaming problems, drug use, gaming engagement, tobacco use, gaming motivation; and negatively correlated with Duncker's box, Duncker's box accuracy, Semantic Fluency, Language Index, gender, GPA, and ACT score. Tobacco use was positively correlated with drug use, gender, gaming motivation, ADHD diagnosis, Stroop Accuracy, Digit Span longest string, and Duncker's box time; and negatively correlated with gaming engagement, List Learning, Immediate Memory Index, and Story Memory. Drug use was positively correlated with gender, and ADHD diagnosis; and negatively correlated with gaming engagement, Picture Naming, List Learning, and Immediate Memory.

i. Attention Deficit/Hyperactivity Disorder

Attention Deficit/Hyperactivity Disorder (ADHD) diagnosis status was significantly positively correlated with Stroop time and significantly negatively correlated with time management, GPA, Immediate Memory Index, Story Recall, List Learning, Story Memory, Attention Index, and List Recall.

j. Measure Intercorrelations

See tables 6 and 7 for correlations between measures utilized in the study. Table 6 lists correlations among questionnaires while table 7 lists correlations between cognitive skill measures utilized in this study. The TMQ was found to be negatively correlated with the GAMS, GEQ, and gaming problems and gaming reasons sections of the GHQ. It thus appears that time management shares an inverse relationship with the level of immersion in the gaming experience. The GEQ, GAMS, and gaming problems and gaming reasons sections of the GHQ were all positively correlated, suggesting that gaming problems exhibit a positive relationship with level of immersion in the gaming experience. The gaming school performance section of the GHQ was negatively correlated with the GAMS and GEQ, suggesting that individuals who are more immersed in their gaming perceive that gaming affects their academic performance in a negative way, despite the lack of objective evidence to support this belief.

CHAPTER IV. DISCUSSION

The findings from this correlational study counter the once-polarized view that VGP is harmful by suggesting that VGP effects are much more complex. VGP was positively associated with skills strongly related to academic success, such as time management, attention, executive control, memory, and spatial abilities – when VGP occurs in moderation. However, as VGP frequency increases beyond a critical point, gaming engagement and problems associated with gaming rise and, coupled with deficits in time management, may counterbalance these gains.

The effects of VGP on time management may be related to an alteration in time perception. Rivero, et al. (2013) suggested that VGP may lead to alterations in neural pathways that may in turn make individuals more sensitized to the passage of time. It is also very likely that, as seen in the current study, level of engagement in the gaming environment may be a strong factor on time loss and thus time management.

VGP may lead to improved problem solving and cognitive skills based on increased initiative related to cumulative goal directed effort, training of directed concentration, increased creativity and reasoning skills, improved information processing, and increased intrinsic motivation (Holbert & Wilensky, 2014; Fabricatore & Lopez, 2013; Powers, et al., 2013; Adachi & Willoughby, 2012; Gee, 2005). VGP requires individuals to alter strategies and attempt multiple solutions to problems, which can lead to increased problem solving abilities. VGP also trains individuals with a methodology that skills often build upon one another and may be utilized in new ways as they advance. This may be translated into problem solving in non-VGP arenas as well.

VGP effects on cognitive skills could result from several possible modalities. Increased visual sensitivity, enhanced memory capacity, and increased high level decision making have all been suggested as possibilities. However, VGP has been shown to improve visual sensitivity but not cause alterations in visual sensory memory (Applebaum, et al., 2013). Given the findings of the current study, improved decision making and problem solving skills do appear to play a significant role in cognitive skill development related to VGP. This may well be due to increased resilience and effort perseverance which is ingrained in VGP. Additionally, given that iconic memory and attention are linked and use similar neurological pathways, it is possible that exhibited improvements in memory following VGP may in fact also be related to improved attentional skills developed by the multitasking demanded by the game environments, thus improving attentional efficiency. Perception of these improvements by game players may also help lead to something of a self-fulfilling prophecy, as gamers often believe that playing games improves their memory, response time, and visuospatial skills (Whitbourne, et al., 2013).

As educational games are becoming more popularly utilized in academic settings, it is important to study other possible effects of VGP, both positive and negative. This study suggests that VGP in moderation may lead to improvements in cognitive skills which may translate to the classroom; however, overuse of VGP may subsequently lead to declines in performance as well. Students need to become more educated about the possible consequences of overindulging in VGP, but also suggests that students and educators alike could effectively take advantage of VGP as a skill-building exercise.

Gender was found to be a significant factor in several areas of this study. Male participants were more likely to be more heavily engaged in and to report higher levels of motivation to engage in VGP, while also reporting higher numbers of problems related to their VGP compared to females. Males were also more likely to engage in more frequent VGP than females. Gender differences were also seen in task performances. Females exhibited better memory and self-reported time management, while males showed better performance on measures of language, attention, and spatial skills. Interaction effects were seen as well, in which males in the sometime gaming category tended to perform best on measures while females in the sometime gaming category tended to perform worst. Males generally showed an inverted U-performance curve; sometime gamers performed best while heavy gamers and non-gamers showed lesser performance. However, females exhibited the opposite pattern - sometime gamers performed worse while heavy gamers and non gamers performed better. One possible explanation for this is that the time management effects shown by males were not as applicable to females given that females already had a higher level of time management to begin with. It is not readily apparent what would cause a decline in performance among sometime gamer females compared to the other two groups however. Perhaps given the fact that in this sample females seemed to perform worse on most measures overall, the greater effects on performance of heavy gaming was needed to show improvement in performance compared to the more moderate effects of sometime gaming, while females better time management provided a protective effect against the skill loss males with lesser time management saw as their gaming habits moved into the heavy gaming range.

Several limitations were inherent within this study which could be addressed with future studies. Unfortunately, gender balancing of groups was difficult due to the majority of non-gamers presenting as females throughout the study. This led to a confounding factor in which gender affected performance on several measures of cognitive skills and also exhibited interaction effects with VGP status. Better controlling of group membership and balancing groups equally could help strengthen future findings. Also, the use of a large number of measures necessitated analysis with a large number of statistical tests, increasing the likelihood of some findings being due to chance. Additionally, this study took a cross-sectional approach in comparing between groups of differing gaming experience. Training a group of novice gamers with VGP and then measuring within subject differences across time would help to show a stronger link of causality between VGP and cognitive effects that it may have.

REFERENCES CITED

Adachi, P, & T. Willoughby (2013). More than just fun and games: The longitudinal relationship between strategic video games, self-reported problem solving skills, and academic grades. *Journal of Youth & Adolescence*, published online January 24, 2013.

Adachi, P., & T. Willoughby (2012). Do Video Games Promote Youth Development? *Journal of Adolescent Research, 28,* 2, 155-165.

Anand, V. (2007). A study of time management: The correlation between video game usage and academic performance markers. *Cyberpsychology and Behavior, 10*, 4, 552-559.

Anderson, C. & K. Dill (2000). Video games and aggressive thoughts, feelings and behavior in the laboratory and in life. *Journal of Personality and Social Psychology, 78*, 772-790.

Anderson, C., Gentile, D., & K. Buckley (2007). *Violent video game effects on children and adolescents: Theory, research, and public policy*. New York, NY, USA. Oxford University Press.

Andrews, G., & K. Murphy (2006). Does video game playing improve executive functioning? *Frontiers in Cognitive Psychology*. Vanchevsky, M. (ed.) Hauppauge, NY, USA. Nova Science Publishers. pp. 145-161.

Applebaum, L., Cain, M., Darling, E., & S. Mitroff (2013). Action Video Game Playing is Associated with Increased Visual Sensitivity but not Alterations in Visual Sensory Memory. *Attention, Perception, and Psychophysiology*, 75, 1161-1167.

Ashkenazi, S., & A. Henik (2012). Does attentional training improve numerical processing in developmental dyscalculia? *Neuropsychology, 26*, 1, 45-56.

Baniqued, P., Lee, H., Voss, M., Basak, C., Cosman, J., DeSouza, S., Severson, J., Salthouse, T., & A. Kramer (2013). Selling points: What cognitive abilities are tapped by casual video games? *Acta Psychologica, 142*, 74-86.

Barlett, C., Vowels, C., Shanteau, J., Crow, J., & T. Miller (2009). The effect of violent and non-violent computer games on cognitive performance. *Computers in Human Behavior, 25*, 96-102.

Best, J. (2012). Exergaming immediately enhances children's executive function. *Developmental Psychology, 48*, 5, 1501-1510.

Bioulac, S., Arfi, L., & M. Bouvard (2008). Attention deficit/hyperactivity disorder and video games: A comparative study of hyperactive and control children. *European Psychiatry, 23*, 134-141.

Blumberg, F. (2011). Ramifications of video game play for academic learning and cognitive skill acquisition: Introduction. *Child Development Perspectives, 5*, 2, 73-74.

Blumberg, F. (1998). Development differences at play: Children’s selective attention and performance in computer games. *Journal of Applied Developmental Psychology, 19*, 615-624.

Boot, W., & D. Simons (2012). Advances in video game methods and reporting practices (but still room for improvement): A commentary on Strobach, Frensch, and Schubert (2012). *Acta Psychologica, 141*, 276-277.

Boot, W., Kramer, A., Simons, D., Fabiani, M., & G. Gratton (2008). The effects of video game playing on attention, memory, and executive control. *Acta Psychologica, 129*, 3, 387-298.

Bowman, R., and J. Rotter (1983). Computer games: Friend or foe? *Elementary School Guidance and Counseling, 18*, 25-34.

Britton, B. & A. Tesser (1991). Effects of Time-Management Practices on College Grades. *Journal of Educational Psychology, 83*, 3, 405-410.

Brockmeyer, J., Fox, C., Curtiss, K., McBroom, E., Burkhart, K., & J. Pidruzny (2009). The development of the Game Engagement Questionnaire: A measure of engagement in video-game playing. *Journal of Experimental Social Psychology, 45*, 624-634.

Buckley, K., & C. Anderson (2006). *A theoretical model of the effects and consequences of playing video games*. In "Playing Video Games: Motives, responses, and consequences. Vorderer, P. (ed.) Mahwah, NJ, USA. Lawrence Erlbaum Associates Publishers, pp. 363-378.

Burgess, S., Stermer, S., & M. Burgess (2012). Video game playing and academic performance in college students. College Student Journal, 46, 2, 376-387.

Castel, A., Pratt, J., & E. Drummond (2005). The effects of action video game experience on the time course of inhibition of return and the efficiency of visual search. *Acta Psychologica, 119*, 217-230.

Din, F. & J. Calao (2001). The effects of playing educational video games on kindergarten achievement. *Child Study Journal, 31*, 2, 95-102.

Donohue, S., James, B., Eslick, A., & S. Mitroff (2012). Cognitive pitfall! Videogame players are not immune to dual-task costs. *Attention, Perception, and Psychophysics, 74*, 803-809.

Doolittle, J. (1995). Using riddles and interactive computer games to teach problem-solving skills. *Teaching of Psychology, 22*, 1, 33-36.

Drew, B., & J. Waters (1986). Video games: Utilization of a novel strategy to improve perceptual motor skills and cognitive functioning in the non-institutionalized elderly. *Cognitive Rehabilitation, 4*, 2, 26-31.

Druckman, D. (1995). The educational effectiveness of interactive games. Simulation and gaming across disciplines and cultures: ISAGA at a watershed. Crookall, David (Ed.); Arai, Kiyoshi (Ed.); pp. 178-187. Thousand Oaks, CA, US: Sage Publications, Inc, 1995. xxix, 288 pp.

Duncker, K (1945). On problem-solving. *Psychology Monograms, 58*, No. 5 (Whole No. 270).

Durkin, K., & K. Barber (2002). Not so doomed: Computer game play and positive adolescent development. *Journal of Applied Developmental Psychology, 23*, 373-392.

Dustman, R., Emmerson, R., Steinhaus, L., & D. Shearer (1992). The effects of videogame playing on neuropsychological performance of elderly individuals. Journals of Gerontology, 47, 3, 168-171.

Entertainment Software Association (2012) "Essential facts about the computer and video game industry." Available at www.theesa.com/facts/index.php (accessed March 29, 2013).

Fabricatore, C., & X. Lopez (2013). Fostering Creativity through Educational Video Game Development Projects: A Study of Contextual and Task Characteristics. *Creativity Research Journal, 25*, 4, 418-425.

Faul, F., Erdfelder, E., Georg-Lang, A., & A. Buchner (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*, 2, 175-191.

Feng, J., Spence, I., & J. Pratt (2007). Playing an action video game reduces gender differences in spatial cognition. *Psychological Science, 18*, 10, 850-855.

Ferguson, C. (2007). The good, the bad, and the ugly: A meta-analytic review of positive and negative effects of violent video games. *The Psychiatric Quarterly, 78*, 309-316.

Ferguson, C., Cruz, A., & S. Rueda (2008). Gender, video game playing habits and visual memory tasks. *Sex Roles*, *58*, 279-286.

Ferguson, C. (2013). Violent video games and the Supreme Court: Lessons for the scientific community in the wake of Brown v. Entertainment Merchants Association. *American Psychologist*, *68*, 2, 57-74.

Ferguson, C., Garza, A., Jerabeck, J., Ramos, R., & M. Galindo (2013). Not worth the fuss after all? Cross-sectional and prospective data on violent video game influences on aggression, visuospatial cognition and mathematics ability in a sample of youth. *Journal of Youth & Adolescence*, *42*, 109-122.

Gee, J. (2005). Good Video Games and Good Learning. *Phi Kappa Phi Forum, 85*, 33-37.

Gentile, D., Swing, E., Lim, C., & A. Khoo (2012). Video Game Playing, Attention Problems, and Impulsiveness: Evidence of Bidirectional Causality. *Psychology of Popular Media Culture, 1*, 62-70.

Golden, C (1978). *Stroop Color and Word Test: A Manual for Clinical and Experimental Uses*. Chicago, Illinois: Skoelting. pp 1-32.

Goldstein, J., Cajko, L., Oosterbroek, M., Michielsen, M., van Houten, O., & F. Salverda (1997).Video games and the elderly. *Social Behavior and Personality, 25*, 4, 345-352.

Granic, I., Lobel, A., & R. Engels (2013). The benefits of playing video games. *American Psychologist*, Advance online publication, 1-13.

Green, S., & D. Bavalier (2003). Action video game modifies visual selective attention. *Nature, 423*, 534-537.

Green, S., & D. Bavalier (2006). Enumeration versus multiple object tracking: The case of action video game players. *Cognition, 101*, 217-245.

Green, S., & D. Bavalier (2007). Action-video game experience alters the spatial resolution of vision. *Psychological Science, 18*, 88-94.

Greenfield, P., Brannon, G., & D. Lohr (1994). Two-dimensional representation of movement through three-dimensional space: The role of video game expertise. *Journal of Applied Developmental Psychology, 15*, 1, 87-103.

Griffiths, M. (1999). Violent computer games and aggression: A review of the literature. *Aggression and Violent Behavior, 4,* 203-212.

Hamlen, K. (2012). Stochastic frontier estimation of efficient learning in video games. *Computers & Education, 58*, 534-541.

Hamlen, K. (2012). Academic dishonesty and video game play: Is new media use changing conceptions of cheating? *Computers & Education, 59*, 1145-1152.

Harris, M. & R. Williams (1985). Video games and school performance. *Education, 105*, 3, 306-309.

Hellstrom, C., Nilsson, K., Leppert, J., & C. Aslund (2012). Influences of motives to play and time spent gaming on the negative consequences of adolescent online computer gaming. *Computers in Human Behavior, 28*, 1379-1387.

Holbert, N., & U. Wilensky (2014). Constructible authentic representations: Designing video games that enable players to utilize knowledge developed in game to reason about science. *Technology, Knowledge, and Learning, 1*, 1-27.

Hubbard, P. (1991). Evaluating computer games for language learning. *Simulation and Gaming, 22*, 2, 220-223.

Irons, J., Remington, R., & J. McLean (2011). Not so fast: Rethinking the effects of action video games on attentional capacity. *Australian Journal of Psychology, 63*, 4, 224-231.

Jak, A., Seelye, A., & S. Jurick (2013). Crosswords to computers: A critical review of popular approaches to cognitive enhancement. *Neuropsychological Review, 23*, 13-26.

James, L., Phillips, J., & C. Best (2011). Effect of brain-training and gaming on fluid intelligence. *Journal of CyberTherapy and Rehabilitation, 4*, 4, 433-445.

Kearney, P. (2005). Cognitive calisthenics: Do FPS computer games enhance the player's cognitive abilities? In: Proceedings from the DiGRA World Conference.

Koepp, M., Gunn, R., Lawrence, A., Cunningham, V., Dagher, A., Jones, T, Brooks, D., Bench, C., & P. Grasby (1998). Evidence for striatal dopamine release during a videogame. *Nature Magazine, 393,* 266-268.

Krishnan, L., Kang, A., Sperling, G., & R. Srinivasan (2013). Neural Strategies for Selective Attention Distinguish Fast-Action Video Game Players. *Brain Topography, 26*, 83-97.

Lafreniere, M., Filion, J., & R. Vallerand (2012). Development and validation of the Gaming Motivation Scale (GAMS). *Personality and Individual Differences, 53*, 827-831.

Lee, H., Boot, W., Basak, C., Voss, M., Prakash, R., Neider, M., Erickson, K., Simons, D., Fabiani, M., Gratton, G., Low, K., & A. Kramer (2012). Performance gains from directed training do not transfer to untrained tasks. *Acta Psychologica, 139*, 146-158.

Lee, K., & W. Peng (2006). *What do we know about social and psychological effects of video games? A comprehensive review of the current literature*. In: Playing Video Games: Motives, responses, and consequences. Vorderer, P. (Ed.) Mahwah, NJ, USA. Lawrence Erlbaum Associates Publishers, pp. 327-345.

Lenhart, A., Kahne, J., Middaugh, E., Macgill, A., Evans, G., & J. Vitak (2008). Teens, Video Games, and Civics. *Report No. 202-415-4500*. Washington D.C.: Pew Internet American Life Project

Lieberman, D., Chaffee, S., & D. Roberts (1988). Computers, mass media, and schooling: Functional equivalence in uses of new media. *Social Science Computer Review, 6*, 224-241.

Lim, S., & L. Holt (2011). Learning foreign sounds in an alien world: Videogame training improves non-native speech categorization. *Cognitive Science, 35*, 7, 1390-1405.

Maillot, P., Perrot, A., & A. Hartley (2012). Effects of interactive physical-activity video-game training on physical and cognitive function in older adults. *Psychology and Aging, 27*, 3, 589-600.

Nelson, R., & I. Strachan (2009). Action and puzzle video games prime different speed/accuracy tradeoffs. *Perception, 38*, 1678-1687.

Nouchi, R., Taki, Y., Takeuchi, H., Hashizume, H., Akitsuki, Y., Shigemune, Y., Sekiguchi, A., Kotozaki, Y., Tsukiura, T., Yomogida, Y., & R. Kawashima (2012). Brain training game improves executive functions and processing speed in the elderly: A randomized controlled trial. *PLoS ONE 7*, 1, e29676. doi:10.1371/journal.pone.0029676.

Ogletree, S., & R. Drake (2007). College students' video game participation and perceptions: Gender differences and implications. *Sex Roles, 56*, 537-542.

Powers, K., Brooks, P., Aldrich, N., Palladino, M., & L. Alfieri (2013). Effects of Video-game Play on Information Processing: A Meta-analytic investigation. *Psychology Bulletin Review, 20*, 1055-1079.

Randolph, C. (1998). *Repeatable Battery for the Assessment of Neuropsychological Status (RBANS)*. San Antonio, TX: Psychological Corporation.

Ricci, K., Salas, E., & J. Cannon-Bowers (1996). Do computer-based games facilitate knowledge acquisition and retention? *Military Psychology, 8*, 4, 295-307.

Rivero, T., Covre, P., Reyes, M., & O. Bueno (2013). Effects of chronic video game use on time perception differences between sub and multi-second intervals. *Cyberpsychology, Behavior, and Social Networking, 16*, 2, 140-144.

Roe, K., & D. Muijs (1998). Children and computer games: A profile of the heavy user. *European Journal of Communication, 13*, 181-200.

Sassi, R. (2012). Game on: Is there a role for video games in clinical care? *Journal of the American Academy of Child and Adolescent Psychiatry, 51*, 7, 662.

Scantlin, R. (2000). Interactive media: An analysis of children's computer and video game use. Dissertation Abstracts International: Section B: The Sciences and Engineering, 60, 12-B, pp. 6400.

Schubert, T., & T. Strobach (2012). Video game experience and optimized executive control skills – On false positives and false negatives: Reply to Boot and Simons (2012). *Acta Psychologica, 141*, 278-280.

Shallice, T (1982). Specific impairments of planning. *Philosophical Transactions of the Royal Society of London, Biology*, 298, 199-209.

Spires, H. Rower, J., Mott, B., & J. Lester (2011). Problem solving and game-based learning: Effects of middle grade students' hypothesis testing strategies on learning outcomes. *Journal of Educational Computing Research, 44*, 4, 453-472.

Strobach, T., Frensch, P., & T. Schubert (2012). Video game practice optimizes executive control skills in dual-task and task switching situations. *Acta Psychologica, 140*, 13-24.

Tannahill, N., Tissington, P., & C. Senior (2012). Video Games and Higher Education: What can "Call of Duty" Teach our Students? *Frontiers in Psychology, 3*, 1-3.

Terlecki, M., & N. Newcombes (2005). How important is the digital divide? The relation of computer and videogame usage to gender differences in mental rotation ability. *Sex Roles, 53*, 433-441.

Van Eck, R. (2011). Bringing discipline to the study of games and learning. *Information Design Journal, 19*, 2, 181-187.

Ventura, M., Shute, V., & Y. Kim (2012). Video game play, personality and academic performance. *Computers & Education, 58*, 1260-1266.

Ventura, M. Shute, V., & W. Zhao (2013). The relationship between video game use and a performance-based measure of persistence. *Computers & Education, 60*, 52-58.

Voss, M., Prakash, R., Erickson, K., Boot, W., Basak, C., Neider, M., Simons, D., Fabiani, M., Gratton, G., & A. Kramer. (2012). Effects of training strategies implemented in a complex videogame on functional connectivity of attentional networks. *Neuroimage, 59*, 138-148.

Voulgari, I., & V. Komis (2010). 'Elven elder LVL59 LFP/RB. Please PM me.' Immersion, collaborative tasks, and problem-solving in massively multiplayer online games. *Learning, Media, and Technology, 35*, 2, 171-202.

Whitbourne, S., Ellenburg, S., & K. Akimoto (2013). Reasons for playing casual video games and perceived benefits among adults 18 to 80 years old. *Cyberpsychology, Behavior, and Social Networking, 16*, 12, 892-897.

Wiebe, J., & N. Martin (1994). The impact of a computer-based adventure game on achievement and attitudes in geography. *Journal of Computing in Childhood Education, 5*, 1, 61-71.

Williams, D., Consalvo, M., Caplan, S., & N. Yee (2009). Looking for Gender: Gender Roles and Behaviors among Online Gamers. *Journal of Communication*, *59*, 700-725.

Willoughby, T. (2008). A short-term longitudinal study of internet and computer game use by adolescent boys and girls: Prevalence, frequency of use, and psychosocial predictors. *Developmental Psychology, 44*, 1, 195-204.

Wood, R., Griffiths, M., & A. Parke (2007). Experiences of time loss among videogame players: An empirical study. *CyberPsychology and Behavior, 10*, 1, 38-44.

Yang, M., Roskos-Ewoldsen, D., Dinu, L., & L. Arpan (2006). The effectiveness of “in-game” advertising. Comparing college students’ explicit and implicit memory for brand names. *Journal of Advertising, 35*, 4, 143-152.

LIST OF APPENDICES

APPENDIX A: TABLE 1. BACKGROUND AND BASELINE INFORMATION AS A FUNCTION OF CONDITION

Table 1

Background and baseline information as a function of condition

	Heavy Gamers (n = 57)	Sometime Gamers (n = 44)	Non Gamers (n = 107)
Age (in years)	18.94 (SD = 1.93)	19.39 (SD = 3.57)	18.72 (SD = 1.02)
Gender			
Female	20	27	95
Male	37	17	12
Ethnicity			
African American	12	6	10
Asian	3	5	5
Caucasian	41	32	88
Hispanic/Latino	1	0	1
Other	0	1	3
Year in school			
Freshman	32	26	73
Sophomore	18	10	19
Junior	7	7	13
Senior	0	1	2

APPENDIX 2. TABLE 2. CHI-SQUARED ANALYSIS OF DEMOGRAPHIC VARIABLES BY VGP STATUS

Table 2

Chi-Squared analysis of Demographic Variables by VGP Status

	Heavy Gamer	Sometime Gamer	Non-Gamer	*p*
Gender				< .01*
Male	64.9%	37.5%	10.8%	
Female	35.1%	62.5%	89.2%	
Ethnicity				.10
African American	22.6%	14.7%	9.8%	
Caucasian	77.4%	85.3%	90.2%	
Class Standing				.36
Freshman	57.7%	57.9%	69.4%	
Sophomore	30.8%	23.7%	18.5%	
Upper Classmen	11.5%	18.4%	12.0%	

APPENDIX 3: TABLE 3. ANALYSES OF VARIANCE FOR TASKS AND MEASURES WITH VGP STATUS BY GENDER INTERACTION

Table 3

Analyses of Variance for tasks and measures with VGP status by Gender interaction

	F	*p*	η^2
Tower of London time	0.335	0.72	0.003
Tower of London moves	0.355	0.70	0.004
Duncker's box accuracy	0.848	0.43	0.008
Duncker's box time	0.522	0.59	0.005
Stroop time	0.876	0.42	0.009
Stroop accuracy	0.902	0.41	0.009
RBANS			
List Learning Improvement across trials	2.818	0.06	0.027
Story Memory Improvement across trials	4.682	0.01*	0.045
Digit Span longest string	1.855	0.16	0.018
List Learning Retention	0.152	0.86	0.002
Story Memory Retention	0.412	0.66	0.004
Immediate Memory Index	0.133	0.88	0.001
List Learning	1.233	0.29	0.012
Story Memory	0.11	0.90	0.001
Line Orientation	1.507	0.22	0.015
Language Index	0.267	0.77	0.003
Picture Naming	0.145	0.87	0.001
Semantic Fluency	0.682	0.51	0.007
Attention Index	4.099	0.02*	0.039
Digit Span	2.062	0.13	0.02
Coding	2.184	0.12	0.021
List Recall	0.179	0.84	0.002
List Recognition	0.196	0.82	0.002
Story Recall	0.015	0.99	0
IM to ATT discrepancy	1.961	0.14	0.019

IM to LAN discrepancy	0.064	0.94	0.001
ATT to LAN discrepancy	1.926	0.15	0.019
Resident GPA	0.701	0.50	0.007
Cumulative GPA	3.189	0.04	0.031
ACT Score	0.318	0.73	0.003
SAT Score	1.182	0.31	0.012
TMQ	2.266	0.11	0.022
Gaming Problems	0.493	0.61	0.008
Gaming Engagement	0.451	0.64	0.004
Gaming Reasons	0.452	0.64	0.007
Gaming School Performance	0.541	0.59	0.015
Gaming Motivation	0.29	0.75	0.003
GAMS Intrinsic Motivation	0.681	0.51	0.007
GAMS Integrated Regulation	1.587	0.21	0.015
GAMS Identified Regulation	0.174	0.84	0.002
GAMS Introjected Regulation	0.917	0.40	0.009
GAMS External Regulation	0.891	0.41	0.009
GAMS Amotivation	0.123	0.89	0.001

APPENDIX 4: TABLE 4. ANALYSIS OF VARIANCE FOR TASKS AND MEASURES WITH GAMING STATUS GROUP AS INDEPENDENT VARIABLE

Table 4
Analysis of Variance for tasks and measures with gaming status group as independent variable

	F	*p*	η^2
Tower of London time	0.786	0.46	0.008
Tower of London moves	0.679	0.51	0.007
Duncker's box accuracy	1.989	0.14	0.019
Duncker's box time	0.988	0.37	0.01
Stroop time	2.701	0.07*	0.026
Stroop accuracy	3.169	0.04*	0.03
RBANS			
List Learning Improvement across trials	3.278	0.04*	0.031
Story Memory Improvement across trials	3.52	0.03*	0.034
Digit Span longest string	4.37	0.01*	0.042
List Learning Retention	1.448	0.24	0.014
Story Memory Retention	1.286	0.28	0.013
Immediate Memory Index	0.211	0.81	0.002
List Learning	0.577	0.56	0.006
Story Memory	0.182	0.83	0.002
Line Orientation	0.819	0.44	0.008
Language Index	0.952	0.39	0.009
Picture Naming	2.119	0.12	0.021
Semantic Fluency	0.374	0.69	0.004
Attention Index	3.439	0.03*	0.033
Digit Span	4.84	0.01*	0.046
Coding	1.339	0.26	0.013
List Recall	1.174	0.31	0.011
List Recognition	0.333	0.72	0.003
Story Recall	0.233	0.79	0.002
IM to ATT	1.095	0.34	0.011

discrepancy			
IM to LAN discrepancy	1.21	0.30	0.012
ATT to LAN discrepancy	3.425	0.03*	0.033
Resident GPA	0.504	0.61	0.005
Cumulative GPA	3.189	0.04*	0.031
ACT Score	1.152	0.32	0.011
SAT Score	1.884	0.16	0.018
TMQ	4.15	0.02	0.023
GAMS Total	3.81	0.02	0.009
GAMS Intrinsic Motivation	6.341	< 0.01*	0.059
GAMS Integrated Regulation	0.308	0.74	0.003
GAMS Identified Regulation	0.359	0.70	0.004
GAMS Introjected Regulation	0.175	0.84	0.002
GAMS External Regulation	1.964	0.14	0.019
GAMS Amotivation	0.661	0.52	0.007
Gaming Problems	3.499	0.03*	0.052
Gaming Engagement	12.368	< 0.01*	0.109
Gaming Reasons	3.975	0.02*	0.056
Gaming School Performance	0.512	0.60	0.014

APPENDIX 5: TABLE 5. ANALYSES OF VARIANCE FOR TASKS AND MEASURES WITH GENDER AS INDEPENDENT VARIABLE

Table 5

Analyses of Variance for tasks and measures with Gender as independent variable

	F	*p*	η^2
Tower of London time	0.028	0.87	0
Tower of London moves	0.227	0.63	0.001
Duncker's box accuracy	0.005	0.95	0
Duncker's box time	0.803	0.37	0.004
Stroop time	0.791	0.38	0.004
Stroop accuracy	0.521	0.47	0.003
RBANS			
List Learning Improvement across trials	0.156	0.69	0.001
Story Memory Improvement across trials	0.025	0.87	0
Digit Span longest string	7.923	0.01*	0.038
List Learning Retention	5.78	0.02*	0.028
Story Memory Retention	0.284	0.60	0.001
Immediate Memory Index	0.394	0.53	0.002
List Learning	1.052	0.31	0.005
Story Memory	0.001	0.98	0
Line Orientation	4.952	0.03*	0.024
Language Index	4.393	0.04*	0.022
Picture Naming	3.93	0.049*	0.019
Semantic Fluency	0.877	0.35	0.004
Attention Index	2.127	0.15	0.011
Digit Span	12.071	< 0.01*	0.056
Coding	1.865	0.17	0.009
List Recall	6.341	0.01*	0.03
List Recognition	0.044	0.84	0
Story Recall	0.13	0.72	0.001
IM to ATT discrepancy	2.799	0.10	0.014

IM to LAN discrepancy	4.748	0.03*	0.023
ATT to LAN discrepancy	0.4	0.53	0.002
Resident GPA	0.592	0.44	0.003
Cumulative GPA	0.619	0.43	0.003
ACT Score	0.009	0.93	0
SAT Score	1.838	0.18	0.009
TMQ	1.034	0.31	0.005
Gaming Motivation	2.797	0.10	0.014
Gaming Engagement	12.867	< 0.01*	0.06
Gaming Problems	5.639	0.02*	0.042
Gaming Reasons	0.765	0.38	0.006
Gaming School Performance	2.58	0.11	0.035
GAMS Intrinsic Motivation	9.891	< 0.01*	0.047
GAMS Integrated Regulation	0.56	0.46	0.003
GAMS Identified Regulation	0.375	0.54	0.002
GAMS Introjected Regulation	0.9	0.34	0.004
GAMS External Regulation	4.911	0.03*	0.024
GAMS Amotivation	0.143	0.71	0.001

APPENDIX 6: FIGURE 1. VGP STATUS AND GENDER EFFECTS ON STORY MEMORY IMPROVEMENT

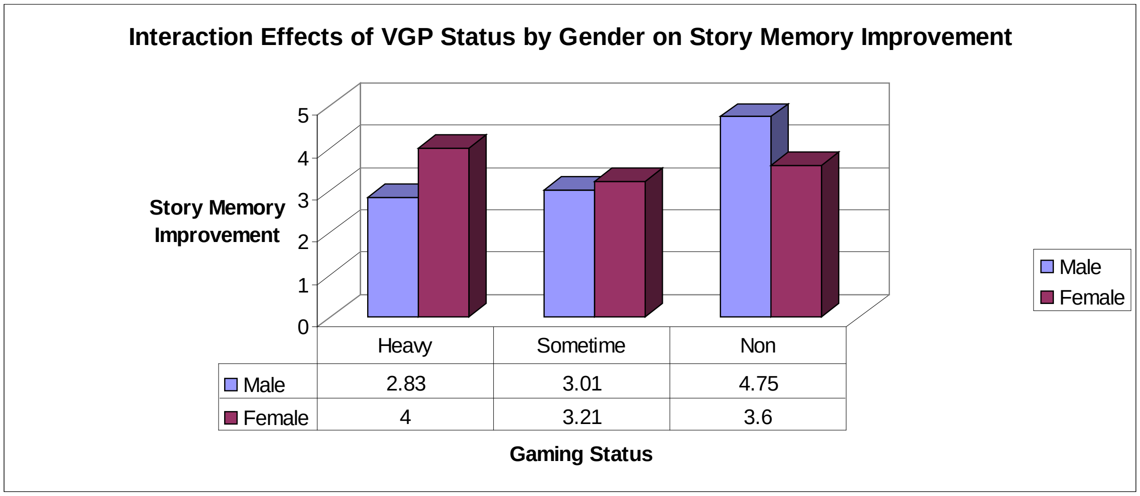

Figure 1. VGP Status and Gender Effects on Story Memory Improvement

APPENDIX 7: FIGURE 2. VGP STATUS AND GENDER EFFECTS ON ATTENTION INDEX

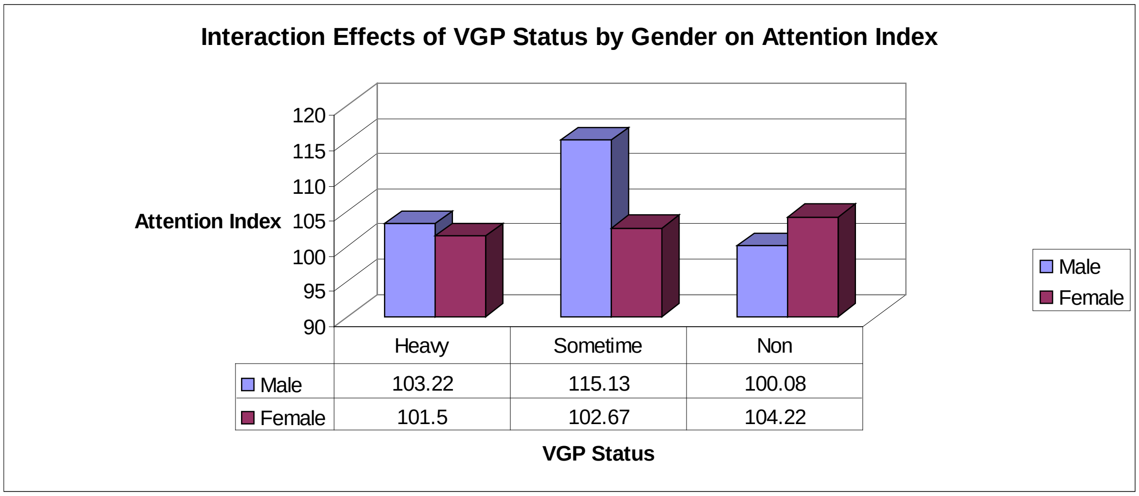

Figure 2. VGP Status and Gender Effects on Attention Index

APPENDIX 8: FIGURE 3. VGP STATUS AND GENDER EFFECTS ON CUMULATIVE GPA

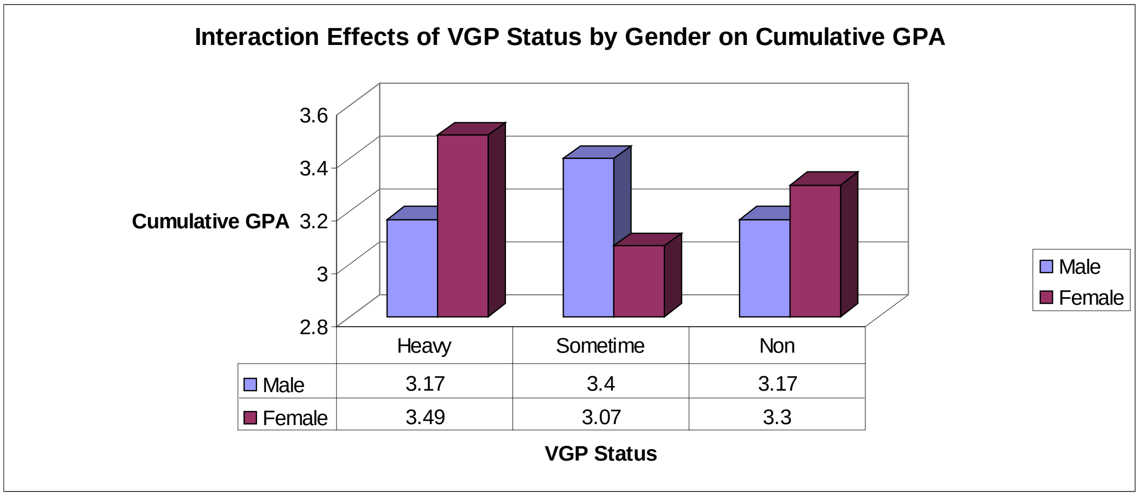

Figure 3. VGP Status and Gender Effects on Cumulative GPA

APPENDIX 9: TABLE 6. CORRELATIONS AMONG QUESTIONNAIRE MEASURES

Table 6

Correlations among questionnaire measures

	TMQ	GAMS	GEQ	GHQ Gaming Problems	GHQ Gaming Reasons	GHQ Gaming School Performance
GAMS	-.146*	-				
GEQ	-.286**	.351**	-			
GHQ Gaming Problems	-.288**	.495**	.636**	-		
GHQ Gaming Reasons	-.208*	.570**	.368**	.228**	-	
GHQ Gaming School Performance	.183	-.291**	-.291**	-.161	-.162	-

$^{**}p = 0.01$; $^{*}p = 0.05$

APPENDIX 10: TABLE 7. CORRELATIONS AMONG COGNITIVE SKILL MEASURES

Table 7

Correlations among cognitive skill measures

	ToL Moves	Box Accuracy	Box Time	Stroop Time	Stroop Accuracy	LL Scaled	SM Scaled	LO Scaled	PN Scaled	SF Scaled	DS Scaled	CD Scaled	LR Scaled	LRecog Scaled	SR Scaled
ToL Time	.65**	.11	.02	.20**	-.08	-.01	.01	-.09	-.05	-.05	.02	-.15*	.03	.06	-.04*
Tol Moves	-	.05	.01	.08	-.12	.05	-.01	-.10	-.02	.02	-.04	-.01	.07	.16*	-.05
Box Accuracy		-	.21**	.05	.12	-.13	-.05	-.09	-.11	-.01	.04	-.04	-.13	-.01	-.05
Box Time			-	.13	-.03	-.09	-.08	.05	-.26**	-.17*	-.06	.00	-.05	.02	-.07
Stroop Time				-	-.30**	-.15*	-.18*	.01	-.07	-.21**	-.05	-.30**	-.12	-.07	-.11
Stroop Accuracy					-	-.01	.03	-.03	.07	-.05	-.09	.05	.05	.05	.07
LL Scaled						-	.50**	.03	.19**	.23**	.06	.25**	.54**	.29**	.46**
SM Scaled							-	.06	.22**	.24**	.10	.23**	.27**	.04	.72**
LO Scaled								-	.03	-.02	.09	.18**	.03	-.02	.10
PN Scaled									-	.30**	.08	.10	.11	-.04	.23**
SF Scaled										-	-.01	.19**	.09	.01	.21**
DS Scaled											-	.07	-.06	-.01	.06
CD Scaled												-	.16*	-.02	.28**
LR Scaled													-	.31**	.37**
LRecog Scaled														-	.03
SR Scaled															-

$**p = 0.01$; $*p = 0.05$

APPENDIX 11: DEMOGRAPHIC QUESTIONNAIRE

Demographic Questionnaire

1) What is your age? _____________
2) What is your gender? Male Female
3) What is your race?
African American Caucasian Hispanic/Latino Asian Other ____________
4) What is your class standing?
Freshman Sophomore Junior Senior Graduate
5) What is your current estimated college GPA? (If a freshman, use high school GPA)_____________
6) What was your ACT and/or SAT score? ___________________
7) Are you currently involved in a romantic relationship?
Yes No
8) Have you ever been diagnosed with any form of Attention Deficit Disorder?
Yes No
9) Have you ever played a video game (computer, Nintendo, Playstation, Xbox, etc.)?
Yes No
10) Do you currently play video games?
Yes No
11) About how many hours a week do you play video games? _____________ N/A
12) What kind of video games do you play?
Strategy Action, non-shooter Action, first-person shooter Racing
Puzzle Role-playing Construction and simulation N/A
Other________
13) What is your preferred method for playing video games?
Computer Console (Xbox, Playstation, Wii, etc.) Phone apps N/A
Facebook/Myspace apps
14) In your opinion, do you spend too much time playing video games?
Yes No
15) Do other people tell you that you spend too much time playing video games?
Yes No
16) Does playing video games ever interfere with completing schoolwork or studying?
Yes No
17) Do you think your video game playing is typical of most people?
Yes No
18) How do you think your video game playing affects your grades in general?
1 2 3 4 5
Helps grades Has no effect on grades Hurts grades
19) How do you think your video game playing affects your ability to spend time studying?
1 2 3 4 5
Helps ability to study Has no effect on ability to study Hurts ability to study
20) How do you think your video game playing affects your ability to learn material you are trying to study?

1 2 3 4 5

Helps ability to study Has no effect on ability to study Hurts ability to study

21) How do you think your video game playing affects your ability to complete assignments on time?

1 2 3 4 5

Helps time management Hurts time management Has no effect

22) Do you use Facebook? Yes No

23) Do you use MySpace? Yes No

24) Do you use Twitter? Yes No

25) Do you use any other form of social networking website? No Yes (list) ____________

26) Have you ever used alcohol? Yes No

27) Have you ever used a tobacco product? Yes No

28) Have you ever used any other type of recreational or prescribed drug? Yes No

29) If yes, which drugs have you used?

Marijuana Ecstasy Cocaine Painkillers Stimulants (ex. Adderall)

Amphetamines Heroin Downers Inhalants PCP LSD

30) Do you currently use alcohol? Yes No

31) If yes, how many days in the last month have you used alcohol? _________________

32) Do you currently use a tobacco product? Yes No

If yes, how many days in the last month have you used a tobacco product? ___________

33) Do you currently use any type of recreational drug?

Yes No

34) If yes, what drug(s)?

Marijuana Ecstasy Cocaine Painkillers Stimulants (Adderall)

Amphetamines Heroin Downers Inhalants PCP LSD

35) If yes, how many days in the last month did you use the drug? ___________________

36) If you do use any sort of recreational drug, do you use it while playing video games? Yes No N/A

37) If you do use any type of recreational drug, are you under the influence right now? Yes No N/A

38) On a scale of 1 to 10, with one being least and ten being most, how closely have you paid attention to this survey? ____________

39) Would you participate in a research study in which you played video games and then were given general tests of memory?

Yes No Unsure

40) Were you previously familiar with any of the tasks which you were asked to perform? Please check which, if any.

Candle task Color word task Word list task Ring task

41) What is your major?

42) How many hours per week do you spend watching others play video games?

APPENDIX 12: GAMING MOTIVATION SCALE (GAMS)

Gaming Motivation Scale (GAMS) - Lafreniere, et al.

Items will be answered on a 5 point Likert scale (Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree.

"I play video games because..."

Intrinsic motivation

1. Because it is stimulating to play
2. For the pleasure of trying/experiencing new game options (e.g., classes, characters, teams, races, equipment)
3. For the feeling of efficacy I experience when I play

Integrated regulation

1. Because it is an extension of me
2. Because it is an integral part of my life
3. Because it is aligned with my personal values

Identified regulation

1. Because it is a good way to develop important aspects of myself
2. Because it is a good way to develop social and intellectual abilities that are useful to me
3. Because it has personal significance to me

Introjected regulation

1. Because I feel that I must play regularly
2. Because I must play to feel good about myself
3. Because otherwise I would feel bad about myself

External regulation

1. To acquire powerful and rare items (e.g., armors, weapons) and virtual currency (e.g., gold pieces, gems) or to unlock hidden/restricted elements of the game (e.g., new characters, equipment, maps)
2. For the prestige of being a good player
3. To gain in-game awards and trophies or character/avatar's levels and experiences points

Amotivation

1. It is not clear anymore; I sometimes ask myself if it is good for me
2. I used to have good reasons, but now I am asking myself if I should continue
3. Honestly, I don't know; I have the impression that I'm wasting my time

APPENDIX 13: TIME MANAGEMENT QUESTIONNAIRE (TMQ)

<u>Time Management Questionnaire - (adapted from Britton & Tesser)</u>

Items will be answered on a 5 point Likert scale (Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree.

Short-Range Planning

1. Do you make a list of the things you have to do each day?
2. Do you plan your day before you start it?
3. Do you make a schedule of the activities you have to do on work days?
4. Do you write a set of goals for yourself for each day?
5. Do you spend time each day planning?
6. Do you have a clear idea of what you want to accomplish during the next week?
7. Do you set and honor priorities?

Time Attitudes

1. Do you often find yourself doing things which interfere with your schoolwork simply because you hate to say "No" to people? *
2. Do you feel you are in charge of your own time, by and large?
3. On an average class day do you spend more time with personal grooming than doing schoolwork?*
4. Do you believe that there is room for improvement in the way you manage your time? *
5. Do you make constructive use of your time?
6. Do you continue unprofitable routines or activities?

Long-Range Planning

1. Do you usually keep you desk clear of everything other than what you are currently working on?
2. Do you have a set of goals for the entire quarter?
3. The night before a major assignment is due, are you usually still working on it? *
4. When you have several things to do, do you think it is best to do a little bit of work on each one?
5. Do you regularly review your class notes, even when a test is not imminent?

* - reverse scored

APPENDIX 14: GAMING HABITS QUESTIONNAIRE (GHQ)

Gaming Habits Questionnaire (adapted from Hellstrom, et al.)

1) On average, how many hours a day do you use a computer during your leisure time (not at school)?
(1) Do not use a computer
(2) Less than 1 h
(3) 1–2 h
(4) 2–5 h
(5) More than 5 h

2) How often do you play computer games?
(1) Never
(2) A few times a year
(3) Occasionally every month
(4) 2–4 times a month
(5) 2–3 days a week
(6) 4–5 days a week
(7) 6–7 days a week

3) How often do you play multi-player online computer games?
(1) Never
(2) A few times a year
(3) Occasionally every month
(4) 2–4 times a month
(5) 2–3 days a week
(6) 4–5 days a week
(7) 6–7 days a week

4) If you play computer games, how long do you play on average on an ordinary weekday?
(1) Do not play
(2) Less than 1 h
(3) 1–2 h
(4) 2–5 h
(5) More than 5 h

If you play computer games, how long do you play on average on an ordinary day over the weekend?
(1) Do not play
(2) Less than 1 h
(3) 1–2 h
(4) 2–5 h
(5) More than 5 h

5) If you play computer games, what are your reasons for doing so?
(1) It is fun
(2) It is relaxing
(3) My friends play
(4) Demands from other players that I have to play

(5) It is exciting
(6) It is social
(7) I have many friends in the game
(8) I get away from all the problems in my ordinary life
(9) I have nothing more fun to do
(10) To earn money
(11) My ordinary life is so boring
(12) I gain status among other players
(13) I gain status among my friends in real life
(14) I become restless and irritated when I'm not playing
(15) I don't have to think about all the worries in my ordinary life

Response alternatives are: (1) Strongly agree, (2) Agree to some extent, (3) Neither agree nor disagree, (4) Disagree to some extent, (5) Strongly disagree.

6) Has your computer gaming led to any problems in your everyday life?
(1) Do not have time to spend with my friends
(2) Do not have time/forget to eat
(3) Quarrel and troubles with family or friends due to gaming
(4) Stayed home from school to play
(5) No time to do school assignments
(6) Less sleep due to gaming late in evenings and nights
(7) Other consequences (Please list)
Answer categories where: (0) Never, (1) Seldom, (2) Occasionally, (3) Often, (4) Almost always.

7) How does video game playing affect your school performance in the following ways?
(1) Video game playing affects my completion of studying or completing schoolwork by...
(2) Video game playing affects my grades by...
(3) Video game playing affects my ability to spend time studying by...
(4) Video game playing affects my ability to learn material I am trying to study by...
(5) Video game playing affects my ability to complete assignments on time by...
Answer categories where: (0) Hurting a great deal, (1) Hurting a little bit, (2) Neither helping nor hurting,
(3) Helping a little bit, (4) Helping a great deal.

8) When it comes to your video game playing habits, how much do you agree with the following statements?
(1) I think I spend too much time playing video games
(2) Other people tell me that I spend too much time playing video games
Answer categories where: (0) Strongly disagree, (1) Disagree, (2) Neither agree nor disagree, (3) Agree, (4) Strongly agree

APPENDIX 15: GAME ENGAGEMENT QUESTIONNAIRE (GEQ)

Game Engagement Questionnaire (GEQ) - Brockmeyer, et al.

Items will be answered on a 5 point Likert scale (Strongly agree, agree, neither agree nor disagree, disagree, strongly disagree.
"When I play games..."

1	I lose track of time
2	Things seem to happen automatically
3	I feel different
4	I feel scared
5	The game feels real
6	If someone talks to me, I don’t hear them
7	I get wound up
8	Time seems to kind of stand still or stop
9	I feel spaced out
10	I don’t answer when someone talks to me
11	I can’t tell that I’m getting tired
12	Playing seems automatic
13	My thoughts go fast
14	I lose track of where I am
15	I play without thinking about how to play
16	Playing makes me feel calm
17	I play longer than I meant to
18	I really get into the game
19	I feel like I just can’t stop playing

VITA

SEAN HOLLIS

EDUCATION

B.S. Psychology Birmingham Southern College 2007

TEACHING EXPERIENCE

June 2014 - present Teaching of PSY 319 Brain and Behavior, University of Mississippi Desoto Campus, Southaven, MS

August 2013- May 2014 Career Counseling and Teaching of PSY 100 Orientation to the Major, University of Mississippi, University, MS

PROFESSIONAL EXPERIENCE

August 2008 - present Psychologist intern at University of Mississippi Psychological Services Center, University MS

September 2013 - present Psychologist intern with Dr. Brian Thomas, Tupelo, MS

July 2012- June 2013 Psychologist intern at the North Mississippi Regional Center Oxford, MS

August 2010-June 2012 Psychologist intern at Timber Hills Region IV Mental Health, Hernando, MS

August 2009 - August 2010 Member of University of Mississippi Psychological Assessment Team, University, MS

August 2008 - July 2010 Research Assistant at St. Jude Children's Research Hospital, Memphis, TN

PUBLICATIONS and PRESENTATIONS

Hollis, S., Lombardo, T., McIlveene, A., Grigg, J., & J. Fulwiler (2014). Cognitive effects and academic consequences of video game playing in college students. Poster presented at the 4th Annual University of Mississippi Graduate School Research Forum, Oxford, MS.

Hollis, S., Lombardo, T., McIlveene, A., Grigg, J., & J. Fulwiler (2014). Cognitive effects of video game playing. Poster presented at the 1st Annual University of Mississippi Conference on Psychological Science, Oxford, MS.

Bentley, S., Grigg, J., Hollis, S., McIntire, L., Fulwiler, J., & T. Lombardo (2013). College students' smoker identity varies with physical activity levels. Poster submitted to the American Public Health Association Conference, 141st Annual Meeting, Boston, MA.

Garvie, P., Wilkins, M., Hollis, S., Corbett, A., Doskey, E., Dallas, R., & E. Midgett (2010). Family factors related to medical appointment adherence in children and adolescents with HIV. Poster presented at the National Institute of Mental Health Annual International Research Conference on the Role of Families in Preventing and Adapting to HIV/AIDS, Nashville, TN.

Garvie, P., Wilkins, M., Dallas, R., Hollis, S., & E. Midgett (2010). Relations among adherence assessment and biomarkers in youth with HIV: Does concurrent viral load and CD4 measurement outperform standard of care comparisons? Poster presented at the Society of Behavioral Medicine 31st Annual Meeting, Seattle, WA.

Garvie, P., Young, J., Wilkins, M., Midgett, E., & S. Hollis (2008). Psychological and behavioral predictors of medication adherence in adolescents with behaviorally acquired HIV-1. Poster presented at the International Association of Physicians in AIDS Care 3rd Annual Meeting, Miami, FL.

Hollis, S., Flynn, M., Lombardo, T., Bentley, J., Payne, T., Crews, K. (2008). Social facilitation in undergraduates: Encouraging and discouraging peer smoking. Poster presented at the Society for Research on Nicotine and Tobacco's 14th Annual Meeting, Seattle, WA.

Hollis, S., Kendra, R.., Wilson, J. P., & Witte, T. (November 2006). Perceived normality and minimization of relationship violence: The role of alcohol use. Poster presented at the Association for Behavioral and Cognitive Therapy's 40th Annual Convention, Chicago, IL.

Witte, T., Wood, K., Wilson, J. P., Neil, J., Hollis, S., & Bell, P. (November 2005). Measuring perceptions of intimate partner violence among college men: Perceived normality and minimization of abuse. Poster presented at the

Association for Behavioral and Cognitive Therapy's 39th Annual Convention, Washington D.C.

Hollis, S., Shaw, C., Rivard, R. (December 2006). Effect of auditory distraction on reading comprehension: The roles of irrelevant speech and white noise. Psychology Senior Conference, Birmingham Southern College