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Brain Drain Or Brain Gain? Cognitive Skill Training Of Novice Video Game Players With Casual Video Games

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BRAIN DRAIN OR BRAIN GAIN? COGNITIVE SKILL TRAINING WITH NOVICE VIDEO GAME PLAYERS UTILIZING CASUAL VIDEO GAMES

A Dissertation presented in partial fulfillment of requirements for the degree of Doctor of Philosophy in the Department of Clinical Psychology
The University of Mississippi

by

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ABSTRACT

Video game playing (VGP) has become a popular and widespread form of entertainment over the past two decades. This form of media is now popular with children, adolescents, and adults alike. While most early research on the effects of VGP focused on the relation of violence in video games and expressions of aggression, more recent research has begun to explore possible beneficial effects of VGP. Study results have been inconsistent, with some suggesting that VGP may improve various cognitive skills such as spatial skills, attentional skills, executive control, and problem solving. Other studies refute or qualify these findings. Additionally, different types of games have been related to improvements in differing cognitive skills. A lack of consistency in VGP training programs and an abundance of correlational rather than causational studies have made interpretation of VGP training results murky at best. The current study aimed to clarify possible causal relationships between VGP and changes in cognitive skill. Novice game players were trained on two different VGP genres (strategy and action-shooter) and administered pre- and post-test batteries of cognitive skill. Forty-nine female participants played 20 hours of a randomly assigned video-game over the course of ten weeks and completed multiple cognitive skills tests pre- and post-study. Individuals who played the first-person shooter-style game exhibited significant improvements in attention, working memory, visuospatial skills, processing speed, and problem-solving. Individuals playing the strategy style game demonstrated significant improvements in working memory, problem-solving, and visuospatial skills as well. Both groups exhibited a decline in self-reported willingness to engage in social conversation following the training paradigm but no cognitive skill declines were

observed. These findings have implications for the utility of commercial video-games as a cognitive skill building tool. They also support the potential efficacy of electronic media as a potentially useful means of addressing cognitive deficits while also remaining highly engaging and motivating for individuals to utilize.

LIST OF ABBREVIATIONS AND SYMBOLS

ADHD   Attention Deficit/Hyperactivity Disorder

ESA   Entertainment Software Association

FPS   First-person shooter game group

GAMS   Gaming Motivation Scale

GEQ   Gaming Engagement Questionnaire

GHQ   Gaming Habits Questionnaire

PRCA   Personal Report of Communication Apprehension

RBANS   Repeatable Battery Assessment of Neuropsychological Status

STR   Strategy game group

T1   Time point one

T2   Time point two

TMQ   Time Management Questionnaire

ToL   Tower of London

VGP   Video game playing

WASI   Wechsler Abbreviated Scale of Intelligence

WCST   Wisconsin Card Sort Task

WTC   Willingness to Communicate Scale

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I. INTRODUCTION

Video games have become a nearly universal form of media entertainment across age and gender. In 2010, 67% of American households played video games (Blumberg, 2011). More recent studies have estimated that among teens, this number may range as high as 95% (Bavelier, et al., 2012). According to the Entertainment Software Association (ESA), consumers spent nearly $22 billion dollars on video games in 2013. Despite a prevailing view that video game players consist primarily of adolescents and young adults, the average video gamer is thirty-one years old. Contrary to popular opinion, gaming is also no longer a male-centric domain. Women now make up 48% of all video game players (ESA, 2014). Smartphones and tablet devices have also increased the prevalence of video game playing (VGP). Up to 44% of gamers play on these devices. The most popular game genre is action/shooters, accounting for 32% of sales, while strategy games are the most popular genre for computer-based gaming and account for 38% of sales in that medium (ESA, 2014).

I-1. "Brain Training"

As possible beneficial aspects of VGP have become more of an area of scientific investigation, "brain training" has become a hot topic in the field as well as an area of rapid commercial growth. 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. 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

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memory but had no effect on explicit memory. However, most studies have focused on specific laboratory tests and have not been generalized to everyday tasks (Goldstein, Cajko, Oosterbroek, Michielsen, et al., 1997; Nouchi, Taki, Takeuchi, Hashizume, et al., 2012).

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 further 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, though this theory has been

debated by others (Bavelier, et al., 2012).

I-2. Spatial Skills

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).

I-3. 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. This review 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.

I-4. 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; Basak, et al, 2008; Drew & Waters, 1986; Dustman, Emmerson, Steinhaus, & Shearer, 1992; Fortman, 2013; 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 while balancing limitations of attentional and information processing resources. 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

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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.

Similarly, Pope and Bogart (1996) found that biofeedback training with a video game helped individuals with Attention Deficit/Hyperactivity Disorder (ADHD) to better focus their attention. McDermott, et al. (2013) also found that VGP improved attentional control, but not short-term memory. Other studies also found improvements in working memory and processing speed (Belchior, et al., 2013; Harrison, et al., 2013). The improvement in working memory was also suggested to potentially lead to improvements in fluid intelligence or solving problems in novel contexts, since working memory is a bridge between attention and memory. However, this proposed link to fluid intelligence was not supported by the study's results (Harrison, et al., 2013).

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.

Anguera, et al. (2013) utilized VGP to improve multitasking performance in elderly adults. First, this study exhibited a linear decline in baseline multitasking performance between the ages of 20-79. However, VGP training increased multitasking performance in elderly adults, even beyond the performance of untrained 20-year-old comparisons.

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.

Another study found that action VGP may enhance visual short-term memory, but does not generalize to verbal working memory or visual long-term memory (Blacker, et al., 2014). Similarly, other studies have found that VGP did not improve verbal reasoning skills following training with a puzzle game among frequent gamers (White, 2014) or improve processing speed in experienced gamers (Ravenzwaaij, et al., 2014).

I-5. 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

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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.

One criticism of VGP training studies has been that they often only lead to improvements in laboratory settings and on narrow skills that do not generalize to other areas. Baniqued, et al, (2014) suggest that the novelty and challenge of playing different games and different game types may lead to improvement in a wider range of areas. The authors also suggest that training programs lead to more generalizable, longer-lasting gains when they are flexible and not overly task-specific. However, this study still utilized brain training games rather than "casual" games.

A previous study by the current lab (Hollis, Lombardo, McIlveene, Grigg, & Fulwiler, 2014) found positive correlational links between moderate levels of playing "casual" games and college student performance on a variety of cognitive skills such as spatial skills, cognitive control, and memory. The current study will expand on these findings by investigating possible causation for this relationship through utilizing a VGP training protocol.

I-6. Possible Mechanisms of VGP Action on the Brain

While no direct mechanism of action has yet been demonstrated to account for the improvements in cognitive ability associated with VGP, several theories have been proposed.

The first of these is that VGP may lead to an increase in neuroplasticity. This may in turn enhance prefrontal cognitive control, as well as improving memory by promoting long-term potentiation (LTP) (Bavelier et al., 2012). This theory proposes that, rather than promoting many different individual skills (attention, visuospatial skills, etc.), VGP may increase the ability to learn the performance of new tasks, or increase "learning to learn" or preparedness. The authors of this proposal suggest that one common theme between areas improved by VGP is that individuals must make decisions based on limited data which may only be tangentially or ambiguously related. This need to make decisions quickly based on imperfect information is similar to most everyday decisions individuals are faced with on a regular basis. Additionally, if VGP improves either the amount of attentional resources available or the efficiency of attentional resource allocation, these greater resources could lead to improvements in several different areas of functioning. Greater levels of available resources may be used for greater degrees of learning in more generalized domains.

Another proposed mechanism of action is that VGP may deactivate or diminish the activity of the default network in the neural cortex (Anguera et al., 2013). This network has been suggested to be active when attention is not focused internally. It is activated when an individual's focus is turned inwards, such as during autobiographical recall or while engaging in metacognition or planning for the future (Buckner et al., 2008). The default network is thought to be located in a series of interconnected neural pathways located primarily in the prefrontal cortex, as well as the medial temporal lobe. These areas of the brain have been shown to be more active in imaging studies when individuals are not externally stimulated and left to think on their own. They are also active when individuals are remembering the past, planning for the future, and considering the perspectives of others. This system has been theorized to be disrupted in

autism, schizophrenia, and Alzheimer's disorders - all disorders which may show deficits in executive functioning and cognitive control skills. It is also thought that this system may be at least partially responsible for lapses in attention and daydreaming. Thus, it is thought that perhaps VGP increases executive control by sharpening attention and dampening the default network (Anguera et al., 2013; Buckner et al., 2008). One study found possible evidence to support this theory as it was found that VGP training increased theta wave activity, which is associated with more focused attention and not with activation of the default network (Anguera et al., 2013).

Additionally, it is possible that VGP may alter neural levels of various neurotransmitters. While no direct link has yet been found, it has been proposed that VGP may increase levels of acetylcholine, which is important for learning and neuroplasticity in the form of LTP. The improvement in cognitive resources seen in VGP effect studies could be accounted for by this increase (Bavelier et al., 2012). Similarly, it is quite likely that VGP increases dopaminergic release, as video games are often rated as highly motivating and reinforcing. The increased dopaminergic activity related to this increased level of reward may transfer to prefrontal areas responsible for cognitive control as well.

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 other 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).

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). Finally, it is also possible that at least part of VGP training's mechanism of action is

simply that games are reinforcing and motivating, and thus may improve participants' motivation

to do well on tasks (Orvis et al., 2009; Granic et al., 2014). It may also involve learning new

mechanisms of applying improved problem solving based on learning in ambiguous situations

with minimal instruction or information given (Granic et al., 2014).

Perhaps unsurprisingly, given these proposed mechanisms of action, studies have

generally found more positive results when participants are given more training sessions spread

over longer time frames. Training gaming novices also tends to lead to greater degrees of

improvement than training experienced gamers (Masson et al., 2011).

I-7. 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. The current study utilized objective measures of problem solving and cognitive control skills 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). This study utilized a training paradigm in which individuals unfamiliar with video game playing were given a pre-test and post-test battery of assessment measures with video game training sessions in between in an effort to evaluate causation.

I-8. Specific Hypotheses

A) Training novice video game players with strategy games will improve performance on measures of problem solving skills compared to action-shooting games.
B) Training of novice video game players with action-shooting games will improve performance on measures of spatial skills compared to strategy games.
C) Training of novice video game players with action-shooting games will improve performance on measures of attention compared to strategy games

II. METHODOLOGY

II-1 Measures

Participants were given a questionnaire battery, an intelligence test, and a series of cognitive and problem solving skills measures during both a pre-test and post-test battery. The tasks completed included the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) (Randolph, 1998); the Stroop color word task; the Tower of London problem solving task; the Wechsler Abbreviated Scale of Intelligence (WASI); the Barkley ADHD Rating Scales; the Conner's Continuous Performance Test (ADHD); the Trail Making Test; and the Wisconsin Card Sorting Test (WCST). 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); the Time Management Questionnaire (Britton & Tesser, 1991); and measures of substance use and socialization. The demographic questionnaire, WASI, and Barkley's ADHD scales were given only in the pretest battery. The GAMS and GEQ were given at each training session.

The demographic questionnaire contained questions about age, race, class standing, GPA, ACT/SAT scores, 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.

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II – 1A 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. The GAMS 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). This measure was utilized to measure participants' interest in playing the training video games.

II – 1B 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). It was used as a screening tool for purposes of classifying participants on gaming experience and subsequent group assignment.

II – 1C 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 at each training session.

II - 1D Time Management Questionnaire (TMQ)

Britton & Tesser (1991) utilized the Time Management Questionnaire in a study of college student academic success. The TMQ consists of 35 items, 18 of which were 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, and was given in both the pre-test and post-test batteries.

II – 1E Personal Report of Communication Apprehension - 24 (PRCA-24)

The PRCA-24 is a self-report measure of apprehension related to engaging with other in a variety of social situations. It is a 24-item questionnaire measure in which responses are given on a five-point Likert scale. The PRCA-24 has a reliability of 0.58 (McCroskey, et al., 1985). It was given in both the pre-test and post-test batteries as a measure of openness to social engagement.

II – 1F Willingness to Communicate Scale (WTC)

The WTC is a self-report questionnaire measure related to engagement in social interactions. It is a 20 item measure in which responses are given on a 100-point scale. The WTC has a reliability of 0.92 (McCroskey, 1992). It was given in both pre- and post-test batteries as a measure of sociability.

II – 1G Tasks

Participants were asked to complete the following additional brief objective measures of cognitive skills including problem solving, memory, and cognitive control.

II – 1H Stroop Test

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 were asked to either read text written in opposing colors or to name ink color which is opposed to the text. The Stroop was given in both the pre-test and post-test batteries.

II – 1I Computerized Cognitive Measures

Several computerized measures of cognitive performance were utilized as well. These measures are made publicly available by Hanover College (Krantz, 2015). A mental rotation task in which participants respond to designs rotated at multiple angles and must identify figures as either rotated or mirror images served as an additional measure of visuospatial abilities.

A dual task attention measure was utilized as an additional measure of attentional and multitasking abilities. This measure requires following a target moving at random across the screen while also performing a distractor task of identifying a target letter in an ongoing sequence of letters appearing on-screen.

An attentional blink task was also utilized, in which stimulus items were presented at a rapid rate and participants were asked to respond to two target stimuli within a sequence.

II – 1J Repeatable Battery of Neuropsychological Status (RBANS)

The Repeatable Battery of Neuropsychological Status (RBANS) was 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 measure working memory. The RBANS Picture Naming and Semantic Fluency tasks measure language skills. Finally, the ten-item RBANS line orientation task and the

figure copy task measure spatial skill ability. The RBANS has been found to have 0.85 reliability (Randolph, 1998). This measure was given both at pre-test and post-test.

II – 1K Wechsler Abbreviated Scale of Intelligence (WASI)

The Wechsler Abbreviated Scale of Intelligence (WASI) is a brief measure of intelligence. It has a reliability of .90 (Wechsler, 1999). It was utilized as a measure of general intelligence as part of the pre-test battery.

II – 1L Wisconsin Card Sort Test (WCST)

The Wisconsin Card Sort Task (WCST) is a measure of cognitive control and problem solving. Individuals are asked to respond according to discerned patterns which are altered at intervals unknown to the examinee. This measure has a reliability of .88 (Heaton, 1981). It was administered at both pre-test and post-test assessments.

II – 1M Barkley's ADHD Rating Scales

The Barkley's ADHD Rating Scales are a self-report measure of current and childhood symptoms of ADHD based on DSM-IV-TR diagnostic criteria. This measure has a reliability of .77 (Barkley, 2010). It was administered in effort to control for symptoms of ADHD in the sample. This measure was administered as part of the pre-test battery.

II – 1N Trail Making Test (TMT)

The Trail Making Test (TMT) is a measure of cognitive control in which participants are asked to connect numbered and lettered dots without allowing breaks in between connections. It has a reliability of .70 (Tombaugh, et al., 1998). It was administered at both the pre-test and post-test assessments.

II – 1O Tower of London (ToL)

Problem solving was measured with the Tower of London. This task consists of asking

participants to 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, represented performance. 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).

II – 2 Participants

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 research credit for introductory psychology classes as well as entry into

a raffle to win a gift card to a local store. The study contained female college students of at least

eighteen years of age. Novice gamers were recruited and trained to play video games in two

experimental groups, varying by game genre. Group sizes were intended to be approximately

twenty-four individuals per group – or 48 total. This group size was based upon convention in

the literature as well as a power analysis utilizing G*Power software which assumes a moderate

effect size of 0.6 (as calculated by Cohen's d) and running an analysis of repeated measures

ANOVAs including both within- and between-group comparisons. See Figure 1 (Appendix) for a

flowchart representation of participant recruitment.

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) and also have been shown to perform at differing levels on

various measures of cognitive skills. Thus, to avoid gender confounds only females were utilized

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in this study. Also, only participants who spoke English as a first language were utilized in this study to minimize possible language confounds.

II -3 Procedures

Participants completed pretest measures in the laboratory in a single session. They were then assigned to one of the two experimental groups and asked to participate in 10 weeks of video game training, 2 hours once per week. Training sessions were administered in groups and individuals in gaming groups played in multiplayer games with and against one another in order to increase interest in the game situation. The researcher performed a ten-minute demonstration of the game prior to beginning the first training session to familiarize individuals with how to play the game. Following the training sessions, they were given a posttest battery.

During the assessment batteries, the RBANS (Randolph, 1998) memory tasks were conducted first in order to allow time for the delayed memory components later on in the battery. To avoid cognitive interference, no other verbal tasks were completed in between the RBANS immediate and delayed memory components. Following the memory tasks, the remaining tasks were administered in counterbalanced fashion. The other tasks completed include the remainder of the RBANS, the Stroop color word task, the Tower of London, the WASI, the Barkley ADHD Scales, the WCST, and the Trail Making Test. At the conclusion of these measures, a questionnaire battery was administered as well. The post-test battery included the same measures as the pre-test battery with the exception of the WASI and the Barkley ADHD Scales. Alternate forms of the RBANS were utilized for the post-test battery.

Eligibility for the study was based on participant responses to the GHQ in a screening survey to determine experience with playing video games. Based on prior studies, experienced gamers are 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, non-experienced 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 the purposes of this study, we considered non-gamers those individuals who play less than one hour per week for the past six months. Only non-gamers were recruited for this study.

The games utilized for this study are free-to-play games. "Team Fortress 2" was utilized as the action/shooting game and places individuals into a cartoon based first-person shooter environment in which they must attack and defend objectives. "Command and Conquer - Tiberium Alliances" was utilized as the strategy game. In this game, individuals must manage resources and build up a base and military forces in order to both defend themselves and attack other players. Participants were brought into a computer lab and participated in game playing in groups for a period of two hours each session, with one session a week for ten weeks. The assessment batteries were administered individually over a period of several weeks before and after the training sessions.

II – 4 Statistical Analysis

SPSS for Windows was utilized for the statistical analysis in the current study. Analyses were completed comparing performance on the pre- and post-test cognitive skill batteries across groups. IQ scores, GPA, test scores, time management, and other demographic variables were computed as cofactors. These analyses were completed utilizing correlations and repeated measures ANOVA comparison tests.

III. RESULTS

Forty-nine participants completed the study. Two who started the procedure discontinued as they did not complete the protocol prior to the end of the semester and were lost to follow-up. Both came from the strategy game group. Twenty-six participants completed the study protocol in the first-person shooter-style game group while twenty-three participants completed the study protocol in the strategy game group. Demographic variables were analyzed with Chi-squared analyses. See table 1 (Appendix) for demographic breakdown by group. Ethnicity and class standing were not significantly related to performance on measures of cognitive performance. Table 2 (Appendix) lists the results of Chi-squared analyses of demographic variable effects on gaming group status. Table 3 (Appendix) displays the results of repeated measures ANOVA analyses for each measure by group.

III -1 Groups

Participants were randomly assigned to either a group playing a first-person shooter-style game (FPS Group) or to a group playing a real-time strategy game (STR Group). Game scores were converted to z-scores to allow comparison of gaming performance and improvement across the training sessions and were utilized as a covariate within repeated measures ANOVA analyses.

III – 2 Demographics

This study utilized only female participants. Ages ranged from eighteen to twenty-seven. Ethnicities represented included African American, Asian, Hispanic, and Caucasian. See tables 1

and 2 (Appendix) for demographic breakdowns and Chi-squared tables. Demographic factors were not significantly related to outcome measures of interest.

III – 3 Game engagement

Participants found the shooter-style (FPS) game to be significantly more engaging than the strategy (STR) game (F [1, 49] = 10.217, p < .01; η^2 = .228). The FPS group reported higher levels of game engagement across the ten game training sessions than the STR group. It is possible this may have impacted results by affecting how invested in the game playing process participants were.

III – 4 Cognitive Skills

The relationship between gaming group status and performance on cognitive measures was analyzed utilizing repeated measures ANOVAs and paired samples t-tests. Correlations between performance and demographic factors were also calculated. Significant findings are described below and displayed in table 3 (Appendix).

A main effect on performance was seen in the RBANS Total Index, an overall measure of cognitive performance. This measure significantly improved from T1 to T2 in both groups (F [1, 49] = 9.20, p = .01; η^2 = .16). The pre-test battery assessment battery will be referred to as T1 while the post-test battery is noted as T2.

III – 5 Time Management

No significant changes were seen from T1 to T2 (F [1, 49] = 0.184, p = .67; η^2 = .004) on time management. Time management was significantly negatively correlated with reported alcohol use (p < .01).

III – 6 Executive Control/Attention

A significant change was seen on the Stroop task from T1 to T2 (F [1, 49] = 5.47, p = .02; η^2 = .10), exhibiting improvements in executive control and task switching.

Significant improvements from T1 to T2 were seen on the RBANS Attention Index (F [1, 49] = 7.657, p < .01; η^2 = .140) which is related primarily to working memory and processing speed.

A significant main effect of improvement on the Attentional Blink Task was seen across groups (F [1, 49] = 31.38, p < .01; η^2 = .310) in rapidly responding to later items in a sequence. Additionally, an interaction effect was seen (F [1, 49] = 5.856, p < .01; η^2 = .203) in rapidly responding to earlier items in a sequence. The FPS group (40.53 ± 2.88 to 31.54 ± 3.02) showed a much greater rate of improvement than the STR group (35.74 ± 3.06 to 34.43 ± 3.21).

The Dual Attention Task showed no change from T1 to T2 (F [1, 49] = 0.405, p = .53; η^2 = .009).

III – 7 Processing Speed

A significant improvement was seen across time on both Trails A (F [1, 49] = 9.777, p < .01; η^2 = .172) and Trails B (F [1, 49] = 4.957, p = .031; η^2 = .095). These measures are primarily related to processing speed, sequencing, and task switching abilities.

III – 8 Problem Solving

Both groups increased completion speed but did not differ on number of moves taken from T1 to T2 on the Tower of London task (F [1, 49] = 6.188, p = .016; η^2 = .116). The aforementioned improved processing speed may have played a role in improving performance on

this measure as well based on the pattern of improved fluency without a corresponding increase in efficiency.

Significant improvement was demonstrated on the Wisconsin Card Sorting Task from T1 to T2 (F [1, 49] = 32.053, p < .01; η^2 = .405). This reflects improved performance on a measure of reasoning and problem solving.

III – 9 Memory

RBANS Immediate Memory showed improvement across time (F [1, 49] = 15.860, p < .01; η^2 = .252). Additionally, an interaction effect was seen (F [1, 49] = 7.42, p = 0.01; η^2 = .10). The FPS group (93.00 ± 2.91 to 106.31 ± 3.28) showed a greater rate of improvement than the STR group (97.13 ± 3.10 to 106.13 ± 3.45).

RBANS Delayed Memory saw no change from T1 to T2 (F [1, 49] = 0.808, p = .37; η^2 = .017). This perhaps suggests an improvement in attention and working memory assisting performance on immediate recall measures, rather than an effect on primary memory.

III – 10 Language

No change was seen from T1 to T2 on the RBANS Language Index (F [1, 49] = 0.292, p = .59; η^2 = .006), suggesting that no impact on language functioning occurred during the course of the study.

III – 11 Spatial Skills

Improvements in the RBANS Visuospatial Index were exhibited from T1 to T2 (F [1, 49] = 5.856, p = .02; η^2 = .10).

On the Mental Rotation Task, a significant main effect of improvement was seen from T1 to T2 (F [1, 49] = 9.45, p = .01; η^2 = .02). Additionally, an interaction effect was seen in which

the FPS group (54.94 ± 28.72 to 80.13 ± 25.38) exhibited greater improvement across time compared to the STR group (81.65 ± 14.72 to 89.62 ± 15.13) (F [1, 49] = 6.55, p = .01; η^2 = .12).

III – 12 Social engagement

No significant changes were seen on the PRCA (F [1, 49] = 2.685, p = .11; η^2 = .054). However, a significant decline on the WTC was seen across groups (F [1, 49] = 5.407, p = .02; η^2 = .103). A possible explanation for this finding and confound for this study is a self-selection effect of undergraduate students willing to give up several hours each week of their evenings and weekends in order to participate in research rather than engage in social activities.

III – 13 Substance Use

Alcohol use was significantly positively correlated with tobacco use, drug use, and ADHD diagnosis; and negatively correlated with performance on Dual Task Attention and the Stroop task. Tobacco use was positively correlated with age, class standing, and drug use. Drug use was negatively correlated with class standing and WASI performance.

III – 14 Attention Deficit/Hyperactivity Disorder

Attention Deficit/Hyperactivity Disorder (ADHD) diagnosis status was significantly positively correlated with PRCA but otherwise not significantly correlated with any other measures in the current study.

III – 15 Wechsler Adult Scale of Intelligence

WASI performance was significantly positively correlated with GPA, ACT score, RBANS Total, Wisconsin Card Sort, Trails A & B, Stroop, Dual Task Error, and Tower of London performance and was thus utilized as a covariate in the analyses. However, WASI performance did not differ significantly across groups (F [1, 49] = 1.843, p = .27; η^2 = .031).

IV: DISCUSSION

Significant improvements on a variety of cognitive skills were exhibited following training with two genres of VGP. The FPS group exhibited improvements in attention, working memory, visuospatial skills, problem solving, processing speed, and reasoning, while a self-reported decline in willingness to engage in social conversation also emerged. Participants found the FPS game to be more engaging than the STR game, which is a possible factor in the results. The STR group also exhibited improvements in attention, working memory, problem solving and reasoning, and visuospatial skills. The improvements seen across time in the visuospatial and attention skills were smaller in the STR group than the FPS group. Similarly, self-report ratings of willingness to engage in social conversation declined. No significant changes were seen on measures of language, delayed memory, time management, or communication apprehension.

As predicted by hypothesis A, VGP was related to improved problem solving skills. However, this effect was seen as a main effect in both game genre groups rather than an interaction effect of improving only in the strategy gaming group as was hypothesized. However, the FPS game used does include some elements of strategy as well such as utilizing tactics and choosing how to allocate resources, similar to the STR game. Thus, it is possible that overlapping set of game demands led to similar improvements in problem solving skills.

First-person shooting action games led to a greater increase in visuospatial skills, as expected, but strategy games also improved performance on visuospatial tasks as well. This finding is consistent with prior literature which has supported increased visuospatial performance following VGP of games of many different genres as compared to non-VGP media. It is also

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unsurprising that FPS games lead to greater improvements in this area given the increased demands of the game style on viewing the entire screen simultaneously and reacting rapidly to dynamic stimuli. However, as predicted in hypothesis B, those trained in the FPS group showed a greater degree of improvement in this area of cognitive ability than those in the STR group.

While both groups exhibited improvements in performance on attention tasks, a greater degree of improvement and wider generalization of improvement on tasks was seen in the FPS group, as predicted in hypothesis C. This also supports prior findings which have suggested that VGP in general, and FPS games specifically, lead to improved attention in a variety of measurement methodologies.

VGP actually led to decreased self-report ratings of willingness to communicate with others in this study, counter to what was expected. This may be a result of a self-selection effect of the participants who were involved in this study and chose to give up evening and weekend hours in order to participate in research.

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 may 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 translate 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 affect 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 integral to 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).

Commercial games such as Portal have been found to be more effective in improving neurocognitive task performance than brain training software such as Lumosity (Shute, et al., 2015). Studies have suggested commercial games may work similarly to preventative treatments for dementia, by activating the brain and providing motivating opportunities for maintaining neural activation. For example, Neuroracer – a sustained attention/multitasking game was utilized in a group of older adults. These individuals showed improvements on game performance but also generalized this improvement to other cognitive skills as well. Increased activation in the prefrontal cortex was observed with imaging methods. These gains were maintained at 6 months post-treatment (Anguera & Gazzeley, 2013).

Other studies have suggested video games may improve neurocognitive performance through effects on attentional skills. VGP enhanced efficiency of task response and task switching even while having no effect on task inhibition. Action video games, especially first person shooters, require rapid reaction to fast moving visual and auditory stimuli and flexibility to adapt behavior to changing contexts (Steenbergen, et al., 2015). Playing action video games improved multitasking and sustained attention in adults whereas alternative media multitasking such as watching television and texting actually worsened ability to filter out distracting stimuli. Moderate media multitasking led to better outcomes than light or heavy media multitasking (Cardoso-Leite, et al., 2016). This is similar to findings from earlier studies by the current research laboratory in which moderate amounts of VGP were positively correlated with higher performance on neurocognitive measures compared to low or high amounts. The level of challenge within the game also seems to affect how much improvement is seen. More challenging games have stronger effects than non-challenging games. One suggested mechanism of action is that action video games require top down attentional processing, selective attention, divided attention, sustained attention, and rapid decision making in order to successfully navigate the demands of the game. Utilizing the game as a highly motivating tool to practice these skills may lead both to direct gains in these areas well as indirect gains in other cognitive domains as attentional resources improve and are freed up for alternative usage (Cardoso-Leite, et al., 2016). Additionally, fMRI evidence suggests that learning new cognitive patterns from VGP may generalize across settings and to multiple cognitive skills (Lobel, et al., 2014).

Moreover, evidence suggests that the form of training with electronic media may have an effect on efficacy. A study by Lee, et al. (2015) found that individuals with high levels of fluid intelligence exhibited a higher degree of cognitive gain when engaging in VGP as a holistic

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activity and working towards maximizing their scores on a game. However, individuals with lower levels of fluid intelligence benefited more by focusing on mastery of specific elements of game play which were more directly related to cognitive abilities being measured. These findings suggest that the use of VGP may be tailored based on the characteristics of an individual to create the most efficacious impact on cognitive improvement.

Additionally, recent evidence has suggested that brain injuries such as TBI may alter brain functioning by inducing neurodegeneration and reducing cognitive reserve. Environmental interventions such as VGP may slow or halt the process of this negative neuroplasticity. Frequently TBI rehabilitation is marked by recovery, plateau, and then possible cognitive decline. This decline is frequently associated with substantial neuronal losses during the chronic phase of recovery. This appears to at least partially result from post-injury factors which are thus potential targets for intervention. Specifically, cognitive declines may be related to disuse. Thus, environmental enrichment may be beneficial in addressing this. TBI frequently also results in less efficient processing and lessened executive control, which should also be targets of an intervention. VGP is a potential modality which may be utilized to address these complications.

Similarly, strategy games require near constant monitoring of information and frequent task switching. VGP may over time reduce switch costs – the amount of time necessary to switch from attending to one stimulus to another. VGP may also reduce mixing costs – sustained global control over monitoring and sustaining competing tasks (Hartanto, et al., 2016). Additionally, greater cognitive effects are seen in individuals who began playing games at an earlier age and have longer history of gaming, meaning perhaps they have had more opportunity to utilize the attentional resources necessary for switch costs elsewhere (Hartanto, et al., 2016).

Chen, et al., found that VGP increased engagement and enjoyment in neurocognitive task training but had no effect on motivation to engage in this training (Chen, et al., 2015). Therefore, it remains to be seen whether individuals would "buy-in" to utilizing video games as a means of training cognitive skills.

In summary, this study's findings challenge the popular view that VGP is solely harmful by suggesting that VGP effects are much more nuanced. Novices trained on one of two genres of games and completing a pre- and post-test battery of neurocognitive measures showed VGP was positively associated with increased performance on neurocognitive skills such as attention, working memory, problem solving, and spatial abilities.

As educational games are becoming more popularly utilized in academic settings, it is important to clarify positive and negative effects of VGP, as well as to investigate generalizability of influence. This study suggests that VGP in moderation may lead to improvements in cognitive skills which may possibly translate to the classroom or vocation. Individuals should become more educated about the possible consequences of overindulging in VGP, but these findings also suggest that students and educators alike could effectively take advantage of VGP as a skill-building exercise.

Specifically, VGP may be useful as a rehabilitation strategy for individuals with brain injuries. Given the large percentage of individuals with brain injuries are young adults under the age of 35 who are familiar with electronic games (Shapi'i, et al., 2015), utilizing VGP may be an effective means of facilitating cognitive rehabilitation. Adherence to rehabilitation training regimens frequently is poor as patients report the exercises are boring (Shapi'i, et al., 2015). Increasing motivation by utilizing VGP as a rehabilitation modality may help to maximize efficacy of these approaches.

Additionally, rehabilitation gaming systems may allow the creation of individualized, custom games such as mazes and puzzles that the individual must solve and may play a hand in creating. Matching the challenge of a game to an individual's abilities is essential to ensure the game process is interesting but not too hard as to discourage involvement. Thus the process must be tailored and dynamic to be able to change along with an individual's changing level of abilities. VGP is uniquely positioned to meet these requirements. (Nair, et al., 2015).

Several limitations were inherent within this study which could be addressed with future studies. Due to gender confounds in prior studies, the current study utilized only female participants and thus may not generalize to males. Stronger control of group membership and balancing groups better could help strengthen future findings. Most importantly, the lack of a true control group means that practice effects cannot be ruled out as a possible confounding factor. 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. However, this is the first study to measure a comprehensive battery of neurocognitive skills in a population both prior to and following training with common, commercial video games. Future studies may continue to advance this line of research by further investigating the effect of additional game genres and by utilizing more population- representative samples. Neuroimaging could also suggest neurological mechanisms for VGP-improved performance.

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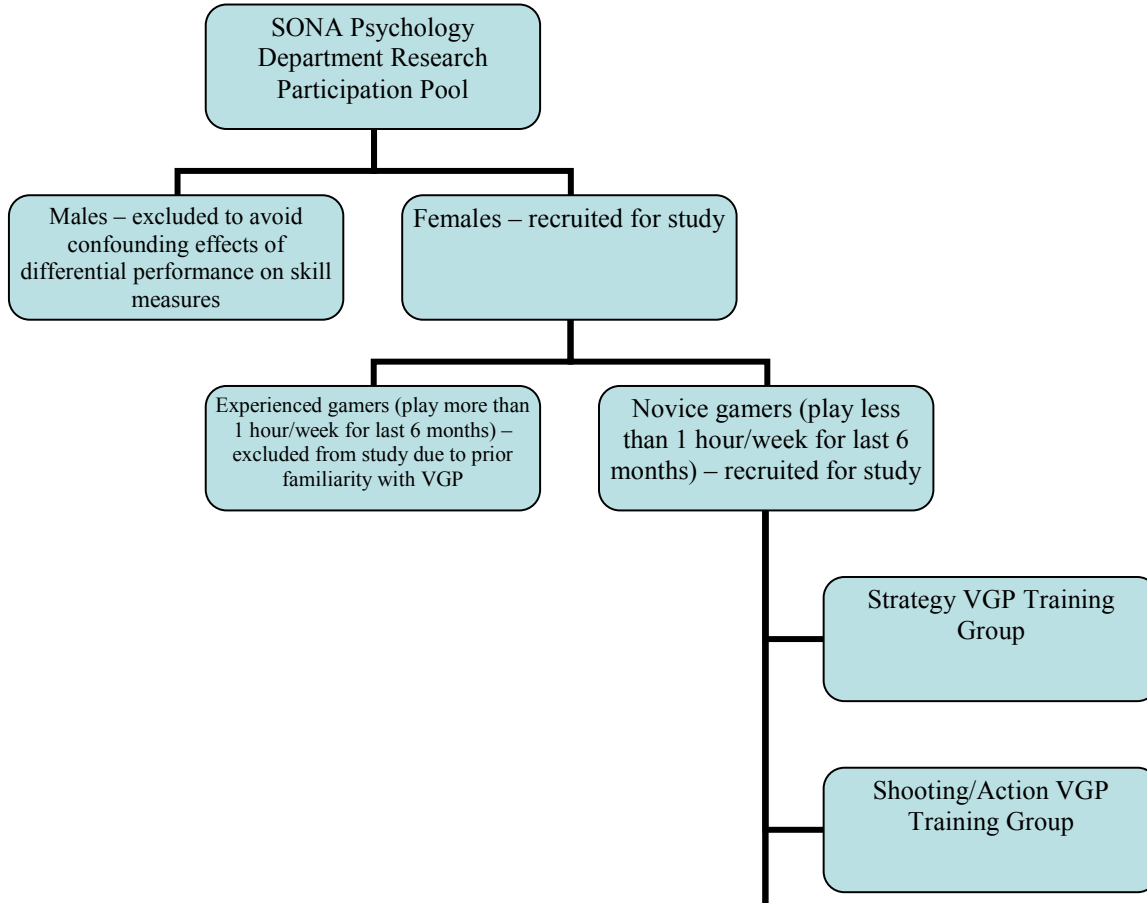
APPENDIX

Figure 1. Participant Recruitment Flow-Chart

Table 1. Group Demographic Breakdown

	FPS Group (n = 26)	STR Group (n = 23)
Age (in years)	19.74 (SD = 1.93)	20.68 (SD = 2.57)
Ethnicity		
African American	7	6
Asian	1	0
Caucasian	18	15
Hispanic/Latina	0	2
Year in school		
Freshman	7	7
Sophomore	5	5
Upper Classmen	13	9
Graduate	1	2

Table 2. Chi-Squared Analysis of Demographic Variables by VGP Status

	FPS Group	STR Group	*p*
Ethnicity			0.5
African American	26.90%	26.10%	
Asian	3.80%	N/A	
Caucasian	69.30%	65.20%	
Hispanic or Latina	N/A	8.70%	
Class Standing			
Freshman	27.00%	30.40%	0.1
Sophomore	19.20%	21.70%	
Upper Classmen	50.00%	39.20%	
Graduate	3.80%	8.70%	

Table 3. Effect of Group Membership on Measured Cognitive Abilities

Measure	Group		Mean T1	Standard Deviation T1	Mean T2	Standard Deviation T2	F value	p value	Effect Size
RBANS Total	FPS		96.69	10.07	107.00	14.23			
	STR		100.35	12.34	103.43	14.46			
		Main effect					9.20	.01*	0.16
		Interaction					2.68	0.11	0.05
RBANS Attention	FPS		99.54	12.88	112.00	16.59			
	STR		101.78	15.47	103.97	14.96			
		Main effect					7.66	0.01*	0.14
		Interaction					3.78	0.06	0.07
RBANS Immediate Memory	FPS		93.00	12.50	106.31	16.14			
	STR		97.13	17.19	106.13	17.37			
		Main effect					15.86	< .01*	0.25
		Interaction					7.42	0.01*	0.10
RBANS Delayed Memory	FPS		100.27	9.70	104.42	13.61			
	STR		100.65	13.25	101.09	16.21			
		Main effect					0.81	0.37	0.02
		Interaction					0.53	0.47	0.01
RBANS Language	FPS		95.96	15.43	95.62	13.16			
	STR		100.78	12.41	98.83	12.22			
		Main effect					0.29	0.59	0.01
		Interaction					0.14	0.71	0.01

RBANS Visuospatial	FPS		100.81	9.81	106.04	12.75			
	STR		101.87	10.25	101.48	13.12			
		Main effect					5.86	0.02	0.10
		Interaction					2.01	0.16	0.04
Tower of London	FPS		143.03	54.15	101.34	60.46			
	STR		111.83	70.89	79.91	44.61			
		Main effect					6.19	0.02*	0.12
		Interaction					0.61	0.44	0.01
WCST	FPS		47.31	9.93	55.69	5.93			
	STR		47.83	7.35	55.04	4.65			
		Main effect					32.05	< .01*	0.41
		Interaction					0.18	0.67	0.01
Mental Rotation	FPS		54.94	28.72	80.13	25.38			
	STR		81.65	14.72	89.62	15.13			
		Main effect					9.45	0.01*	0.17
		Interaction					6.55	0.01*	0.12
Dual Task Attention	FPS		15.38	2.75	15.90	4.21			
	STR		15.25	1.94	15.28	2.69			
		Main effect					0.41	0.53	0.01
		Interaction					0.33	0.57	0.01
Attentional Blink	FPS		40.53	2.88	31.54	3.02			
	STR		35.74	3.06	34.43	3.21			
		Main effect					21.38	< .01*	0.31
		Interaction					5.86	< .01*	0.20
Stroop	FPS		1054.00	224.98	986.15	204.77			
	STR		1070.87	192.14	1016.00	224.29			
		Main effect					5.47	0.02*	0.10
		Interaction					3.25	0.07	0.07

Trails A	FPS		47.04	13.23	56.62	14.32			
	STR		47.82	6.91	51.56	11.61			
		Main effect					9.78	0.01*	0.18
		Interaction					1.90	0.18	0.04
Trails B	FPS		46.46	9.06	52.77	14.08			
	STR		48.26	10.16	51.48	13.91			
		Main effect					4.96	0.03*	0.10
		Interaction					0.52	0.48	0.01
TMQ	FPS		61.73	7.34	61.00	7.05			
	STR		57.65	7.60	57.00	11.50			
		Main effect					0.18	0.67	0.01
		Interaction					0.01	0.98	< .01
PRCA	FPS		73.15	3.80	74.11	3.22			
	STR		72.57	4.71	73.96	3.32			
		Main effect					2.69	0.11	0.05
		Interaction					0.09	0.76	0.01
WTC	FPS		124.11	47.55	100.84	44.66			
	STR		121.17	45.42	105.21	51.07			
		Main effect					5.41	0.02*	0.10
		Interaction					0.19	0.67	0.01

* - p < .05

<u>Demographic Questionnaire</u>

1) What is your age? _____

2) What is your major? _____

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

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

Time Management Questionnaire - (adapted from Britton & Tesser)
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

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

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 D. Hollis

<u>Education</u>
2015 – present Nebraska Internship Consortium for Professional Psychology   Omaha, NE
                    Quality Living, Incorporated
- APA Accredited Pre-Doctoral Internship

2007 - present Doctor of Philosophy, Clinical Psychology (Anticipated)
Oxford, MS
                    University of Mississippi
                    Passed Examination for Professional Practice in Psychology (EPPP) at
                        doctoral level (10/2014)
                    M.A. Clinical Psychology (08/2014)
  - Masters thesis: *Cognitive effects and academic consequences of video game playing*
  - Defended 5/14
  - Advisor Thomas W. Lombardo, Ph.D.
  - Dissertation: *Brain drain or brain gain? Cognitive skill training of novice video game players with casual video games*
  - Proposed 10/14
  - Defense 7/16
  - Advisor: Thomas W. Lombardo, Ph.D.

2003 - 2007   Birmingham Southern College
Birmingham, AL

- B.S. Psychology
- Minors: Biology; History
- Advisor: Tricia H. Witte, Ph.D.

<u>Clinical Experience</u>
07/2015 – present   Predoctoral Neuropsychology Internship
                    Quality Living, Incorporated
Omaha, NE
                    Nebraska Internship Consortium of Professional Psychology
                    Supervisor: Jeff Snell, Ph.D.

08/2008- 05/2015   Graduate Student Therapist
                    University of Mississippi Psychology Services Center

| | Therapy and Assessment Practicum Teams | Oxford, |
MS

Former Supervisors: Tom Lombardo, Ph.D., Karen Christoff, Ph.D., Todd Smitherman, Ph.D.

09/2013 – 05/2015   Graduate Student Intern
Private Neuropsychological Practice   Tupelo, MS
Supervisor: Brian Thomas, Psy.D.

08/2013 – 05/2014   Career Counselor
University of Mississippi

Oxford, MS

Psychology Department Undergraduate Resource Center
Supervisor: Karen Sabol, Ph.D.

07/2012 – 07/2013   Graduate Student Intern
North Mississippi Regional Center

Oxford, MS

Supervisor: Scott Bethay, Ph.D.

08/2010 – 06/2012   Provisionally Certified Mental Health Therapist
Timber Hills Region IV Mental Health

Hernando, MS

Supervisor: Priscilla Roth-Wall, Ph.D.

08/2009 – 08/2010   Graduate Student Intern
University of Mississippi Psychological Services Center

Oxford, MS

Assessment Practicum Team
Supervisor: Stefan Schulenberg, Ph.D.

08/2009 – 08/2010   Verification Specialist
University of Mississippi Office of Student Disability Services

Oxford, MS

Supervisor: Stefan Schulenberg, Ph.D.

08/2008 – 07/2010   Clinical Research Assistant
St. Jude Children's Research Hospital

Memphis, TN

Supervisor: Patricia Garvie, Ph.D.

08/2008 – 08/2010   Tobacco Cessation Specialist
University of Mississippi Psychological Services Center

Oxford, MS

Supervisor: Thomas Lombardo, Ph.D.

08/2008 – 06/2013   Liaison to University of Mississippi School of Pharmacy
University of Mississippi Psychological Services Center
Supervisor: Thomas Lombardo, Ph.D.

Presentations/Publications

Publications

- Witte, T., Kopkin, M., & Hollis, S. (2014). Is it dating violence or just "drunken behavior?" Judgments of intimate partner violence when the perpetrator is under the influence of alcohol. *Substance Use and Misuse*, *50*, 11, 1421-1426.

Presentations

- Hollis, S., Lombardo, T., McIlveene, A., Grigg, J., & Fulwiler, J. (2015). *Cognitive effects and academic consequences of video game playing in undergraduates.* Poster presented at the 49th Annual Association of Behavioral and Cognitive Therapies 49th Annual Convention, Chicago, IL.

- Grigg, J., Lombardo, T., Fulwiler, J., & Hollis, S. (2015). *Evaluation of cognitive processing therapy's five cognitive distortion themes.* Poster presented at the 49th Annual Association of Behavioral and Cognitive Therapies 49th Annual Convention, Chicago, IL.

- Hollis, S., Lombardo, T., McIlveene, A., Grigg, J., & Fulwiler, J. (2014). *Video game playing may lead to alterations of a wide range of cognitive and academic processes 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., & Fulwiler, J. (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., & Lombardo, T. (2013). *College students' smoker identity varies with physical activity levels.* Poster presented at the American Public Health Association Conference, 141st Annual Meeting, Boston, MA.

- Garvie, P., Wilkins, M., Hollis, S., Corbett, A., Doskey, E., Dallas, R., & Midgett, E. (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., & Midgett, E. (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., & Hollis, S. (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.

- 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.

- 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.

Panel Discussions
- Hollis, S., Cox, L., & J. Bailey (March 2015). *Surviving the internship application process: How to prepare for and excel during internship applications and interviews.* Panel discussion presented at the 2nd Annual University of Mississippi Conference on Psychological Science, Oxford, MS.

Teaching Experience

08/2014 – 05/2015	University of Mississippi	Oxford, MS
	- Instructor of record for Psychology 311: Abnormal Psychology	
06/2014 – 07/2014	University of Mississippi Desoto Campus	Southaven, MS
	- Instructor of record for Psychology 319: Brain and Behavior	
08/2013 – 05/2014	University of Mississippi	Oxford, MS
	- Instructor of record for Psychology 100: Introduction to the Major	